تغطية امتحان نهاية الفصل: القوى والحركة – الموقع والحركة (أسئلة اختيار من متعدد) Inspire

تم تحميل هذا الملف من موقع المناهج الإماراتية	
موقع المناهج ⇦ المناهج الإماراتية ⇦ الصف الثامن ⇦ علوم ⇦ الفصل الأول ⇦ الامتحان النهائي ⇦ الملف	
تاريخ إضافة الملف على موقع المناهج: 2026-11-13 14:57:14	
المزيد من مادة علوم:	ملفات ا كتب للمعلم ا كتب للطالب ا اختبارات الكترونية ا اختبارات ا حلول ا عروض بوربوينت ا أوراق عمل منهج انجليزي ا ملخصات وتقارير ا مذكرات وبنوك ا الامتحان النهائي ا للمدرس

التواصل الاجتماعي بحسب الصف الثامن					
صفحة المناهج الإماراتية على فيسبوك					
المواد على تلغرام	التربية الاسلامية	اللغة العربية	اللغة الانجليزية	الرياضيات	

المزيد من الملفات بحسب الصف الثامن والمادة علوم في الفصل الأول	
1	تغطية امتحان نهاية الفصل: القوى والحركة – الموقع والحركة (أسئلة اختيار من متعدد) Inspire
2	تغطية امتحان نهاية الفصل: أسئلة اختيار من متعدد في تحديد الموقع والحركة – الدرس الأول من الوحدة الثانية Inspire
3	مراجعة للاختبار النهائي - الثامن المتقدم
4	الهيكل الوزاري للثامن المتقدم - انسباير
5	EOT BASED PRACTICE QUESTIONS المتقدم للثامن

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وزارة التربية والتعليم
MINISTRY OF EDUCATION

End of Term 1 Exam Coverage

Grade 8 General – Science

Academic Year 2026-2027

Inspire

اِحجِزْ مَكانَكَ وَاستَعِدَّ لِلْامتِحَانِ بِثِقَةٍ كَامِلَةٍ

احصل على الشرح الكامل للصف من خلال:

التواصل والحجز عبر الـ Whatsapp
اضغط على الرقم: 0566410429

للتواصل والحجز

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لا تتردد في التواصل
معنا قم بمسح الـ QR

Q1 : Unit 2: Energy and Motion

Module 1: Forces and Motion · Lesson 1: Position and Motion

Understand how the location of an object is determined using a reference point.

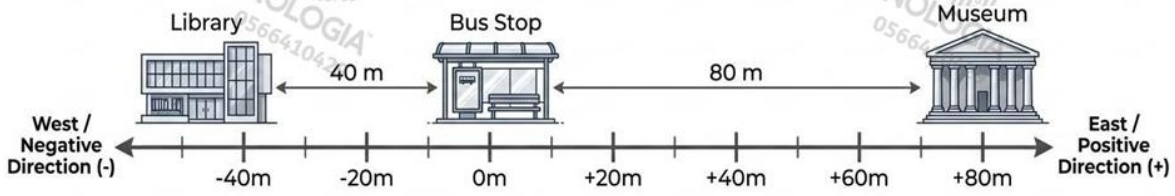
(Page 11)

Multiple Choice Questions - MCQ

Describing Position To describe position you must state your location relative to a certain point. A **reference point** is the starting point you choose to describe the location, or position, of an object. The chosen point is arbitrary, which means that you pick the point based on your preference. The reference points from the paragraph on the previous page are your friend, your school, the center of town, and the Sun.

A description of your location also includes your distance and direction from the reference point. Describing your location in this way defines your position. A **position** is an object's distance and direction from a reference point. A complete description of your position includes a distance, a direction, and a reference point. Let's explore the relationships between those three things.

DEFINING POSITION IN SPACE



Reference Point: The arbitrary starting point chosen to describe a location (e.g., the bus stop).

Distance: How far away the object is from the reference point (measured in meters, the SI base unit).

Reference Direction: The orientation from the reference point (e.g., **positive**/negative, East/West).

POSITION = REFERENCE POINT + DISTANCE + DIRECTION

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احصل على الشرح كاملاً بـ 99 درهم فقط

Questions :

Question 1: What is a reference point?

(A) The total length of the path an object travels	(B) The starting point you choose to describe the location, or position, of an object
(C) The speed at which an object moves in a given direction	(D) The final destination reached by a moving object

Question 2: In order to determine an object's location, you need a _____.

(A) speed	(B) force
(C) mass	(D) reference point

Question 3: "The bus stop is 50 m east of my house." What is the reference point?

(A) My house	(B) The bus stop
(C) 50 m	(D) East

Question 4: A complete description of your position includes which three things?

(A) Mass, weight, and force	(B) Speed, time, and acceleration
(C) A distance, a direction, and a reference point	(D) Kinetic energy, potential energy, and work

Question 5: What is defined as an object's distance and direction from a reference point?

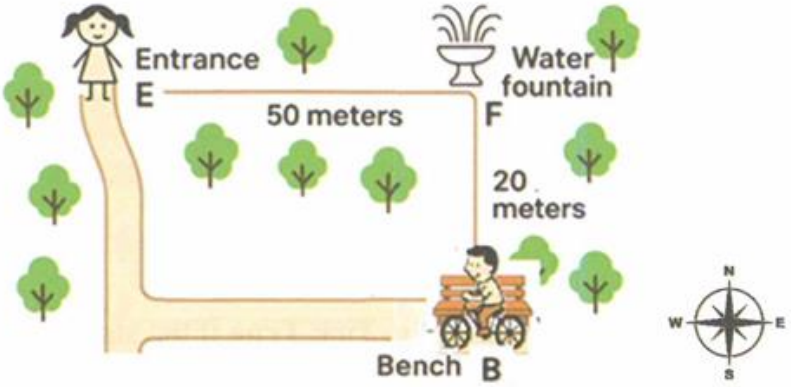
(A) Acceleration	(B) Force
(C) Speed	(D) Position

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Ministry Exam Questions

This question is about Position and Motion.

Hamad is riding his bicycle in a park. He starts at the entrance (Point E), rides 50 meters east to a water fountain (Point F), then turns and rides 20 meters south to a bench (Point B). His sister Laila watches him from the entrance.



2026-2025

Question 1 : Read the statement below carefully. Tick True if the statement is correct, and False if it is incorrect.

Hamad is considered to be in motion from his sister's point of view because his position changes relative to her.

(A) Cannot be determined from the reference point	(B) False
(C) Only true when Hamad stops at the bench	(D) True

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Q2 : Unit 2: Energy and Motion

Module 1: Forces and Motion · Lesson 1: Position and Motion

Identify suitable reference points for describing the location of an object.

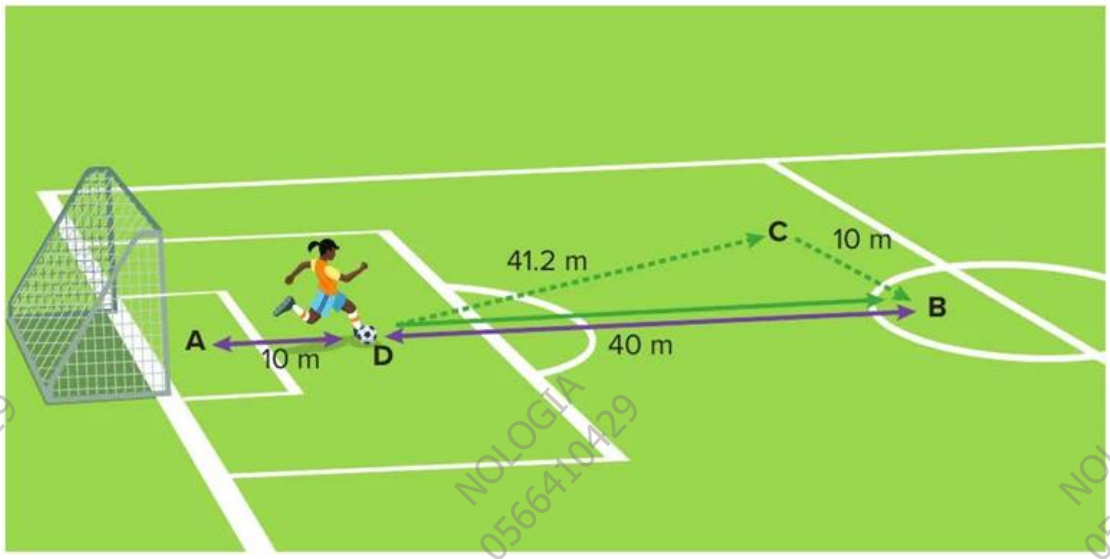
(Pages 11 ,18)

Multiple Choice Questions - MCQ

Describing Position To describe position you must state your location relative to a certain point. A **reference point** is the starting point you choose to describe the location, or position, of an object. The chosen point is arbitrary, which means that you pick the point based on your preference. The reference points from the paragraph on the previous page are your friend, your school, the center of town, and the Sun.

A description of your location also includes your distance and direction from the reference point. Describing your location in this way defines your position. A **position** is an object's distance and direction from a reference point. A complete description of your position includes a distance, a direction, and a reference point. Let's explore the relationships between those three things.

Motion Using Reference Points Suppose you are watching a soccer game like the one in the figure below. The position of a player depends on a reference. If the reference point is the goal, or point A, the player's position is 10 m in front of the goal. If the reference point is center field, point B, the position of the player is 40 m toward the goal. Notice that the actual location of the player has not changed. Only the description of the position changed because the reference point changed.



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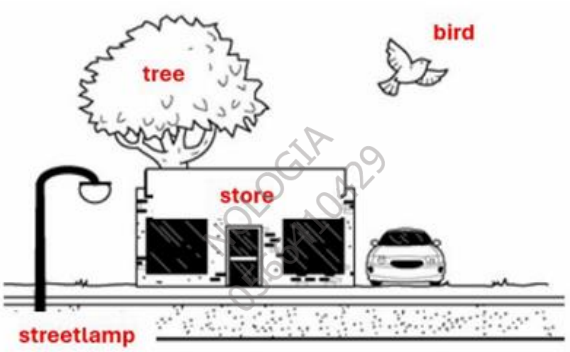
احصل على الشرح كاملاً بـ 99 درهم فقط

Questions :

Question 1: A player stands 10 m from the goal (Point A). Is he in the same place if we say he is 40 m from the center of the field (Point B)?

(A) No - the goal moved closer to the center of the field	(B) No - the player walked 30 m across the field
(C) Yes - only the description changed, because the reference point changed	(D) Yes - because 10 m and 40 m are the exact same distance

Question 2: Which is the least useful reference point to describe the location of a parked car?



(A) a tree	(B) a shop
(C) a streetlamp	(D) a flying bird

Question 3: Which is the best reference point to describe where your classroom is?

(A) a student walking in the corridor	(B) the school main gate
(C) a cloud in the sky	(D) a moving school bus

Question 4: Which is the least useful reference point to describe the location of a parked car?

(A) a tree	(B) a shop
(C) a flying bird	(D) a streetlamp

للتواصل اضغط الرقم: 0566410429

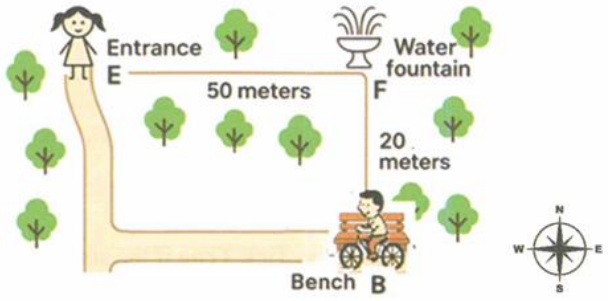
احصل على الشرح كاملاً بـ 99 درهم فقط

Ministry Exam Questions

2026-2025

This question is about Position and Motion.

Hamad is riding his bicycle in a park. He starts at the entrance (Point E), rides 50 meters east to a water fountain (Point F), then turns and rides 20 meters south to a bench (Point B). His sister Laila watches him from the entrance.



Question 1 : What is Hamad's new position? Tick the correct answer in the table below.

(A) 20 m south	(B) 50 m west, 20 m south
(C) 70 m southeast	(D) 30 m east

Question 2 : Fill in the blank with the correct word: Hamad's position changes because position is a measure of an object's location relative to a _____.

(A) reference point	(B) net force
(C) time interval	(D) kinetic energy

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Q3 : Unit 2: Energy and Motion

Module 1: Forces and Motion · Lesson 1: Position and Motion

Recall the definition of speed.

(Page 22)

Multiple Choice Questions - MCQ

Changes Over Time In the Lab *Be the Fastest*, did all of the toys move at the same rate? Did some move slowly and others move quickly? Describing how fast something moves is the same as determining its speed. **Speed** is a measure of the distance an object travels in a given amount of time.

• Speed is a measure of the distance an object travels in a given amount of time.

• Formula for speed: Speed = Distance ÷ Time (s = d ÷ t).

• The SI unit of speed is meters per second (m/s). Other units of speed include kilometers per hour (km/h).

Speed Quantities and SI Units (Unit 2, p. 22)

Quantity	Symbol	SI Unit	Common Other Unit
Distance	d	meter (m)	kilometer (km)
Time	t	second (s)	hour (h)
Speed	s (or v)	meters per second (m/s)	kilometers per hour (km/h)

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Questions :

Question 1: What is the definition of speed?

(A) The total amount of matter in an object	(B) A push or a pull exerted on one object by another object
(C) A measure of the distance an object travels in a given amount of time	(D) The starting point chosen to describe the location of an object

Question 2: Speed is a measure of the _____ an object travels in a given amount of _____.

(A) distance, time	(B) force, mass
(C) mass, distance	(D) time, force

Question 3: Which unit is a unit of speed?

(A) kg	(B) N
(C) m/s	(D) m

Question 4: Which formula is used to calculate the speed (s) of an object that travels a distance (d) in a time (t)?

(A) $s = d \div t$	(B) $s = t \div d$
(C) $s = d + t$	(D) $s = d \times t$

Question 5: Which statement correctly describes the difference between speed and velocity?

(A) Speed includes direction, while velocity does not	(B) Velocity is only used for objects that are at rest
(C) Speed is measured in Newtons, while velocity is measured in kilograms	(D) Velocity includes both speed and direction of motion, while speed does not include direction

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Q4 : Unit 2: Energy and Motion

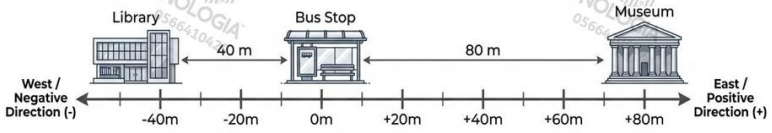
Module 1: Forces and Motion Lesson 1: Force and Acceleration

Understand how distance-time graphs represent the motion of an object and how average speed can be determined from the slope of the graph.

(Pages 27-29)

Multiple Choice Questions - MCQ

DEFINING POSITION IN SPACE



Reference Point: The arbitrary starting point chosen to describe a location (e.g., the bus stop).

Distance: How far away the object is from the reference point (measured in meters, the SI base unit).

Reference Direction: The orientation from the reference point (e.g., **positive**/negative, East/West).

POSITION = REFERENCE POINT + DISTANCE + DIRECTION

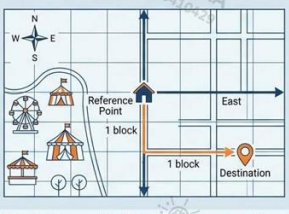
From One Dimension to Two

1D Navigation:



1D Navigation: Movement along a single straight line. Requires only one distance and one direction (e.g., positive or negative).

2D Navigation:



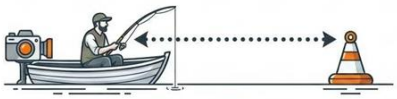
2D Navigation: Finding position on a plane. Requires a reference point, two reference directions (e.g., South and East), and distances along both directions.

Note: Scientists use SI (International System of Units) meters to eliminate confusion in all measurements.

The Perspective of Motion

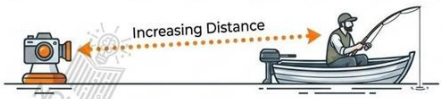
Key Principle: All motion is relative to a certain point in space.

Scenario A (Observer = Boat)



If the fishing pole is the reference point, the man's position does not change. He is not moving.

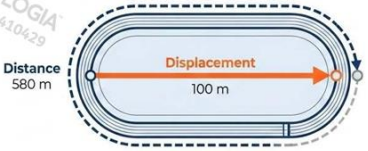
Scenario B (Observer = Buoy)



If the buoy is the reference point, the man's distance is changing. He is in motion.

Conclusion: The actual location hasn't changed; only the description changes because the reference point changed.

Distance vs. Displacement



Distance	Displacement
The total length of the actual path traveled	The shortest straight-line difference between initial and final position.
Highly dependent on the exact route taken	Completely independent of the route; only cares about Start and Finish.
Cannot be zero if the object moves	Is exactly zero if the object finishes exactly where it started (e.g., completing one full lap on a race track).

The Mathematics of Speed

Speed measures how fast something moves—the distance an object travels in a given amount of time.

Average Speed (in m/s). Most moving objects don't travel at a constant rate, so we calculate the average over the whole trip.

$$\bar{v} = \frac{d}{t}$$

Total Distance (in m). **Total Time** (in s).

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Constant vs. Changing Speed

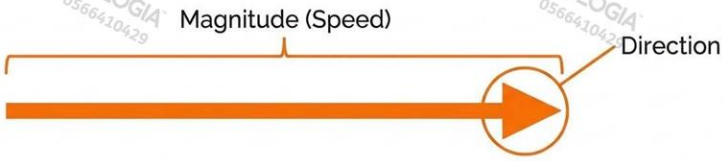
Constant Speed: The object covers the exact same distance during each equal time interval.



Changing Speed: The distance traveled each second gets larger (or smaller). Speed is actively changing.



Vectors and Velocity



Vector: A measurement quantity that requires BOTH magnitude (size/amount) and direction.

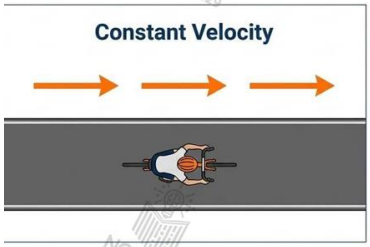
Velocity: The speed AND the direction of a moving object.

Key Takeaway: You can share the magnitude and direction by drawing a simple arrow. A short arrow means slow; a long arrow means fast.

When Does Velocity Change?

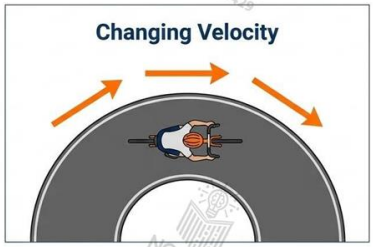
Rule: Because velocity is a vector, it changes if the speed changes OR if the direction changes.

Constant Velocity



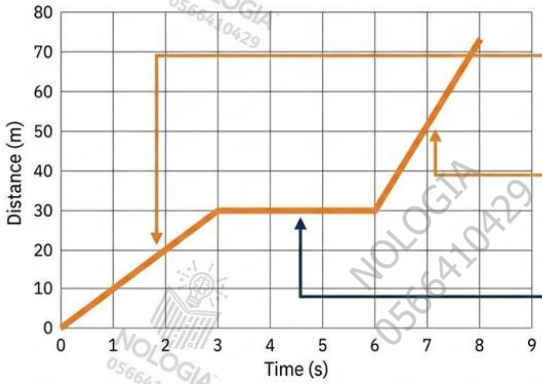
Constant Velocity: Object moves at a steady speed in a perfectly straight line. Arrows are identical in length and direction.

Changing Velocity



Changing Velocity: Even if the cyclist pedals at the exact same speed, going around a curve means the direction changes. Therefore, the velocity is constantly changing.

Decoding Distance-Time Graphs



Straight Line = Constant Speed. The object is moving at a steady rate.

Steeper Line = Greater Speed. The object is covering more distance in less time.

Flat Line = Zero Speed. Position is not changing as time passes; the object is stopped.

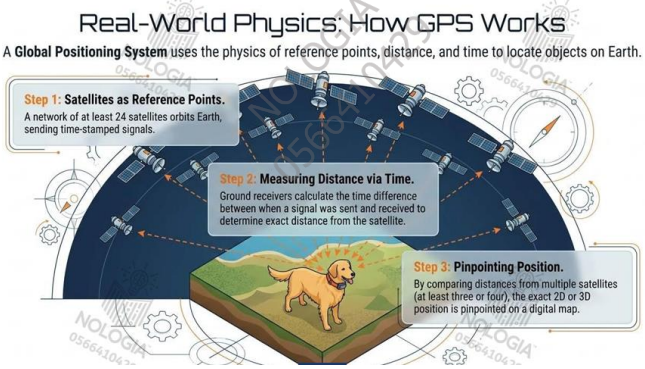
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اضغط على الاسم لتحصل على مزيد من
الملفات في تلغرام: NOLOGIA

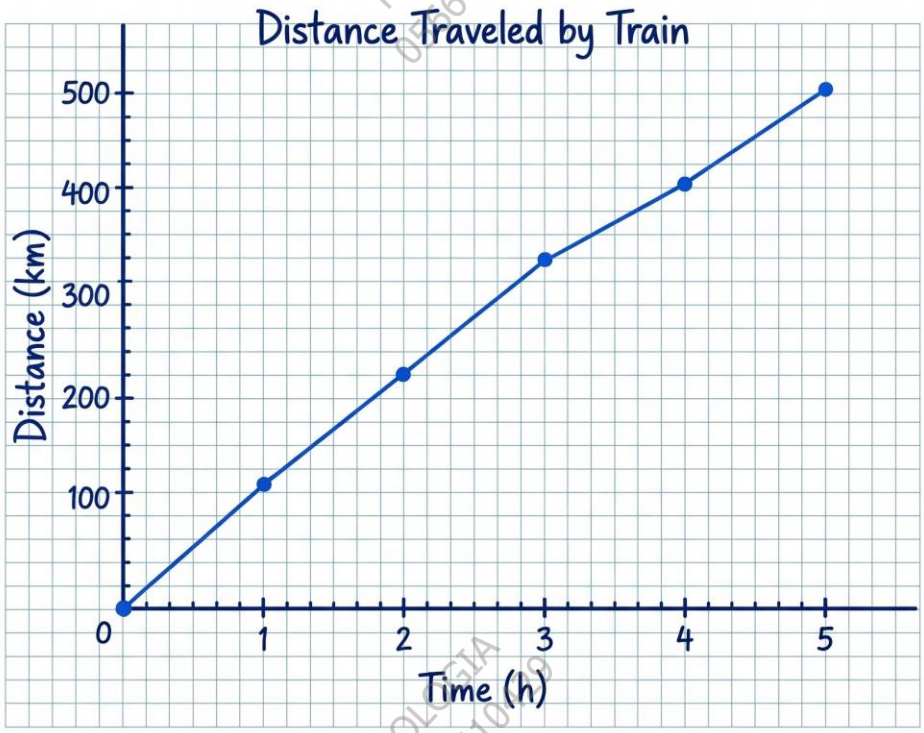


Plot It



1. Plot the distance and time data for distance the train traveled on the grid below. Plot the distance on the vertical axis and time on the horizontal axis. Label the axes and add a title to your plot.

Distance Traveled by Train	
Time (h)	**Distance (km)**
0	0
1	110
2	220
3	330
4	400
5	500



2. Draw a line that goes through the points on the grid in order.

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3. What does the graph tell you about the distance traveled by the train?

The train traveled a total distance of 500 km, and the distance increased as time passed.

4. What does the graph tell you about the amount of time that has passed?

A total of 5 hours has passed.



5. What do you think happened to the speed of the train during each hour represented on the graph?

The speed was constant at 110 km/h for the first 3 hours, slowed to 70 km/h between hours 3 and 4, and was 100 km/h between hours 4 and 5.

6. **MATH Connection** Choose two points on your graph. Find the time difference of the points. Next, find the distance difference of the points. Then, divide the difference in the distance by the difference in time. What is your answer? What mathematical value did you calculate?

Points: (1, 110) and (3, 330).
Time difference: $3 - 1 = 2$ h.
Distance difference: $330 - 110 = 220$ km.
Calculation: $\frac{220}{2} = 110$ km/h.
This value is the speed (average speed) of the train.

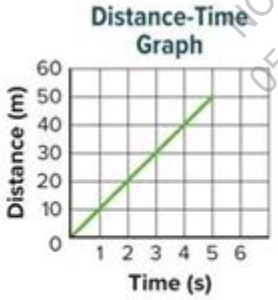
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Questions :

Distance-Time Graphs The plot you made in the Investigation *Plot It* is a distance-time graph. This type of graph shows how an object's position changes during each time interval. A distance-time graph does not show you the actual path the object took.

Did you notice that the line through the points in the investigation wasn't completely straight? When an object is moving at a constant speed, the line will be straight. The steeper the line, the greater the slope, which means the greater the speed of the object.

If the slope of the line changes, this means the speed of the object has changed. Even if the speed has changed, the average speed can still be calculated.



Question 1: What does a distance-time graph look like when an object is at rest?

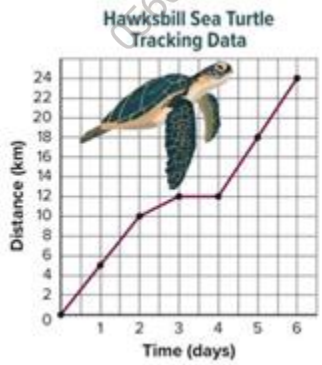
(A) A flat (horizontal) line	(B) A straight line going up steeply
(C) A curved line going up	(D) A vertical line

Question 2: On a distance-time graph, a steeper straight line means _____ speed. If the slope changes, the speed has _____.

(A) smaller; disappeared	(B) slower; stayed constant
(C) zero; stopped	(D) greater; changed

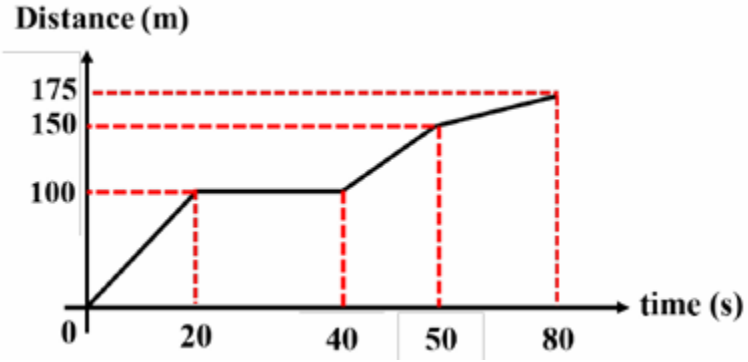
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Question 3: Analyze the data on the hawksbill sea turtle plot below. What is the speed of the hawksbill sea turtle from Day 0 to Day 2, and from Day 3 to Day 4?



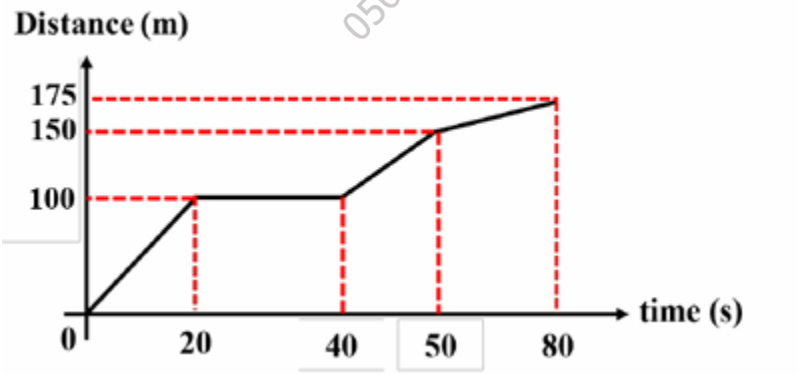
(A) Day 0 to Day 2: 12 km/day; Day 3 to Day 4: 14 km/day	(B) Day 0 to Day 2: 6 km/day; Day 3 to Day 4: 0 km/day
(C) Day 0 to Day 2: 2 km/day; Day 3 to Day 4: 5 km/day	(D) Day 0 to Day 2: 5 km/day; Day 3 to Day 4: 2 km/day

Question 4: The diagram below shows a distance-time graph of a runner. Calculate the average speed of the runner between 0 s and 20 s.



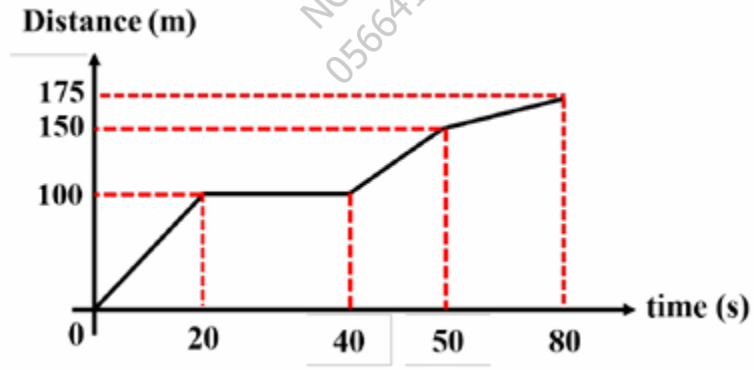
(A) 5 m/s	(B) 2 m/s
(C) 10 m/s	(D) 20 m/s

Question 5: The diagram below shows a distance-time graph of a runner. Calculate the average speed of the runner between 40 s and 50 s.



(A) 2.5 m/s	(B) 3.0 m/s
(C) 5 m/s	(D) 15 m/s

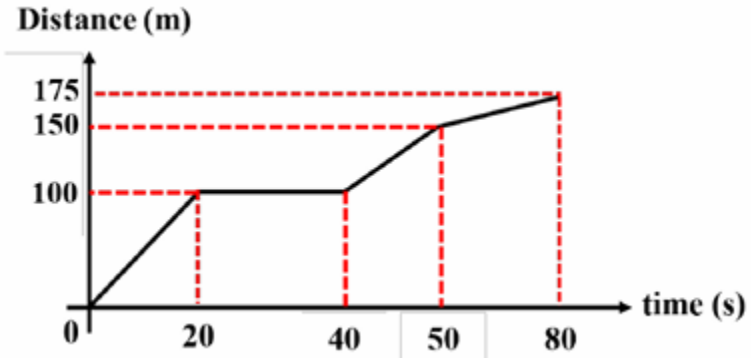
Question 6: The diagram below shows a distance-time graph of a runner. Calculate the average speed of the runner between 50 s and 80 s.



(A) 2.19 m/s	(B) 0.83 m/s
(C) 5.0 m/s	(D) 25.0 m/s

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Question 7: The diagram below shows a distance-time graph of a runner. Determine for how long the runner was at rest?



(A) 10 s	(B) 100 s
(C) 40 s	(D) 20 s

Question 11: A camel in a race in Al Ain has this data.

(a) What is the camel's speed from 0 s to 10 s, and

(b) what is the camel doing from 10 s to 20 s?

Time (s)	0	10	20	30
Distance (m)	0	50	50	110

(A) (a) 5 m/s; (b) moving at 5 m/s	(B) (a) 5 m/s; (b) at rest (not moving)
(C) (a) 10 m/s; (b) accelerating	(D) (a) 50 m/s; (b) turning around

(c) Using the same camel race table above, calculate the speed of the camel from 20 s to 30 s.

(A) 3.67 m/s	(B) 5 m/s
(C) 11 m/s	(D) 6 m/s

Q5 : Unit 2: Energy and Motion

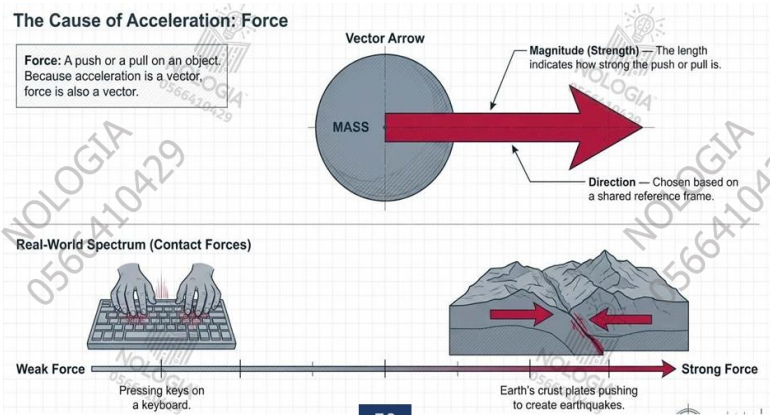
Module 1: Forces and Motion · Lesson 2: Force and Acceleration

Apply Newton's second law of motion to calculate the acceleration of an object using its mass and the net force acting on it.

(Page 44)

Multiple Choice Questions - MCQ

Mathematical Model Isaac Newton, an English scientist and mathematician, developed laws of motion. **Newton's second law of motion** states that the acceleration of an object equals the net force on the object divided by the object's mass. With a mathematical model, scientists can make predictions about how objects will accelerate with a given force. This can be shown by the mathematical model, the acceleration equation.



Acceleration Equation

$$\text{acceleration (in m/s}^2) = \frac{\text{force (in N)}}{\text{mass (in kg)}}$$

$$a = \frac{F}{m}$$

MATH Connection In the PhET interactive simulation, a force of 100 N is applied to the wrapped present, giving it an acceleration of 2 m/s². What is the mass of the object?

Given: $F = 100\ N$ (Force)
$a = 2\ m/s^2$ (Acceleration)

Formula: $m = \frac{F}{a}$

Calculation: $m = 100\ N / 2\ m/s^2$
$m = 50\ kg$

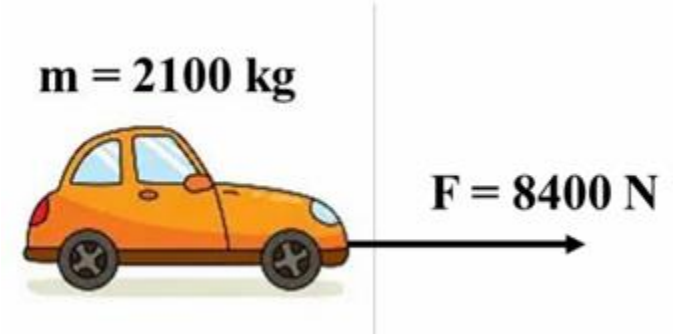
Answer: The mass of the object is 50 kg.

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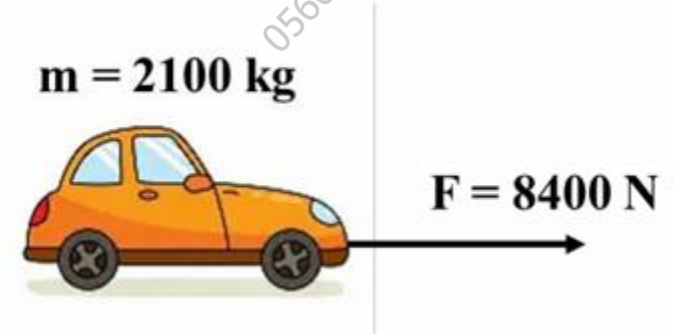
Questions :

Question 1: The net force acting on a car of 2100 kg is 8400 N as shown below. What is the magnitude of the acceleration of the car?



(A) 4 m/s²	(B) 0.25 m/s²
(C) 6 m/s²	(D) 10.5 m/s²

Question 2: According to Newton's second law of motion, a larger force acting on an object causes a greater _____ of that object.



(A) mass	(B) weight
(C) acceleration	(D) reference point

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Question 3: Acceleration depends on which two factors?

(A) mass and position	(B) net force and mass
(C) mass and velocity	(D) position and net force

Question 4: A bicycle and rider have a mass of 80 kg. The net force is 160 N. Calculate the acceleration.

(A) 0.5 m/s²	(B) 4 m/s²
(C) 80 m/s²	(D) 2 m/s²

Question 5: A shopping trolley of 20 kg is pushed with a net force of 60 N. Calculate the acceleration.

(A) 0.33 m/s²	(B) 3 m/s²
(C) 40 m/s²	(D) 1200 m/s²

Question 6: If the mass of an object is doubled while the net force acting on it stays the same, what happens to its acceleration?

(A) The acceleration doubles	(B) The acceleration increases by four times
(C) The acceleration stays the same	(D) The acceleration is cut in half

Question 7: What net force is required to give a 1,200 kg car an acceleration of 3 m/s²?

(A) 3,600 N	(B) 1,203 N
(C) 2,400 N	(D) 400 N

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Q6 : Unit 2: Energy and Motion

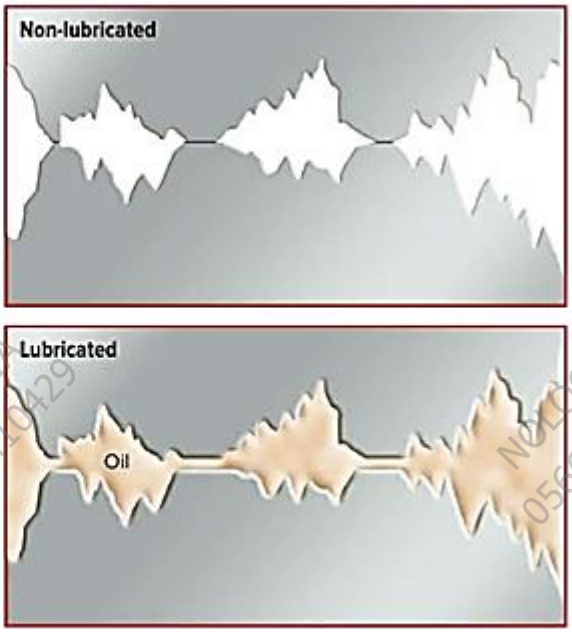
Module 1: Forces and Motion · Lesson 2: Force and Acceleration

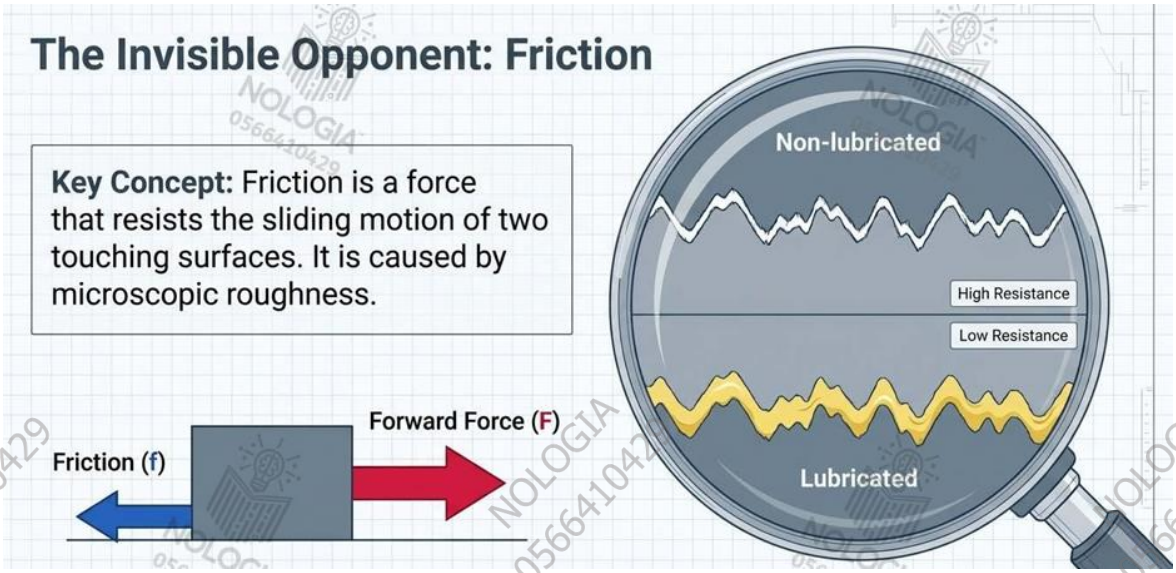
Identify friction as a force that opposes motion between surfaces in contact and explain how it causes moving objects to slow down or stop.

(Page 46)

Multiple Choice Questions - MCQ

Friction Rub your hands together. What do you feel? The resistance you feel is friction. **Friction** is a force that resists the sliding motion of two surfaces that are touching. If your hands were soapy, you could slide them past each other easily. You feel more friction when you rub your dry hands together than when you rub your soapy hands together. To the right is a close-up view of two metal surfaces. Microscopic dips and bumps like the ones shown cover all surfaces. When surfaces slide past each other, the dips and bumps on one surface catch on the dips and bumps on the other surface. This microscopic roughness slows sliding and is a source of friction. When you switched to sandpaper in the Lab *Sticky Situation*, the dips and bumps became exaggerated which made the block harder to pull across the surface.





Friction and Newton's Laws Think about how friction affects an object's movement. Imagine a book sitting on a table. When you push the book, the force you apply to the book is greater than the friction between the book and the table. The book moves in the direction of the greater force. If you stop pushing, friction stops the book, just like the friction between tires and the road stops a car.

What would happen if there were no friction between the book and the table? According to Newton's second law, the book would continue to move at the same speed in the same direction because no force changed its motion. The book stopping is evidence that friction must be acting on the book. On Earth, friction can be reduced but not totally removed. For an object to start moving, a force greater than friction must be applied to it. This is why all objects on Earth come to a stop after some time. To keep the object in motion, a force at least as strong as friction must be continuously applied. Objects stop moving because friction or another force acts on them.



Questions :

Question 1: What force resists the sliding motion of two surfaces that are in contact?

(A) Gravity	(B) Inertia
(C) Magnetism	(D) Friction

Question 2: Soapy water and oil are lubricants. What effect do they have on friction?

(A) They increase friction	(B) They reduce friction
(C) They have no effect on friction	(D) They turn friction into gravity

Question 3: In which direction does friction act on a moving object?

(A) the same direction as the motion	(B) friction has no direction
(C) upward	(D) opposite to the motion

Question 4: In what direction does the book move?

(A) In the direction of the smaller force	(B) In the direction of the greater force (the push)
(C) Opposite to the direction of the push	(D) Upwards

Question 5: What is the evidence that friction must be acting on the book?

(A) The book moves faster after you stop pushing it.	(B) The book changes direction after you stop pushing it.
(C) The book stops moving after you stop pushing it.	(D) The book continues to move at a constant speed after you stop pushing it.

Question 6: An object is moving under the effect of an applied force. Which force is larger, the applied force or friction?

(A) The applied force	(B) Friction
(C) They are equal	(D) It depends on the object's mass

Question 7: When friction is reduced, does the distance covered by an object increase or decrease?

(A) It decreases.	(B) It remains the same.
(C) It increases.	(D) It fluctuates.

Question 8: A ball rolls on grass and then stops. Which force made it stop?

(A) Friction between the ball and the grass	(B) Applied push force
(C) Electrical force	(D) Magnetism

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Question 9: When you push a book across a table and it moves forward, which force is larger while you are pushing, and what is the evidence that friction acts on the book?

(A) Friction is larger; the book speeds up forever	(B) Gravity is larger; the book floats upward
(C) The applied force is larger; the book stops when you stop pushing	(D) Both forces are zero; the book never moves

Question 10: What causes friction between two solid surfaces that are touching?

(A) Electrical currents flowing through the air	(B) Magnetic attraction between the nuclei of atoms
(C) Gravitational pull between the two surfaces	(D) Microscopic hills and valleys (dips and bumps) on the surfaces catching on each other

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Ministry Exam Questions

This question is about Force and Acceleration

Ali is riding his skateboard on a smooth school playground. He gives himself a strong push and starts gliding forward. After a short while, he stops moving.



2026-2025

Question 1 : The force that caused Ali to stop moving is _____. This force works by opposing the direction of Ali's _____.

(A) friction; motion	(B) gravity; friction
(C) motion; gravity	(D) friction; gravity

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Q7 : Unit 2: Energy and Motion

Module 1: Forces and Motion · Lesson 2: Force and Acceleration

Predict and explain how changes in friction between surfaces affect the distance travelled by an object under the same initial conditions.

(Page 47)

Multiple Choice Questions - MCQ

Friction and Newton's Laws Think about how friction affects an object's movement. Imagine a book sitting on a table. When you push the book, the force you apply to the book is greater than the friction between the book and the table. The book moves in the direction of the greater force. If you stop pushing, friction stops the book, just like the friction between tires and the road stops a car.

What would happen if there were no friction between the book and the table? According to Newton's second law, the book would continue to move at the same speed in the same direction because no force changed its motion. The book stopping is evidence that friction must be acting on the book. On Earth, friction can be reduced but not totally removed. For an object to start moving, a force greater than friction must be applied to it. This is why all objects on Earth come to a stop after some time. To keep the object in motion, a force at least as strong as friction must be continuously applied. Objects stop moving because friction or another force acts on them.



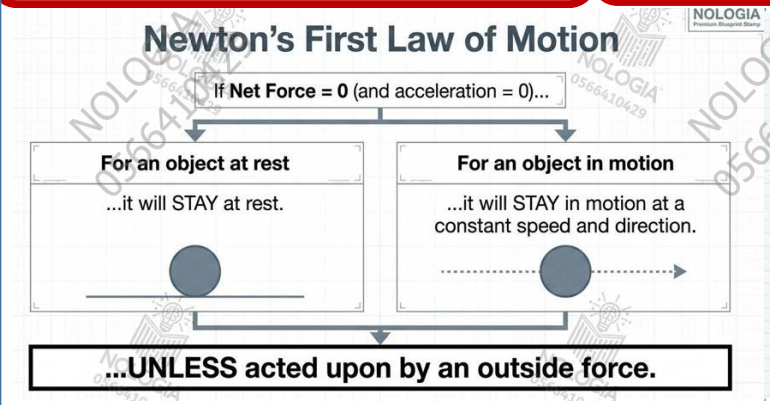
THREE-DIMENSIONAL THINKING

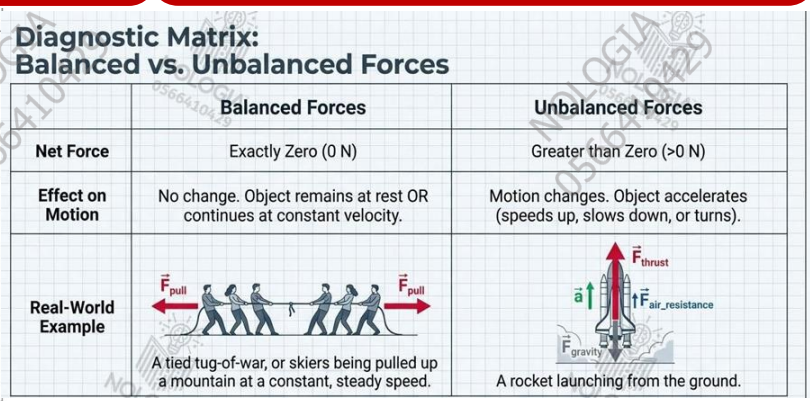
If you cause the surfaces between two touching objects to change, how will the friction be affected? Make a claim. Support your explanation with evidence and logical connections.

Claim: Changing the surfaces between two touching objects will change the amount of friction between them, either increasing or decreasing it.

Evidence & Logic: Friction depends on the roughness and materials of the contacting surfaces. For example, if you make the surfaces rougher (like adding sand or tread), or tread), friction will increase, making it harder for the objects to slide. Conversely, if you make them smoother (like adding ice, wax, or lubricant), the surfaces will slide over each other more easily, significantly decreasing the friction. Therefore, altering the physical characteristics of the touching surfaces directly changes the frictional force acting between them.

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Questions :

Question 1: In what direction does a book move when you push it across a table?

(A) In the direction opposite to your push	(B) In the direction of the greater force (the push)
(C) Straight upward into the air	(D) It does not move in any direction

Question 2: What is the evidence that friction is acting on the book?

(A) The book changes color on the table	(B) The book speeds up after you let go
(C) The book stops when you stop pushing	(D) The mass of the book increases

Question 3: An object is moving under the effect of an applied force. Which force is larger: the applied force or friction?

(A) Friction	(B) Air resistance
(C) Both forces are zero	(D) The applied force

Question 4: When friction is reduced, does the distance covered by an object increase or decrease?

(A) It decreases	(B) It increases
(C) It drops to zero immediately	(D) It stays the exact same on all surfaces

Question 5: The same toy car is pushed with the same force on carpet, wood and ice. On which surface will it travel the farthest? Explain.

(A) Carpet - because it has the most friction	(B) Wood - because it has medium friction
(C) Ice - because it has the least friction	(D) All three surfaces - because the push force is the same

Ministry Exam Questions

This question is about Force and Acceleration

Ali is riding his skateboard on a smooth school playground. He gives himself a strong push and starts gliding forward. After a short while, he stops moving.



2026-2025

Question 1 : Ali's friend observes him slowing down and wonders why. Use Newton's First Law to explain why Ali slows down and eventually stops.

Friction acts as an unbalanced force opposing motion, causing him to slow down and stop

Question 2 : Ali performs an experiment where he pulls a wooden block across two different surfaces: one dry, and the other lubricated with oil.

Complete the table by ticking the force needed for each surface and also choose the correct explanation.

Surface Type	Force Needed	Explanation
Dry Surface	More force	More friction
Lubricated Surface	Less force	Less friction

Dry Surface: More force (More friction) | Lubricated Surface: Less force (Less friction)

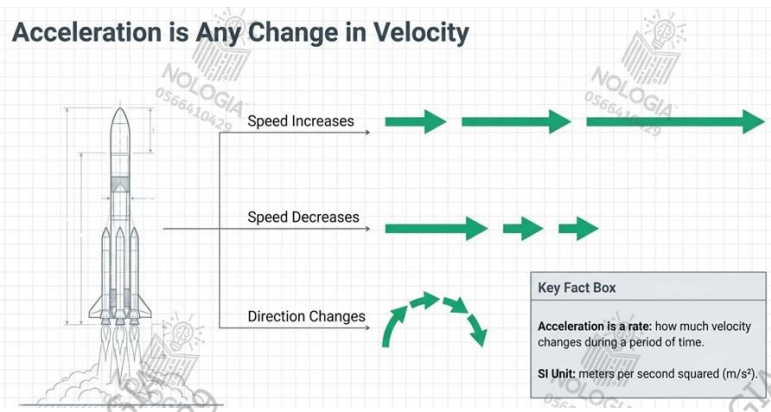
Q8 : Unit 2: Energy and Motion

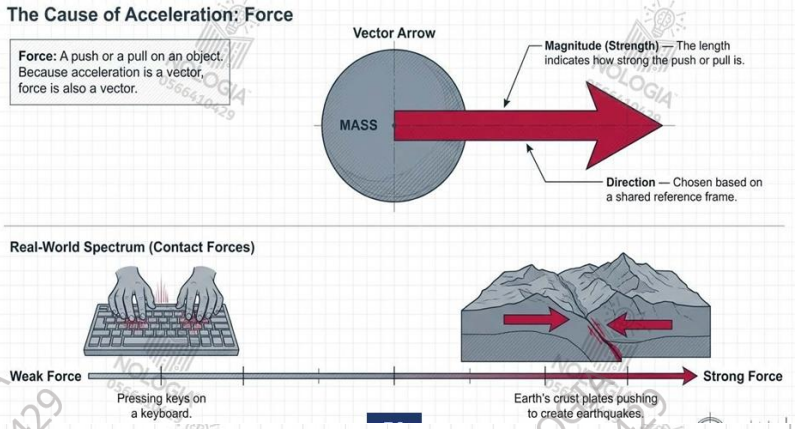
Module 1: Forces and Motion · Lesson 2: Force and Acceleration

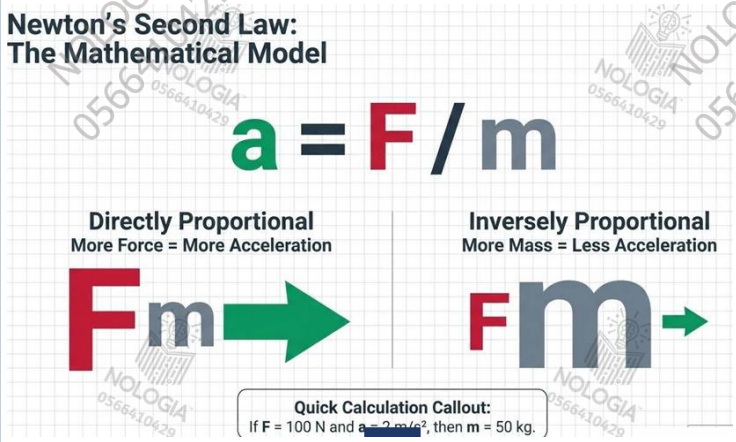
Calculate the magnitude and determine the direction of the net force acting on an object when two forces act on it.

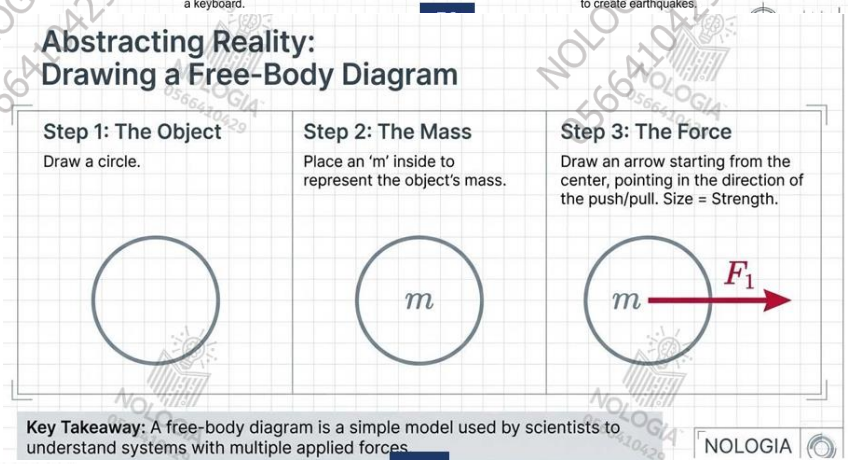
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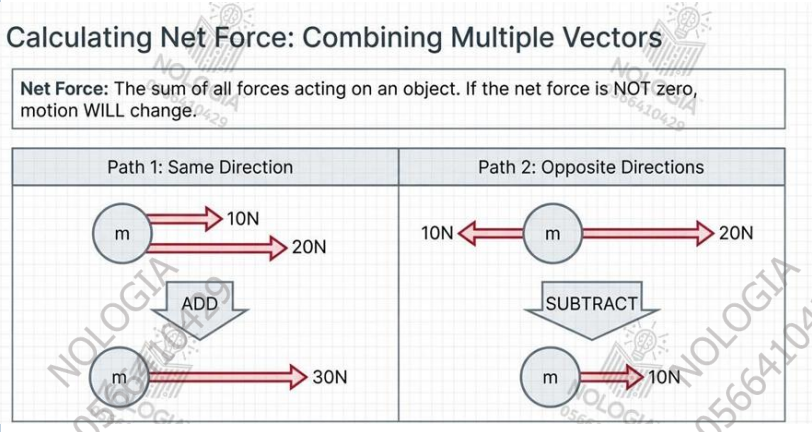
Multiple Choice Questions - MCQ

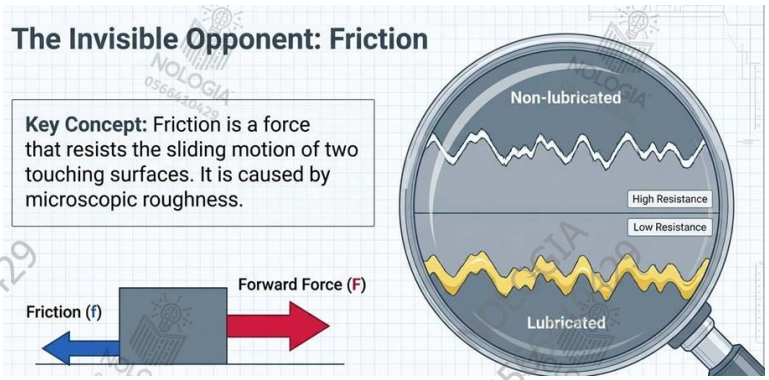




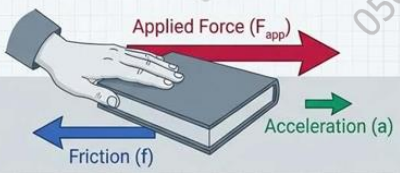
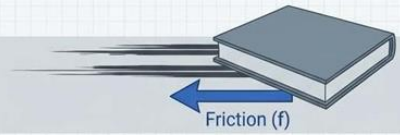








Why Objects Stop on Earth

Panel 1: The Push	Panel 2: The Release
	
Applied force > Friction	Applied force is gone.
Result: Book accelerates.	**Result:** Book slows down and stops.

Thought Experiment Box

What if there were zero friction? According to Newton's second law, the book would continue moving at the exact same speed and direction forever, because no net force would exist to change its motion.

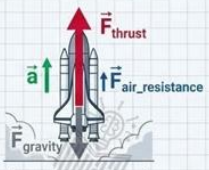
Newton's First Law of Motion

If **Net Force = 0** (and acceleration = 0)...

For an object at rest	For an object in motion
...it will STAY at rest.	...it will STAY in motion at a constant speed and direction.

...UNLESS acted upon by an outside force.

Diagnostic Matrix: Balanced vs. Unbalanced Forces

	Balanced Forces	Unbalanced Forces
Net Force	Exactly Zero (0 N)	Greater than Zero (>0 N)
Effect on Motion	No change. Object remains at rest OR continues at constant velocity.	Motion changes. Object accelerates (speeds up, slows down, or turns).
Real-World Example	 A tied tug-of-war, or skiers being pulled up a mountain at a constant, steady speed.	 A rocket launching from the ground.

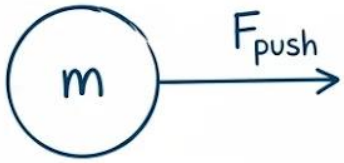
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Diagram a Force

A circle is drawn to represent the object as shown to the right. An *m* is placed inside to represent the mass of the object. Next, an arrow is drawn to represent the direction that the force is applied. The size of the arrow indicates how strong the push or pull is.



1. Sketch a free-body diagram of an object being pushed to the right.



Sketch of a free-body diagram showing a force (push) applied to the right.

To model an object with multiple forces, simply add one arrow to the circle in the direction of each force as shown below.

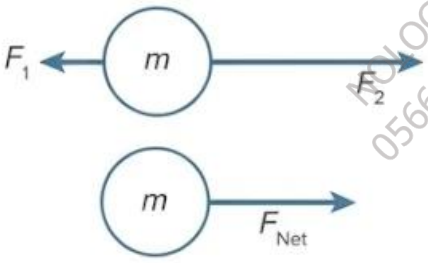


2. In the free-body diagram above, the force to the left (F_1) is less than the force to the right (F_2). Which direction do you think the object will begin to move?

The object will begin to move to the right.
This is because the force to the right (F_2) is larger than the opposing force to the the left (F_1), resulting in a net force to the right.

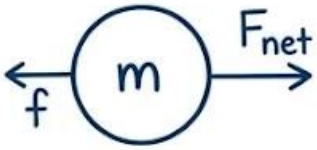
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When all the arrows are added together, the result it is called the net force. The **net force** is the sum of all the forces acting on an object. To model the net force, simply add together the forces in the same direction and subtract the forces in the opposite direction. The sizes of the arrows show how much is added or removed. Then draw a free-body diagram of the net force.



3. Make a free-body diagram for the net force on the object shown below. The object is sliding across a surface with friction.





Net Force ($F_{net} = F - f$)

4. An object is pushed to the right with 10 Newtons of force, and pulled to the left with 20 Newtons. Sketch a free-body diagram of this system, and draw a diagram with the net force. Ignoring friction, identify the direction and motion of the object.

Diagram of System:

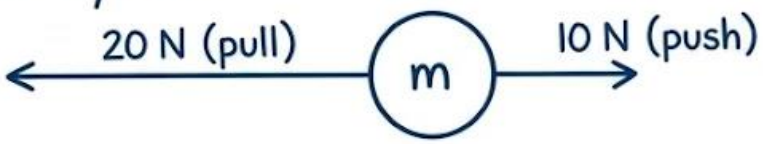


Diagram of Net Force:



The object will begin to move to the left. Since the force to the left (20 N) is greater than the right (1 N), the net force is 10 N to the left, which determines the direction of motion.

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Three-Dimensional Thinking

An object has a force acting on it to the right and has a frictional force to the left as shown below. Use the model below to answer questions 2 and 3.



2. What change in motion will result from the forces modeled?

   A There will be no change in motion because the forces are in opposite directions.

   B The object will slow down because of the friction force.

   C The object will accelerate to the right.

   D The object will accelerate to the left.

3. What would a model of the net force look like?

   A The arrow would be to the right at the same length as before, because friction is a different force.

   B The arrow would be to the right but shorter than before to account for the friction force.

   C There would be no net force because the two forces are in opposite directions.

   D The arrow would be to the left because friction is slowing the object down.

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Questions :

Question 1: When two forces act in the same direction on an object, the net force is found by _____ the forces.

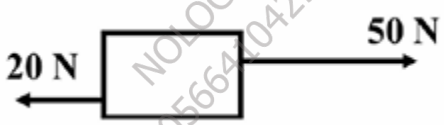
(A) subtracting	(B) adding
(C) multiplying	(D) dividing

Question 2: Lizzie pushes a scooter with 75 N to the left, and Alex helps with 20 N to the left. What is the net force on the scooter?

(A) 55 N to the left	(B) 55 N to the right
(C) 95 N to the left	(D) 95 N to the right

Question 3: The diagram below shows the forces acting on an object

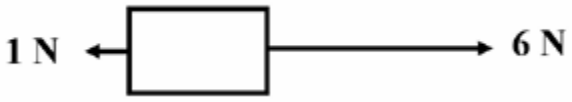
What is the magnitude and direction of the net force?



(A) 30 N to the right	(B) 30 N to the left
(C) 70 N to the right	(D) 0 N (balanced)

Question 4: The diagram below shows the forces acting on an object

What is the magnitude and direction of the net force?



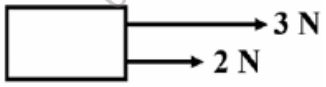
(A) 5 N to the left	(B) 7 N to the right
(C) 5 N to the right	(D) 6 N to the left

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Question 5: The diagram below shows the forces acting on an object

What is the magnitude and direction of the net force?



(A) 5 N to the right	(B) 5 N to the left
(C) 1 N to the right	(D) 6 N to the right

Question 6: In a tug-of-war, Team A pulls with 300 N to the left and Team B pulls with 250 N to the right. What is the net force? Which team wins?

(A) 0 N - Neither team wins	(B) 50 N to the right - Team B wins
(C) 550 N to the left - Team A wins	(D) 50 N to the left - Team A wins

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Ministry Exam Questions

This question is about Force and Acceleration

Ali is riding his skateboard on a smooth school playground. He gives himself a strong push and starts gliding forward. After a short while, he stops moving.



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Question 1 : Ali pushed his skateboard forward with a force of 30 N. The friction force acting against the motion of the skateboard is 20 N. Determine the net force and state its direction.

10 N forward

Question 2 : The free body diagram shown below represents Ali pushing forward on his skateboard. Draw arrows to show: • The push force applied by Ali

• The friction force that acts against his motion



Q9 : Unit 2: Energy and Motion

Module 1: Forces and Motion· Lesson 3: Force Pairs

Apply Newton's third law of motion to determine the magnitude and direction of the forces exerted by two interacting objects on each other.

(Page 64 , 66 , 73)

Multiple Choice Questions - MCQ

Opposing Forces In the activity at the beginning of the lesson, you moved because the wall exerted a force on you. This force exists because you were pushing against the wall. If you push only a little amount against the wall, the wall will push only a little against you. If you push against the wall with a lot of force, the wall will push against you a lot. Newton also noticed this phenomenon and described it by saying that for every action, there is an equal and opposite reaction. It is now known as the third law of motion.

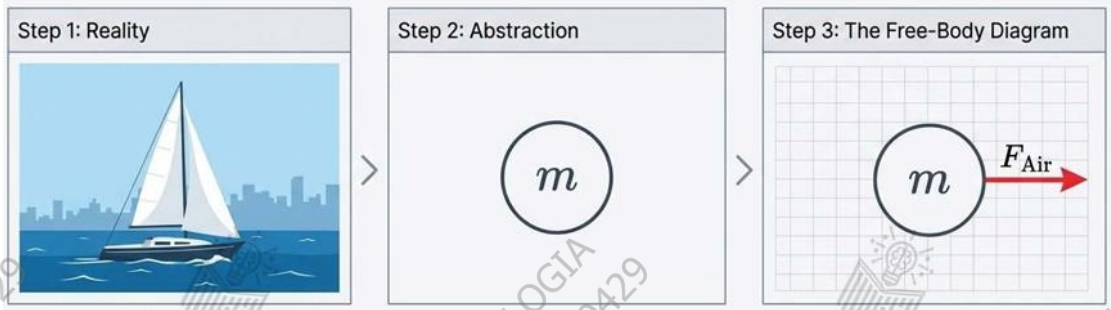
Newton's third law of motion states that when an object applies a force on another object, the second object applies a force of the same strength on the first object, but the force is in the opposite direction. This idea explains how helicopters and drones work. When a drone pushes the air down, the air pushes the drone up. Air particles may be small and not very massive, but pushing a large amount of air can lead to a large push back.



Visualizing Physics: Free-Body Diagrams

How scientists simplify complex forces to calculate motion.

All forces come in pairs, which can make understanding motion complicated. Free-body diagrams strip away the environment (water, air, background) and focus only on the net forces acting on the specific object being measured.



Force Pairs The forces described by Newton's third law depend on each other. A **force pair** is the forces two objects apply to each other. Recall that you can add forces to calculate the net force. If the forces of a force pair always act in opposite directions and are always the same strength, why don't they cancel each other? Force pairs are not the same as balanced forces. Balanced forces act on the same object. The force from gravity and the force from the floor act on the same object—you—and are balanced. In force pairs, each force acts on a different object. Look at the ball and the tennis racket below. The ball has the force of the racket pushing it. The racket has the force of the ball pushing on it. The forces do not result in a net force of zero because they act on different objects. Adding forces can only result in a net force of zero if the forces act on the same object.

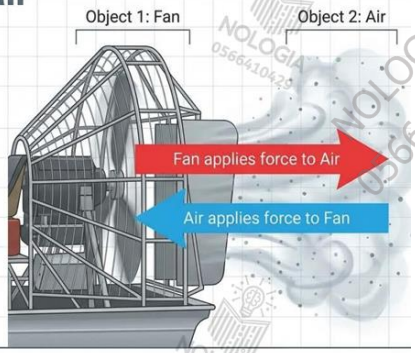
Normal Force The force that pushes back is sometimes called the normal force. The **normal force** is the force that pushes perpendicular to the object's surface. When you push on the wall, the wall has a normal force that is pushing straight out from the wall. When a tennis ball hits a tennis racket, the racket applies a normal force perpendicular to the racket. This is why a tennis player will turn her racket when she wants to turn the ball to the left or right. The racket applies a normal force in the direction that the player wants the ball to go.



Anatomy of a Force Pair

Forces never exist alone. A force pair is the specific combination of forces two interacting objects apply directly to each other.

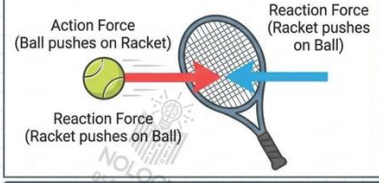
The 3 Rules of Pairs
☑ 1. They depend entirely on each other.
☑ 2. They are always the exact same strength.
☑ 3. They always act in opposite directions.

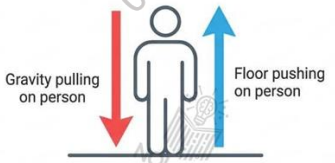


NOLOGIA **NOLOGIA Study Tip:** Force pairs are the fundamental building blocks of all movement, from walking on the ground to rockets in space.

The Ultimate Distinction: Why Objects Move
Force Pairs vs. Balanced Forces

Force Pairs (Newton's 3rd Law)	Balanced Forces (Newton's 1st Law)
• **Target Rule:** Forces act on DIFFERENT objects. • **Net Force:** Does NOT equal zero. (Objects can accelerate).	• **Target Rule:** Forces act on the SAME object. • **Net Force:** Results in exactly ZERO. (No change in motion).



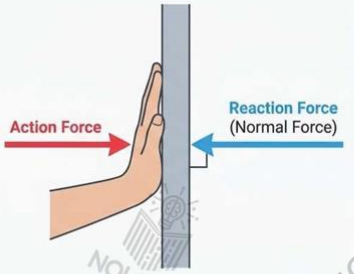


Adding forces only results in a net force of zero if the forces act on the exact same object.

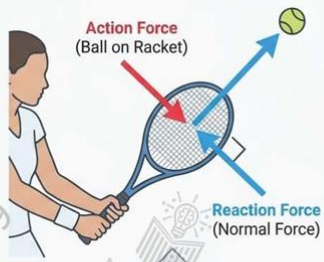
The Normal Force: When Surfaces Push Back

The **normal force** is the specific reaction force that pushes back perpendicular (at a 90-degree angle) to an object's surface.

Flat Surface



Angled Surface



This is why a tennis player turns her racket! The racket applies a normal force in the exact perpendicular direction she wants the ball to travel.

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Three-Dimensional Thinking

A person is applying a force to the right on an object as shown.
Use the model below to answer questions 2 and 3.



2. What forces are acting on the person?

A a slightly smaller force to the left because the object is accelerating

B a force equal to the force applied going to the left

C a force to the right to apply the force to the object

D a force to the right because the object is accelerating

3. The person is standing on ice with little to no friction. What will be the motion of the person applying the force to the object?

A begin to move to the right because that is the direction of the push

B no change in motion because the person is pushing the object

C begin to move to the left because the object pushes on the person

D begin to move to the right with the object

---

4. Which of the following systems does NOT represent a force pair?

A When you push on a bike's brakes, the friction between the tires and the road increases.

B When a diver jumps off a diving board, the board pushes the diver up.

C When an ice skater pushes off a wall, the wall pushes the skater off of the wall.

D When a boy pulls a wagon, the wagon pulls back on the boy.

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Questions :

Question 1: Read the Section Newton's third law: State Newton's third law?

(A) The acceleration of an object equals the net force divided by its mass	(B) An object at rest remains at rest unless acted on by an unbalanced force
(C) When one object applies a force on a second object, the second applies a force of the same strength on the first, in the opposite direction	(D) Gravitational force increases with mass and decreases with distance

Question 2: What is a force pair?

(A) The forces two objects apply to each other	(B) Two forces acting in the same direction on one object
(C) The sum of mass and acceleration of a single object	(D) Gravity and friction acting on the same book

Question 3: Why do force pairs not cancel each other out?

(A) Because one force is always larger than the other	(B) Because they act in the same direction
(C) Because they happen at different times	(D) Because each force acts on a different object

Question 4: When you push a pole downward on Earth to make a pole vault, Earth exerts an equal force on the pole. (True / False)

(A) True	(B) False

Question 5: The statement "for every action, there is an equal but opposite reaction" is a statement of ___.

(A) the law of conservation of energy	(B) Newton's first law
(C) Newton's third law	(D) Newton's second law

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Question 6: Kelly sits on a rock in a field. Which of the following correctly names a force pair?

(A) Kelly pushes on the rock, and the rock pushes on Kelly	(B) Kelly pushes on the rock, and Earth pulls on Kelly
(C) The rock pushes on Earth, and Kelly pulls on the rock	(D) Earth pulls on Kelly, and the rock pushes on Kelly

Question 7: A student pushes on a wall with a force of 30 N. What force does the wall push on the student? In which direction?

(A) 0 N	(B) 15 N in the same direction
(C) 30 N, in the opposite direction	(D) 60 N in the opposite direction

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Q10 : Unit 2: Energy and Motion

Module 1: Forces and Motion · Lesson 4: Gravitational Force

Interpret graphs showing the relationship between gravitational force and distance.

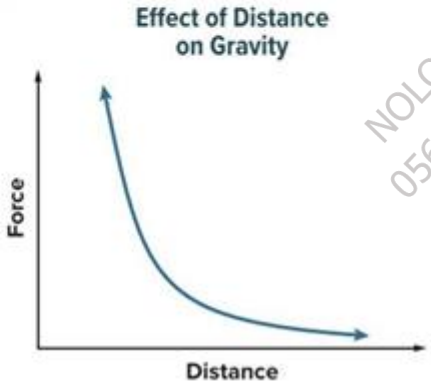
(Page 84)

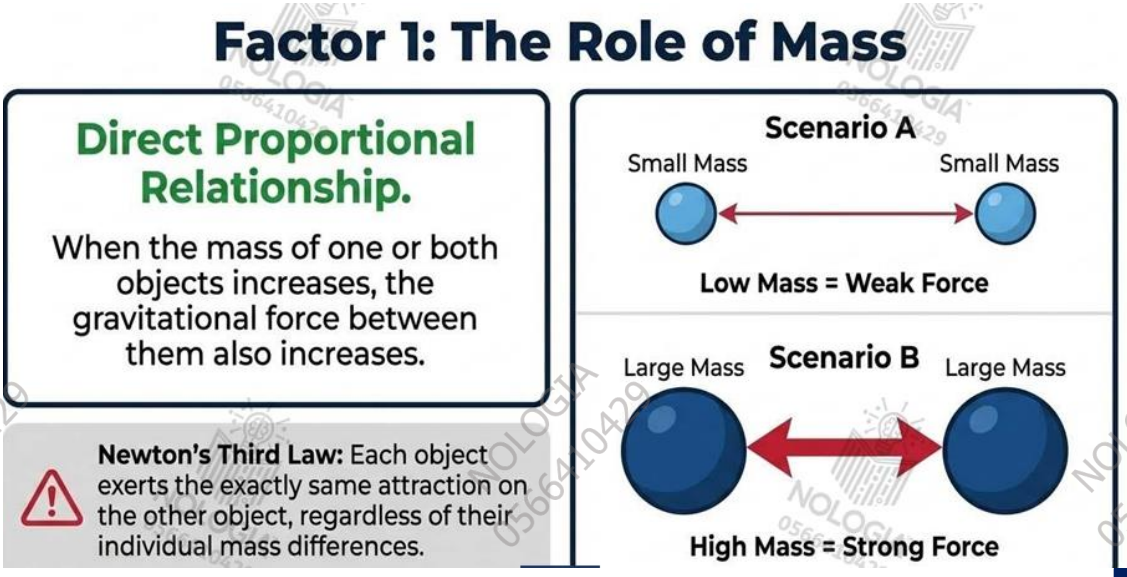
Multiple Choice Questions - MCQ

Gravitational Force and Mass When the mass of one or both objects increases, the gravitational force between them also increases. This is a direct proportional relationship. Each object exerts the same attraction on the other object.

If both objects exert the same attraction on each other, why does it look like the pencil falls toward Earth? The effect of mass on the force of gravity is most noticeable when one object is very massive, such as a planet, and the other object has much less mass, such as a pencil. Even though the force of gravity acts equally on both objects, the less massive object accelerates more quickly due to its smaller mass. Because the planet accelerates so slowly, all you observe is the object with less mass "falling" toward the object with greater mass.

Gravitational Force and Distance As the distance between objects increases, the attraction between objects decreases. This is an inverse proportional relationship as seen in the graph on the right. For example, if your mass is 45 kg, the gravitational force between you and Earth is about 440 N. On the Moon, about 384,000 km away, the gravitational force between you and Earth would only be about 0.12 N.





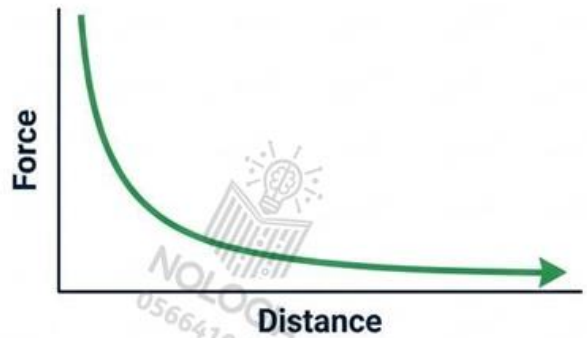
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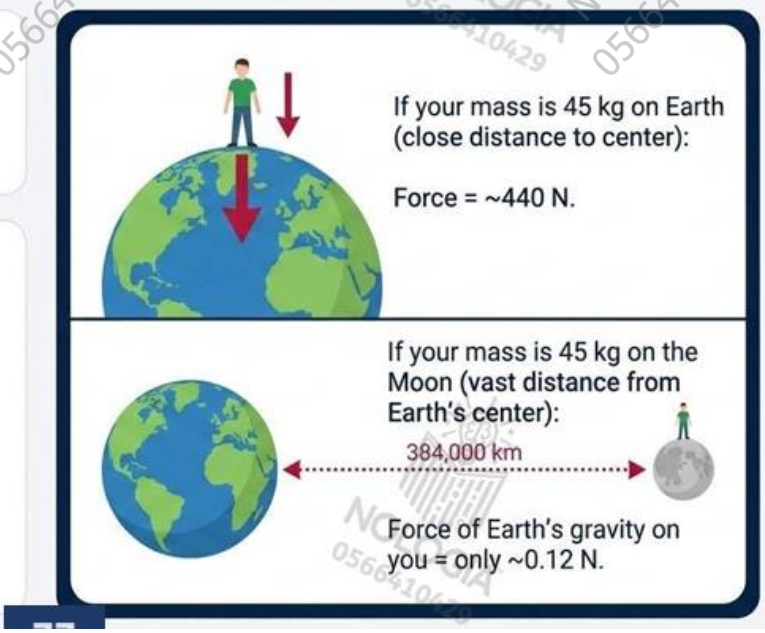
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Factor 2: The Role of Distance

Inverse Proportional Relationship.

As the distance between objects increases, the attraction between them decreases.





Questions :

Question 1: What happens to the gravitational force as the distance between objects increases?

(A) It decreases	(B) It increases
(C) It stays the same	(D) It reverses direction

Question 2: Sketch a graph to show the effect of increasing distance on the gravitational force. Label the axes.

(A) Straight line going up as distance increases (force on y-axis, distance on x-axis)	(B) Curve starting high and going down (force on y-axis, distance on x-axis)
(C) Flat horizontal line that never changes with distance	(D) Vertical line at zero distance

Question 4: Two objects move closer together (the distance between them decreases). The gravitational force between them _____.

(A) decreases	(B) becomes zero
(C) increases	(D) stays constant

Question 5: As a spacecraft travels farther and farther away from Earth, what happens to Earth's gravitational pull on the spacecraft?

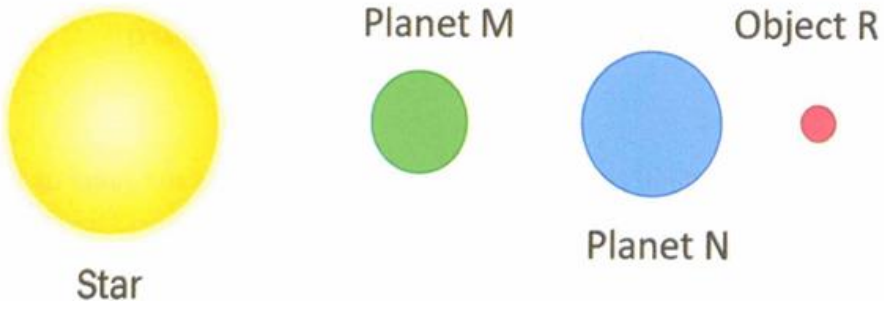
(A) It increases steadily	(B) It pushes the spacecraft away
(C) It remains exactly 9.8 N/kg everywhere in the universe	(D) It decreases as distance increases

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Ministry Exam Questions

This question is about the Gravitational Force.

You are helping a space research team understand how gravity affects objects in space and on Earth. They have given you the diagram below showing a star, two planets (Planet M and Planet N), and a small object (Object R) in space. **(The mass is represented by the size of the objects.)**





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Question 1 : : i. Decreasing the distance between the two objects X and Y → _____ the force of gravity on X / _____ the force of gravity on Y. ii. Increasing the distance between the two objects X and Y → _____ the force of gravity on X / _____ the force of gravity on Y.

Condition	Force of Gravity on X	Force of Gravity on Y
i. Decreasing the distance between the two objects X and Y	increases	increases
ii. Increasing the distance between the two objects X and Y	decreases	decreases

(A) i. decreases, decreases | ii. increases, increases	(B) i. increases, increases | ii. decreases, decreases
(C) i. increases, decreases | ii. decreases, increases	(D) i. stays the same | ii. stays the same

Q11 : Unit 2: Energy and Motion

Module 1: Forces and Motion · Lesson 4: Gravitational Force

Distinguish between mass and weight, and calculate the weight of an object using its mass and gravitational acceleration.

(Page 89)

Multiple Choice Questions - MCQ

Weight Even though the washers were not falling, the force due to Earth's gravity still was pulling them downward. **Weight** is the gravitational force exerted on an object. Near Earth's surface, an object's weight is the gravitational force exerted on the object by Earth. Because weight is a force, it is measured in newtons (N). Near Earth's surface, the weight of an object in newtons is about ten times its mass in kilograms. The weight of an object can be calculated by using the following equation.

Weight Equation

weight (N) = mass (kg) × gravitational acceleration (m/s²)

$W = mg$

Normal Force A pencil sitting on a table is acted on by gravity. This force in the downward direction is equal to its weight. Because gravity is acting on the pencil, the pencil is pushing down on the table. Recall, Newton's third law of motion states that for every force there is an opposite equal force. The table pushes up on the pencil with an equal but opposite force. The force of the table on the pencil is referred to as the normal force.



The Weight Equation Breakdown

$W = m \times g$

Weight (Measured in Newtons, N)	Mass (Measured in Kilograms, kg)	Gravitational Acceleration (9.8 m/s² on Earth)

Mini-Calculation Example

Example: If a book has a mass of 2 kg on Earth...
W = 2 × 9.8 = 19.6 N

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Questions :

Question 1: Mass and weight are different. Mass depends on _____. Weight depends on _____.

(A) gravitational force, the amount of matter	(B) the amount of matter, gravitational force
(C) the amount of matter, volume	(D) location, the amount of matter

Question 2: Mass varies depending on where the object is located.

(A) True - mass increases on larger planets	(B) True - mass is measured in Newtons
(C) True - mass becomes zero on the Moon	(D) False - mass does not change with location

Question 3: A student stands on a bathroom scale and the reading is 50 kg. What is the mass of the student (and its unit), and what is the weight of the student on Earth (and its unit)?

(A) Mass = 490 N (measured in N); Weight = 50 kg (measured in kg)	(B) Mass = 50 kg (measured in kg); Weight = 490 N (measured in N)
(C) Mass = 50 N (measured in N); Weight = 490 kg (measured in kg)	(D) Mass = 5.1 kg (measured in kg); Weight = 50 N (measured in N)

Question 4: A water bottle has a mass of 2 kg. Calculate its weight on Earth (use $g = 9.8\ m/s^2$).

(A) 4.9 N	(B) 11.8 N
(C) 98.0 N	(D) 19.6 N

Question 5: If a 50 kg student travels from Earth (g = 9.8 N/kg) to the Moon (g = 1.6 N/kg), what are the student's mass and weight on the Moon?

(A) Mass = 50 kg, Weight = 80 N	(B) Mass = 8.2 kg, Weight = 80 N
(C) Mass = 50 kg, Weight = 490 N	(D) Mass = 80 kg, Weight = 50 N

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Ministry Exam Questions

This question is about the Gravitational Force.

You are helping a space research team understand how gravity affects objects in space and on Earth. They have given you the diagram below showing a star, two planets (Planet M and Planet N), and a small object (Object R) in space. **(The mass is represented by the size of the objects.)**



Image Source: AI-generated

Use the diagram above to answer questions in part A.

2026-2025

Question 1 :

An object has a mass of 2 kg. Calculate its weight on Earth. (Use gravitational acceleration = 9.8 m/s²)

Step	Formula / Substitution	Final Answer
1. Formula	Weight = Mass × Gravitational Acceleration	–
2. Substitution	Weight = 2 kg × 9.8 m/s²	19.6 N
Answer: Weight = 2 × 9.8 = 19.6 N		

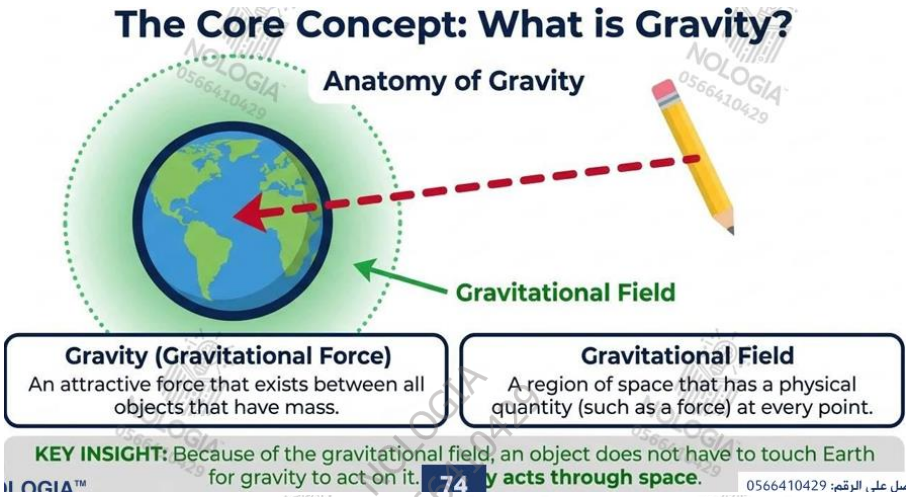
Q12 : Unit 2: Energy and Motion

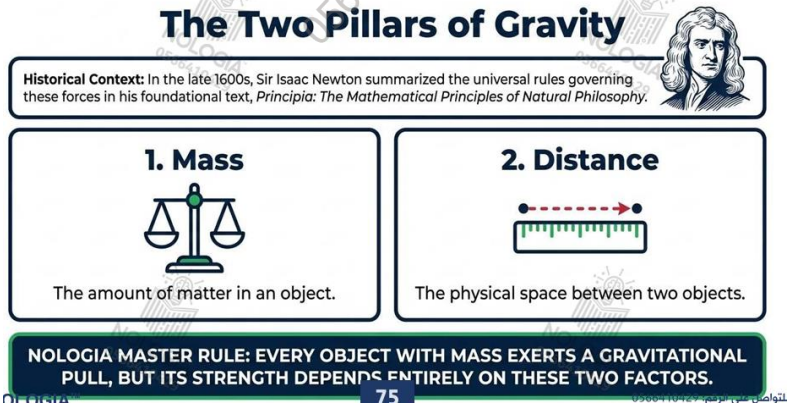
Module 1: Forces and Motion · Lesson 4: Gravitational Force

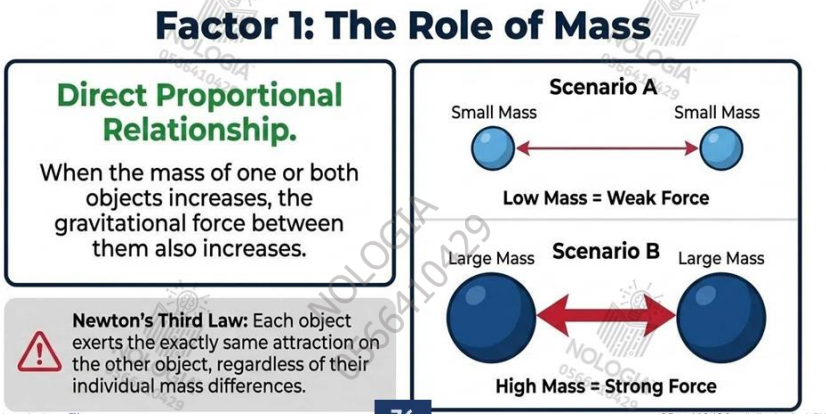
Predict how changes in the masses of objects affect the gravitational force of attraction between them when the distance remains constant.

(Page 83 , 84 , 85)

Multiple Choice Questions - MCQ



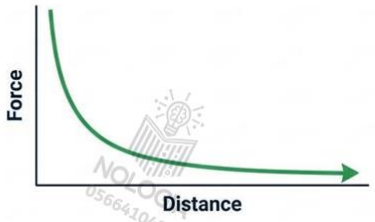


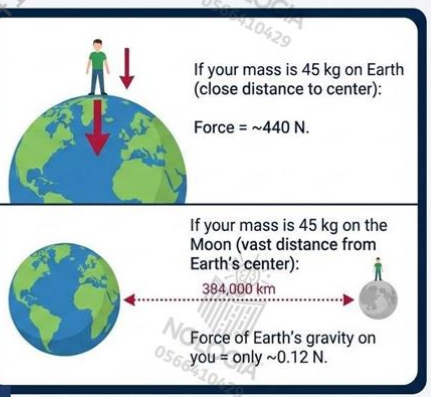


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Factor 2: The Role of Distance

Inverse Proportional Relationship.
As the distance between objects increases, the attraction between them decreases.





Synthesis Matrix: Mass vs. Distance

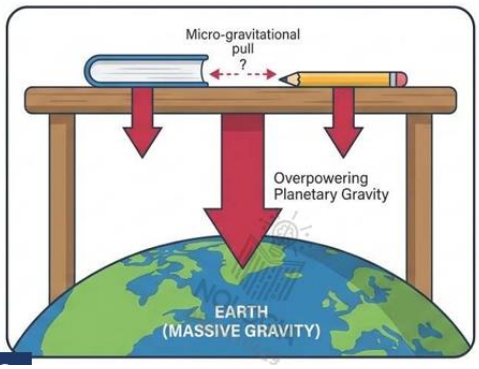
Change in Mass	Change in Distance: Decreased Distance	Change in Distance: Increased Distance
Baseline Mass	Force	Force Decreases
Increased Mass	Force Increases	Force

Synthesis Insight: Maximum gravity requires maximum mass and minimum distance

Addressing the Misconception: The Gravity of Small Objects

Why don't a pencil and a book attract each other on a desk?

- All objects have mass, meaning all objects possess a gravitational field.
- The masses of the pencil and book are microscopic compared to Earth.
- They do pull on each other slightly, but the force is incredibly weak—not enough to overcome friction and cause a change in motion.



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Gravitational Acceleration (g)

The Law

When gravity is the only force acting on falling objects, they all fall at the exact same acceleration regardless of their mass.

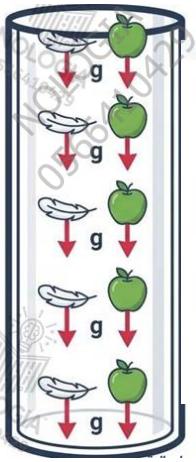
The Constant

$g = 9.8\ m/s^2$

Close to Earth's surface.

The Air Resistance Caveat

The feather and apple only fall at the same time in a vacuum. In the real world, air resistance opposes gravity and slows lighter objects down.



NOLOGIA SCIENCE STUDY GUIDE

MASS VS. WEIGHT: THE ULTIMATE COMPARISON

	MASS	WEIGHT
Definition	The amount of matter in an object.	The gravitational force exerted on an object.
Unit of Measurement	Kilograms (kg)	Newtons (N)
Location Dependency	Never changes. A 45 kg student is 45 kg on Earth, the Moon, and in deep space.	Changes constantly based on the strength of the local gravitational field.

The Weight Equation Breakdown

$$W = m \times g$$

Weight (Measured in Newtons, N)

Mass (Measured in Kilograms, kg)

Gravitational Acceleration ($9.8\ m/s^2$ on Earth)

Mini-Calculation Example

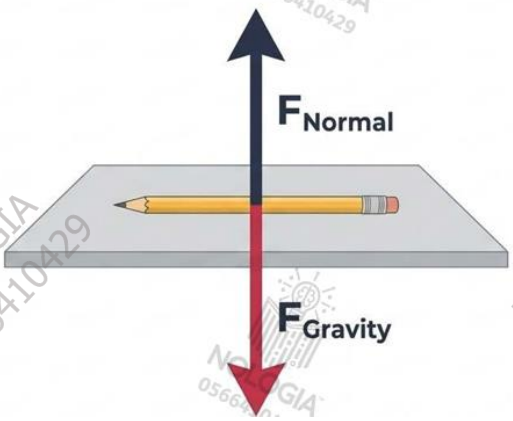
Example: If a book has a mass of 2 kg on Earth...

$W = 2 \times 9.8 = 19.6\ N$

NOLOGIA SCIENCE STUDY GUIDE

NORMAL FORCE: NEWTON'S THIRD LAW IN ACTION

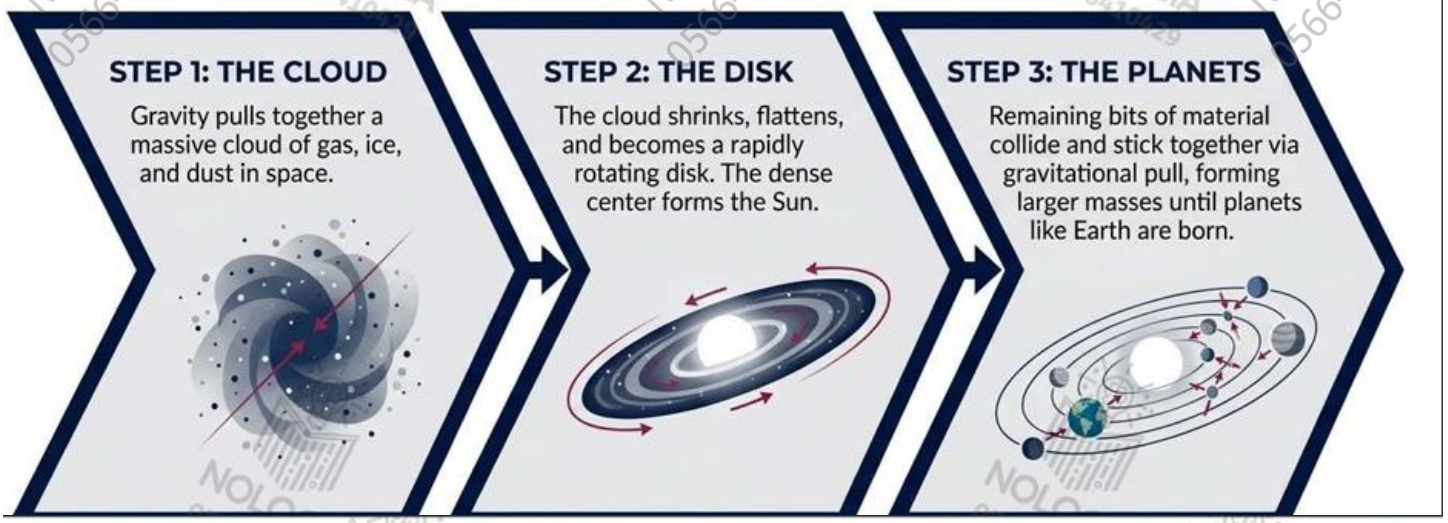
- **Normal Force:** Newton's third law of motion states that for every force, there is an equal but opposite force.
- The gravity of Earth pulls the pencil downward (its weight).
- The table pushes back up on the pencil with an equal, opposite force called the normal force, creating equilibrium.



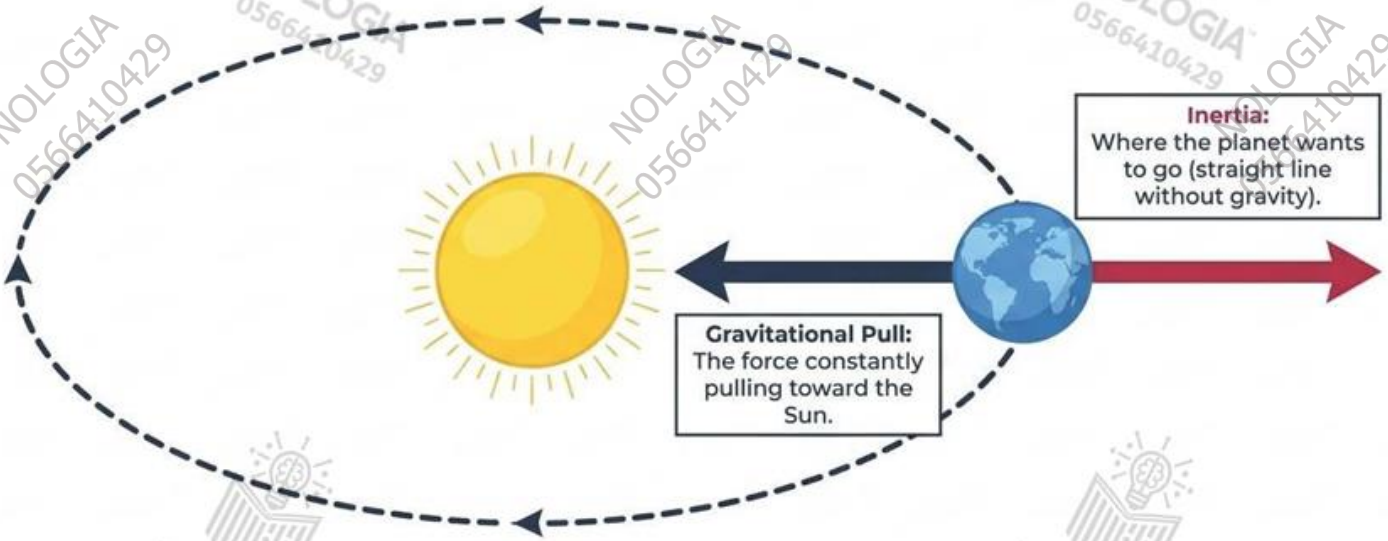
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MACRO-GRAVITY: CREATING THE SOLAR SYSTEM



MACRO-GRAVITY: ORBITAL MECHANICS



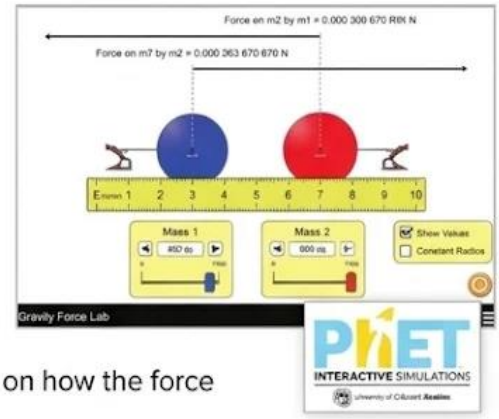
Result: The continuous elliptical orbit. Everything in the solar system is held together by the Sun's gravitational force.

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The Force of Gravity

How could you increase the force of gravity?

GO ONLINE Explore the PhET interactive simulation *Gravity Force Lab*.



After exploring the simulation on your own, reset the simulation and follow the instructions below.

1. Determine how to change the force of gravity on the object on the right. In the graphic organizer below, circle the words that best describe your observations on how the force of gravity on the object on the left changes.

When the force of gravity changes on one object, the force of gravity on the second object always changes by

the same amount. (circled) *a different amount.*

2. Move the object on the right closer to and farther away from the object on the left.

3. Complete the graphic organizer below using *increases or decreases* to explain how changing distance affects the force of gravity on the two objects.

Decreasing the distance between the two objects	*increases* the force of gravity on the first object. *increases* the force of gravity on the second object.
Increasing the distance between the two objects	*decreases* the force of gravity on the first object. *decreases* the force of gravity on the second object.

Copyright © McGraw-Hill Education PhET Interactive Simulations/ University of Colorado Boulder, https://phet.colorado.edu

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4. Next, increase the mass of the object on the right. Then decrease the mass of the object on the right.

5. Complete the graphic organizer using *increases* or *decreases* to explain how changing mass affects the force of gravity on the two objects.

Decreasing the mass of one of the two objects	decreases *the force of gravity on the first object.* decreases *the force of gravity on the second object.*
Increasing the mass of one of the two objects	increases *the force of gravity on the first object.* increases *the force of gravity on the second object.*

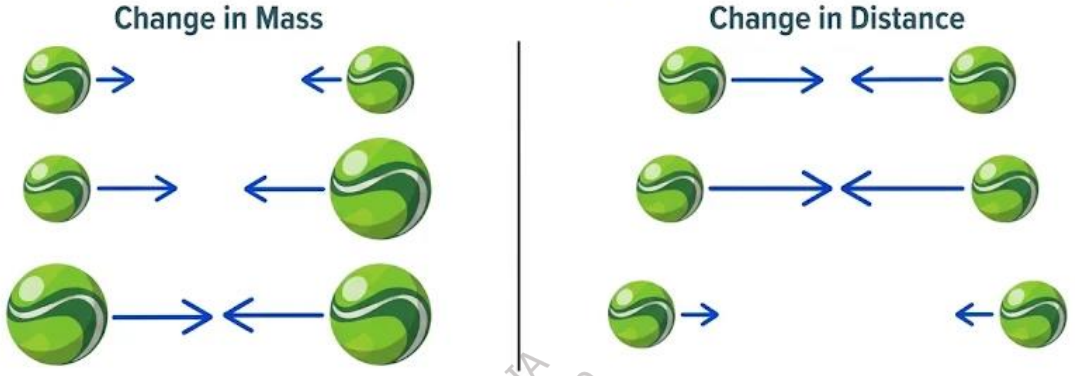
6. Which law of motion explains why the force of gravity between two objects is the same for each object regardless of its mass? Explain.

Newton's third law of motion. It states that for every action, there is an equal and opposite reaction. This means the force object 1 exerts on object 2 is exactly equal to the force object 2 exerts on object 1, regardless of their masses.



THREE-DIMENSIONAL THINKING

On the figure below, add arrows to **model** the size and direction of the force of gravity for the missing forces in each **system** below.



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Questions :

Question 1: Two balls A and B have the same mass. What happens to the force on A and B if the mass of A is increased?



(A) Increases on A only	(B) Stays the same on both A and B
(C) Decreases on both A and B	(D) Increases on both A and B

Question 2: What happens to the force on A and B if the mass of B is decreased?

(A) Decreases on both A and B	(B) Decreases on B only
(C) Increases on both A and B	(D) Stays the same on both A and B

Question 3: Two objects, A and B, have the same mass.

(1) What would happen to the force on A and B if the mass of A is decreased?
(2) What would happen to the force on A and B if the mass of B is increased?

(A) (1) Increases on both; (2) Decreases on both	(B) (1) Decreases on both A and B; (2) Increases on both A and B
(C) (1) Stays the same; (2) Stays the same	(D) (1) Decreases on A only; (2) Increases on B only

Question 4: If the mass of one of two spheres increases, how does it affect the gravity between the two spheres?

(A) The gravity increases.	(B) The gravity decreases.
(C) The gravity stays the same.	(D) The gravity disappears.

Question 5: Gravitational force increases with increasing _____ and decreases with increasing _____.

(A) distance; mass	(B) speed; time
(C) mass; distance	(D) volume; temperature

Question 6: Why do we not see two pencils on a table move toward each other because of gravity?

(A) Because gravity does not act inside a classroom	(B) Because pencils are made of wood and graphite which have zero mass
(C) Because the air pushes the pencils apart with a strong magnetic force	(D) Because their masses are very small, so the gravitational force between them is extremely weak

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Ministry Exam Questions

This question is about the Gravitational Force.

You are helping a space research team understand how gravity affects objects in space and on Earth. They have given you the diagram below showing a star, two planets (Planet M and Planet N), and a small object (Object R) in space. **(The mass is represented by the size of the objects.)**





Image Source: AI-generated

2026-2025

Question 1 : Choose the correct word to fill in the sentences below: The gravitational pull experienced by Planet P is _____ (stronger/weaker) than that of Planet Q. This is because the mass of Planet P is _____ (more/less) than the mass of Planet Q.

Blank	Options	Correct Word
Blank 1 (Gravitational pull on Planet P)	stronger / weaker	stronger
Blank 2 (Mass of Planet P)	more / less	more

Answer: stronger; more

Question 2 : Given that gravity acts between all masses, explain why it is not easily observed between two pencils.

Answer: Because the masses of the two pencils are very small, the gravitational force between them is extremely weak.

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Q13 : Unit 2: Energy and Motion

Module 2: Mechanical Energy· Lesson 1: Kinetic Energy

Compare the kinetic energy of objects based on their masses and speeds.

(Pages 113 , 116 , 120 ,123 ,124)

Multiple Choice Questions - MCQ



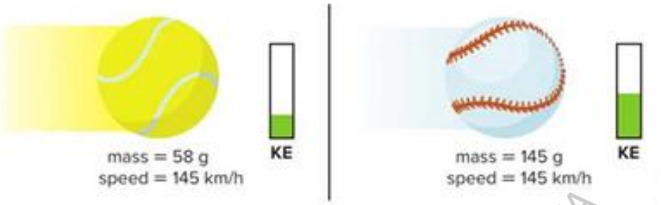
Kinetic Energy The change in motion of the cup occurred because the sphere had a form of energy. This form is called kinetic energy. **Kinetic energy** (KE) is the energy due to motion. When the baseball flies across the field, it also has kinetic energy associated with its motion. All moving objects have kinetic energy. You may have changed how much speed the sphere had before it hit the cup or you may have used a sphere with a different mass. You will investigate how these factors affect the kinetic energy of an object.

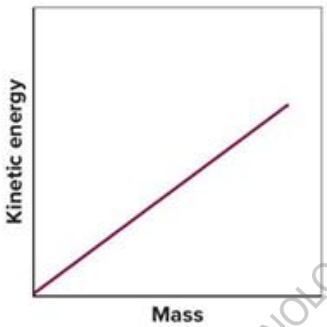
How are kinetic energy and mass related?

Have you ever thrown a baseball or a tennis ball? A baseball has a lot more mass than a tennis ball. How does this affect the amount of kinetic energy the ball has? Let's investigate!

Kinetic Energy and Mass Did you notice in the Lab *Mass Matters* that the sphere with the largest mass created the largest crater? As it fell it had kinetic energy. When it hit the clay it created a larger crater because it had more kinetic energy than the spheres with less mass. A moving object's kinetic energy depends on its mass. If a baseball and a tennis ball move at the same speed, the ball with more mass has more kinetic energy.

Look at the figure below. Note the vertical bars. These are energy bars. Energy bars show relative amounts of energy. The more full the bar, the more energy the object has. The tennis ball and the baseball are traveling at the same speed, but the baseball has a greater mass. For objects traveling at the same speed, the more mass an object has, the greater its kinetic energy.





The relationship between mass and kinetic energy is a proportional, linear relationship that can be described mathematically.

$KE \propto m$

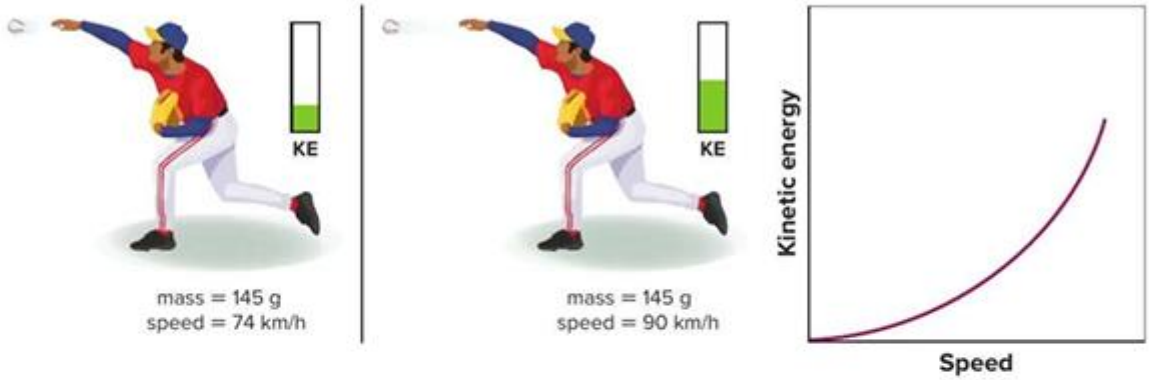
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Kinetic Energy and Speed In the Lab *Picking Up Speed*, you observed that an object's kinetic energy also depends on its speed. The faster an object moves, the more kinetic energy it has. Look at the figure below. The pitcher used the same softball, but the speed was different for the two pitches. The faster pitch has more kinetic energy. This is represented in the energy bars.



There is a proportional relationship between kinetic energy and speed. Did you notice that the speed-volume graph in the Lab *Picking Up Speed* was different from the mass-volume graph in the Lab *Mass Matters*? This is because even though both are proportional relationships, they are not the same type of proportional relationship.

When you increase the mass of an object, the kinetic energy increases by the same factor. When you increase the speed of an object, the kinetic energy increases by the square of the factor. This is a square, nonlinear relationship, which is shown in the graph above. A ball gains kinetic energy when thrown. If a pitcher throws the ball twice as fast, this quadruples its kinetic energy. This relationship can be expressed mathematically by the following expression:

$$KE \propto v^2$$

Summary الملخص

- **Kinetic energy** is the energy due to **motion**. All moving objects have kinetic energy.
- Not moving (speed = 0) → **zero** kinetic energy.
- **More mass** → more KE. **More speed** → more KE.
- To compare: check speed first. If speeds are equal, the **heavier** object has more KE.

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Three-Dimensional Thinking

2. Aiden collected canned goods for a neighborhood service project. He pulled a plastic wagon behind him to put the items in. From the time Aiden began until he finished collecting, the mass of the wagon tripled. The walk back to Aiden's house was downhill and the speed of the wagon tripled. What happened to the kinetic energy when the mass tripled? What happened to the kinetic energy when the speed tripled?

A When the mass tripled, the kinetic energy increased by a factor of 3. When the speed tripled, the kinetic energy increased by a factor of 3.

B When the mass tripled, the kinetic energy increased by a factor of 3. When the speed tripled, the kinetic energy increased by a factor of 9.

C When the mass tripled, the kinetic energy increased by a factor of 9. When the speed tripled, the kinetic energy increased by a factor of 3.

D When the mass tripled, the kinetic energy increased by a factor of 9. When the speed tripled, the kinetic energy increased by a factor of 9.

The figure below shows mass and relative kinetic energy in energy bars for three vehicles.



3. What can you determine about the speed of the blue car?

A The blue car's speed is the same as the red car's speed.

B The blue car's speed is less than the truck's speed.

C The blue car's speed is equal to the truck's speed.

D The blue car's speed is greater than the red car's speed.

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Real-World Connection

4. **Analyze** Which vehicle will have more kinetic energy, a parked semi-truck or a car moving at 50 km/h? Explain your reasoning.

A car moving at 50 km/h will have more kinetic energy.

Reasoning: The parked semi-truck is at rest, meaning its speed is 0 km/h. Since kinetic energy is the energy of motion (Formula: $KE = \frac{1}{2} \cdot m \cdot v^2$), an object must be moving to have kinetic energy. Since the semi-truck is not moving, its energy is exactly 0 J, regardless of how massive it is. Conversely, the moving car has cantaat velocity (50 km/h), meaning it possesses a non-zero, active kinetic energy, which is significantly greater than the 0 J of the parked truck.

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Questions :

Question 4: Which would increase the kinetic energy of a wagon? Select all that apply.

(A) Add mass to the wagon	(B) Decrease the mass of the wagon
(C) Increase the speed of the wagon	(D) Decrease the speed of the wagon.

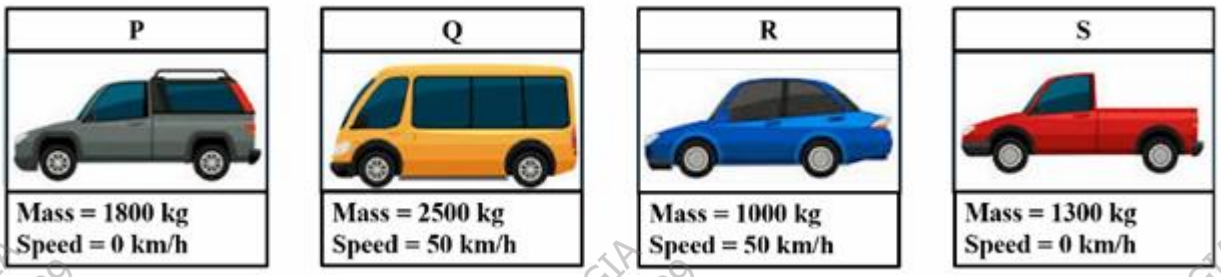
Question 5: A dump truck, a sports car, and a bicycle are traveling at the same velocity . Which is true?

(A) They all have the same kinetic energy.	(B) The sports car has the most kinetic energy.
(C) The bicycle has the least kinetic energy.	(D) More information is needed to compare their kinetic energy.

Question 6:"Kinetic energy is the energy _____. All moving objects have _____." Which words correctly complete the sentences?

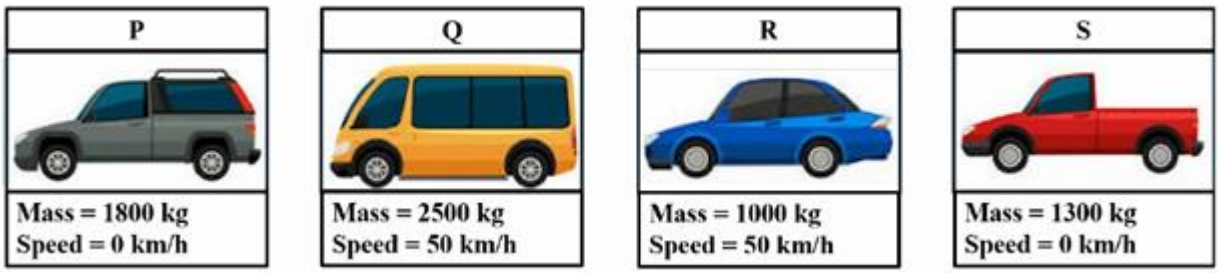
(A) an object has due to its position; potential energy	(B) only stationary objects have; zero energy
(C) stored in chemical bonds; thermal energy	(D) an object has due to its motion; kinetic energy

Question 7: Look at the four vehicles Which of the following vehicles has the largest amount of kinetic energy?



(A) Vehicle P	(B) Vehicle Q
(C) Vehicle R	(D) Vehicle S

Question 8: Using the same four which vehicles have the least amount of kinetic energy, and why?



(A) Vehicle R, because its mass is 1000 kg	(B) Vehicle Q, because its speed is 50 km/h
(C) Vehicles P and S, because their speed is 0 km/h so their kinetic energy is 0	(D) Vehicles Q and R, because they are moving at the same speed

Question 9: Which would increase the kinetic energy of a wagon?

(A) Add mass to the wagon and increase the speed of the wagon	(B) Decrease the mass of the wagon and decrease the speed of the wagon
(C) Stop the wagon completely so its speed is 0 km/h	(D) Decrease the speed of the wagon while keeping mass constant

Question 10: If the speed of a moving object is doubled while its mass stays the same, what happens to its kinetic energy?

(A) Its kinetic energy quadruples (increases by 4 times)	(B) Its kinetic energy doubles (x2)
(C) Its kinetic energy is cut in half	(D) Its kinetic energy remains unchanged

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Q14: Unit 2: Energy and Motion

Module 2: Mechanical Energy· Lesson 2: Potential Energy

Compare the gravitational potential energy of an object at different heights.

(Page 135)

Multiple Choice Questions - MCQ

Gravitational Potential Energy You have seen that an object can have energy even if it is not moving. If you hold a ball 1 m above the ground and let it go, you know that the ball will fall. The ball falls because the ball is in Earth's gravitational field. There is gravitational attraction between the ball and Earth. To increase the energy of an object in relation to Earth's gravitational field a force must be applied to move these two objects farther apart. This type of energy is called gravitational potential energy. **Gravitational potential energy** is stored energy due to the interactions of objects in a gravitational field. Gravitational potential energy exists between all objects but is only significant when at least one very large object is involved, such as Earth.

Recall that objects can be located anywhere inside a gravitational field. The farther away the object is from the center of the gravitational field, the more gravitational potential energy the object has in relation to the field. The difference in gravitational potential energy depends on the change in position of the object and the object's mass.

Change in Position Examine the figure of the girl and the backpack on the right. The girl in the figure increases the gravitational potential energy between her backpack and Earth by lifting the backpack. To increase the gravitational potential energy of the backpack, she exerts a force on the backpack that opposes the force of gravity. When she applies this force, she increases the energy of the backpack. The potential energy of the backpack increases as its height increases.



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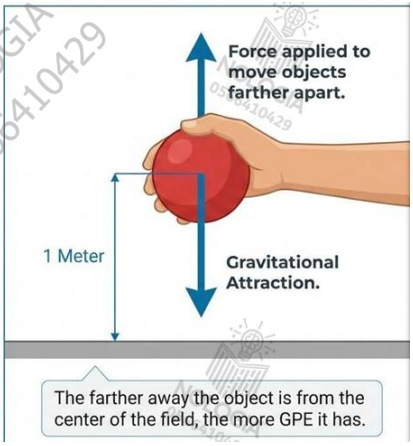
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Gravitational Potential Energy (GPE)

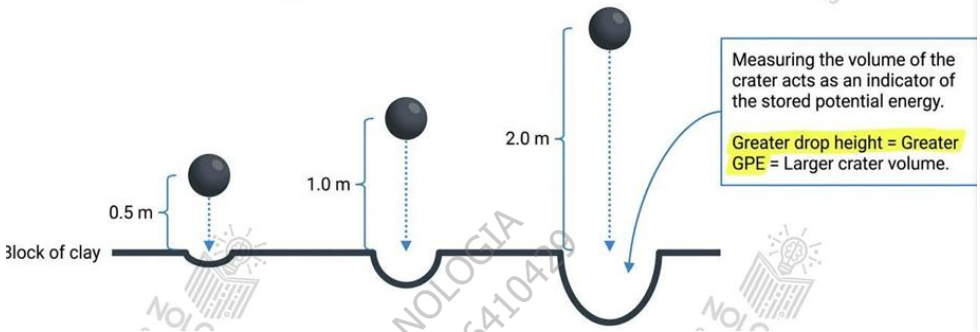
Definition: Stored energy due to the interactions of objects in a gravitational field.

Key rule: GPE only becomes significant when at least one very large object is involved, such as Earth.



The Position Variable (Height vs. Energy)

The Crater Impact Model



The Ultimate Synthesis: EPE vs. GPE

Elastic Potential Energy (EPE)	Gravitational Potential Energy (GPE)
The Trigger: Changing an object's SHAPE.	The Trigger: Changing an object's POSITION in a field.
Key Variable: Distance of stretch/compression.	Key Variables: Distance from surface (Height) and Mass.
Classic Example: Rubber bands, springs, slingshots.	Classic Example: Dropping a ball, lifting a backpack.

Regardless of the type, ALL potential energy represents a change in the relative positions of c[illegible]nents within a system.

Summary الملخص

- **Potential energy** is stored energy due to interactions between objects when the distance between them changes. It depends on **position**.
- **Gravitational potential energy (GPE)** depends on **height**.
- **Higher** → **more** GPE. **Lower** → **less** GPE.
- Moving an object **down** (book to a lower shelf) **decreases** its GPE.

Questions :

Question 1: At which position does the ball have the most gravitational potential energy?



(A) Position N	(B) Position M
(C) Position L	(D) Position O

Question 2: At which position does the ball have the least gravitational potential energy?



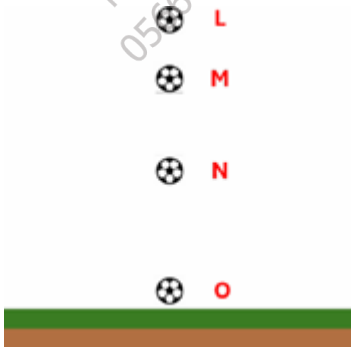
(A) Position O	(B) Position M
(C) Position N	(D) Position L

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Question 3: Does the ball have more gravitational potential energy at M or N? Explain.



(A) At N, because N is closer to the ground than M	(B) Neither M nor N has gravitational potential energy
(C) Both M and N have the exact same gravitational potential energy	(D) At M – because M is higher above the ground than N

Question 4: "Moving a book to a lower shelf decreases its potential energy."

(A) False, because moving a book to a lower shelf increases its potential energy	(B) True, because decreasing the height above the floor decreases gravitational potential energy
(C) False, because height has no effect on potential energy	(D) True, because the book loses mass on a lower shelf

Question 5: A kite stuck in a tree has _____ energy due to its position.

(A) potential	(B) kinetic
(C) chemical	(D) thermal

Question 6: If an object is on top of a hill or in a position raised above the ground, it must have _____.

(A) kinetic energy	(B) elastic potential energy
(C) gravitational potential energy	(D) chemical potential energy

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Question 7: What is potential energy, and what does it depend on?

(A) Energy due to motion; it depends only on speed	(B) Stored energy due to interactions between objects or particles when distance changes; it depends on the positions of objects or particles
(C) Thermal energy released by friction; it depends on surface roughness	(D) Energy that exists only when objects are moving at constant velocity

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Q15 : Unit 1: Geologic Time

Lesson 1: Analyzing The Rock & Fossil Record

Describe the principle of uniformitarianism, recognizing that the geological processes occurring today also occurred in the past.

(Page 10)

Multiple Choice Questions - MCQ

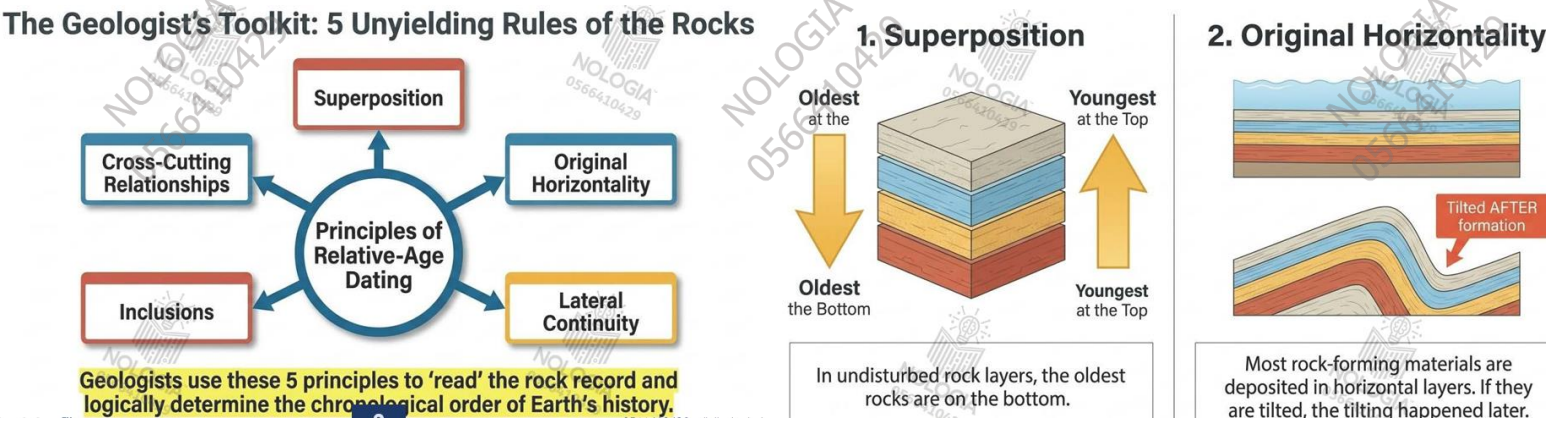
Principle of Uniformitarianism Before the late 1700s, most people thought that Earth was only a few thousand years old. James Hutton rejected this idea. He was one of the first scientists to think of Earth as very old. Hutton was a naturalist and a farmer in Scotland. He observed how the landscape on his farm gradually changed over the years. Hutton thought that the processes responsible for changing the landscape on his farm could also shape Earth's surface. For example, he thought that erosion caused by streams on his farm could also wear down mountains or carve deep canyons. Because he realized that this would take a long time, Hutton proposed that Earth is much older than a few thousand years.

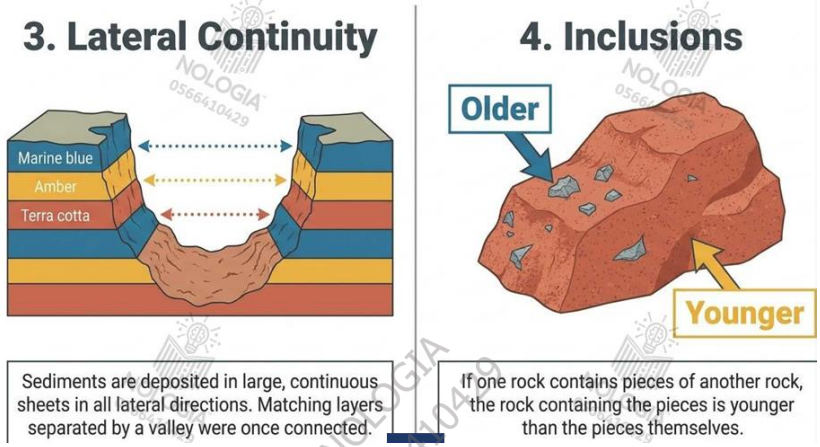
Hutton's ideas are the foundation of a principle called uniformitarianism. The principle of **uniformitarianism** states that geologic processes that occur today are similar to those that have occurred in the past. In other words, the same processes that we see today have been occurring since Earth formed.

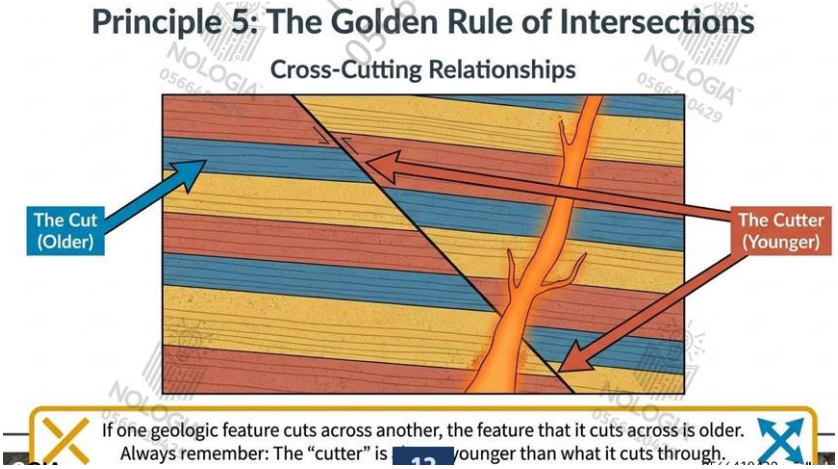
Because of uniformitarianism, scientists can learn about Earth's past by studying the present. One way to do this is by studying the order in which geologic events occurred using a method called relative-age dating. This does not allow scientists to determine the **absolute age,** or the actual age of the events. But it gives scientists a clearer understanding about geologic events in Earth's history.

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Summary الملخص

- **Uniformitarianism:** geologic processes that happen **today** are similar to those that happened in the **past**.
- The same processes we see today have been happening since Earth formed: **erosion**, deposition, volcanoes.
- **James Hutton** (Scotland, 1700s) saw erosion slowly change his farm and concluded that **Earth is very old**.

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THREE-DIMENSIONAL THINKING

Scientists use the principle of uniformitarianism to **interpret** Earth's history. Suppose you discover a rock from an ancient beach. Now imagine you are standing on that ancient beach. What do you think you would you see? **Explain** how your answer relates to the principle of uniformitarianism.

I would see waves crashing against the shore, sandy ground, and perhaps some rocks and shells. etc. Modern natural forces like waves, tides, wind, and erosion would be actively shaping the shoreline, just as they do today. Uniformitarianism.

Relation to Uniformitarianism:
This observation is based on the principle of uniformitarianism, which states that "the present is the key to the past."
This principle means that the same geological and natural processes (such as wave wind, and sedimentation) that we observe on beaches today are the same processes that operated on ancient beaches millions of years ago.
Since wave action and sand deposition happen the same way now as they did in the past, an ancient beach would look and behave very much like a modern beach.



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Questions :

Question 1: What does the principle of uniformitarianism state?

(A) Earth's surface never changes and all rocks formed at the same time	(B) Fossils are only found in volcanic rocks on top of mountains
(C) Only sudden global catastrophes shaped Earth's mountains and canyons	(D) Geologic processes that occur today are similar to those that have occurred in the past

Question 2: Which scientist's ideas are the foundation of uniformitarianism?

(A) Isaac Newton	(B) James Hutton
(C) Gregor Mendel	(D) Galileo Galilei

Question 3: Hutton saw streams wear down rock very slowly. What did this tell him about the age of Earth?

(A) Earth is very old	(B) Earth is only a few thousand years old
(C) Earth just formed last century	(D) Streams cannot change solid rock

Question 4: Which of the following is an example of a geologic process that happens today and also happened in the past?

(A) Artificial satellite launches into orbit	(B) Human construction of highways and skyscrapers
(C) Erosion, deposition, weathering, or volcanic eruptions	(D) Plastic manufacturing in factories

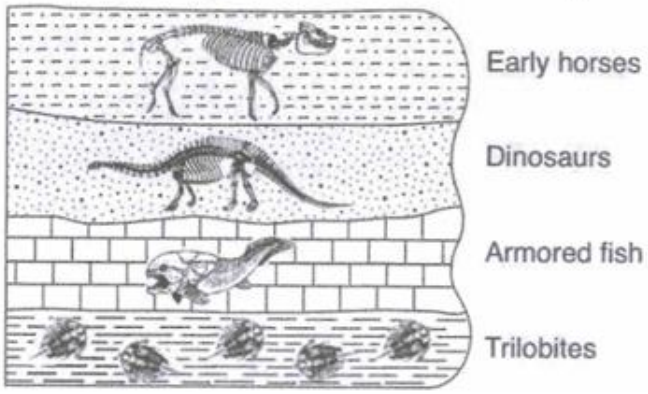
Question 5: Which phrase is commonly used by geologists to summarize the principle of uniformitarianism?

(A) "Every action has an equal and opposite reaction"	(B) "The present is the key to the past"
(C) "The oldest layer is always on top"	(D) "Energy cannot be created or destroyed"

Ministry Exam Questions

This question is about Analyzing the Rocks and Fossil Records.

You are part of a young geology team exploring a new canyon. As you walk through the canyon, you see fossils, cracks (faults), and different layers of rocks. Your job is to use these clues to discover the canyon's history.



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Question 1 : What does this tell you about the environment when that layer was formed?

Answer: It was underwater / a marine or aquatic environment.

Question 2 : What does this example show about Earth's surface? Tick the correct answer.

Answer: It can change over time.

Question 3: What principle explains that the same natural processes (like volcanic eruptions) happened in the past, the same way they do now?

Answer: Uniformitarianism.

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Q16 : Unit 1: Geologic Time

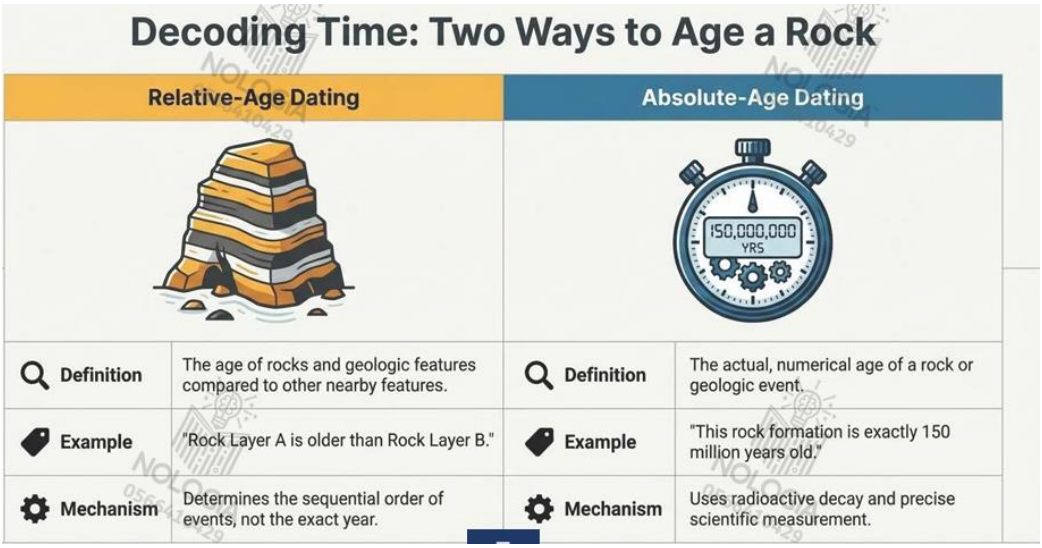
Lesson 1: Analyzing The Rock & Fossil Record

Identify and describe the principles of relative-age dating namely, superposition, original horizontality, lateral continuity, inclusions and cross-cutting relationships.

(Pages 13 - 17)

Multiple Choice Questions - MCQ





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The Canvas of History: How Strata Forms

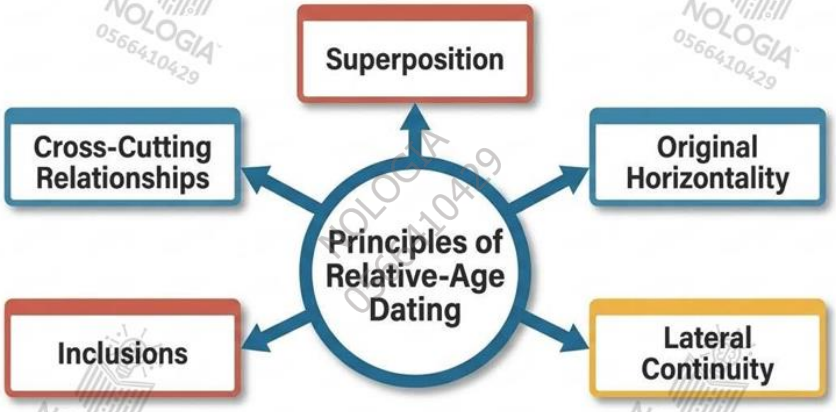


Weathering breaks exposed rock into smaller pieces called sediment. Gravity, water, and wind carry it downhill.

Sediment is deposited in low areas, building up over time.

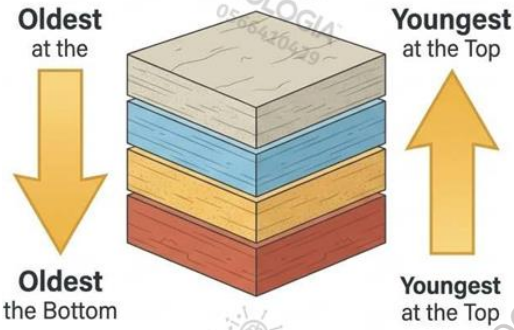
Increasing weight forces the sediment to compress, forming distinct layers of solid rock called strata.

The Geologist's Toolkit: 5 Unyielding Rules of the Rocks



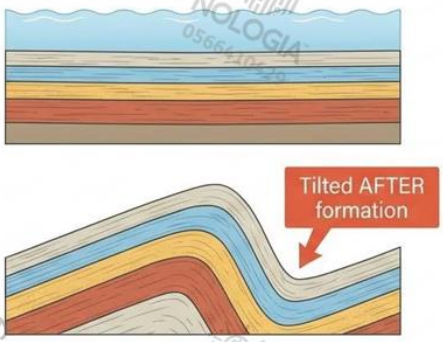
Geologists use these 5 principles to 'read' the rock record and logically determine the chronological order of Earth's history.

1. Superposition



In undisturbed rock layers, the oldest rocks are on the bottom.

2. Original Horizontality



Most rock-forming materials are deposited in horizontal layers. If they are tilted, the tilting happened later.

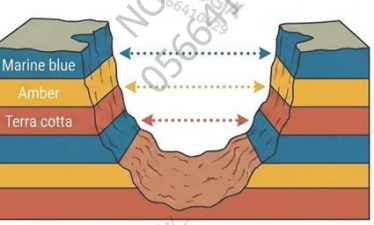
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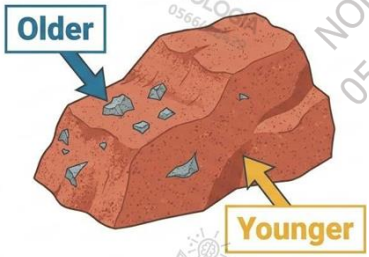
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3. Lateral Continuity



Sediments are deposited in large, continuous sheets in all lateral directions. Matching layers separated by a valley were once connected.

4. Inclusions



If one rock contains pieces of another rock, the rock containing the pieces is younger than the pieces themselves.

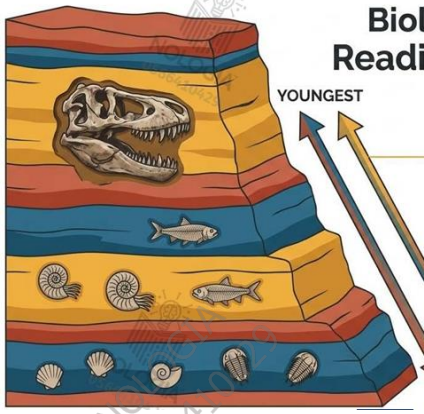
Principle 5: The Golden Rule of Intersections

Cross-Cutting Relationships



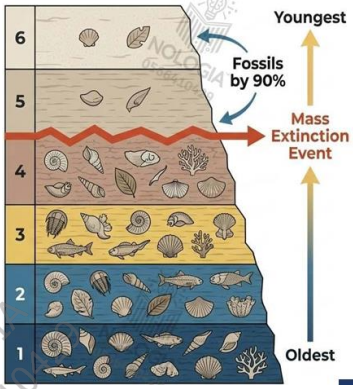
If one geologic feature cuts across another, the feature that it cuts across is older.
Always remember: The "cutter" is younger than what it cuts through.

Biological Clues: Reading Reading the Fossil Record



Fossils act as parallel timestamps. Thanks to Superposition, fossils in upper layers are younger and often more complex.

Ancient Environments: Fossils reveal what an area used to be. Finding an ancient coral fossil on dry land proves the region was once a marine environment.



The Ultimate Disruption: Mass Extinctions

A **mass extinction** is a time when many species on Earth died or became **extinct** within a relatively short period of time.

In the fossil record, this appears as the **sudden, abrupt disappearance** of many types of organisms from one rock layer to the younger layer immediately above it.

Drilling into the Past: Climate Clues



Seafloor cores hold dust, minerals, and micro-fossils.



The Key Organism: Foraminifera

Tiny, unicellular organisms smaller than a grain of sand. When they grow, they **incorporate oxygen** from the surrounding ocean water into their shells. Their shells become permanent chem[illegible]ords of ancient ocean temperatures.

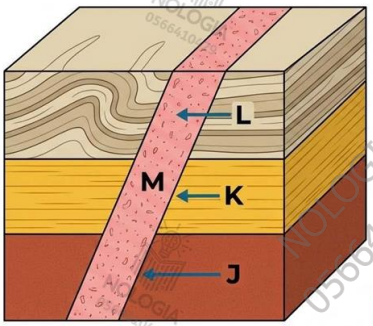
The Oxygen Isotope Thermometer

Oxygen has two varieties: Heavy (^{18}O) and Light (^{16}O).

1. When global climates are cooler, Light (^{16}O) water evaporates easily.
2. Wind carries Light (^{16}O) to the poles, where it falls as snow and gets trapped in vast ice sheets.
3. Because the Light (^{16}O) is trapped in ice, the oceans are left with a very high concentration of Heavy (^{18}O).
4. Foraminifera build their shells in this heavy-oxygen-rich water.

The Rule of Thumb: More Heavy Oxygen (^{18}O) in ancient shells = A Colder Ancient Climate (Glacial Period).

Three-Dimensional Thinking: Solving the Puzzle



Task: Order the features from oldest to youngest.

Step 1: Layer J is the oldest (Principle of Superposition).

Step 2: Layer K formed next on top of J (Superposition).

Step 3: Layer L formed next on top of K (Superposition).

Step 4: Feature M is the youngest. It cuts through J, K, and L, so it must have occurred last (Cross-Cutting Relationships).

Final Order: J → K → L → M

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Relatively Speaking

Analyze the image below.



1. Do you think all of the rock layers in the picture formed at the same time? Why or why not?

No, they did not form at the same time. Rock layers are deposited sequentially over very long periods. As new sediments settle on top of older ones, distinct layers are created chronologically, representing different historical times.

2. If you think the rocks formed at different times, which layers are the oldest and which are the youngest? Explain.

According to the Principle of Superposition, the layers at the very bottom are the oldest because they were deposited first. The layers at the very top are the youngest because they were deposited last on top of the pre-existing layers.

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Now, study this image.



3. Do you think the small pieces of rock in the picture formed at the same time as the rock containing the pieces? Why or why not?

No, they did not. According to the Principle of Inclusions, if one rock contains fragments of another rock, those embedded pieces must have existed first before being incorporated into the new, surrounding rock layer.

4. If you think the rock formed at different times, which is oldest—the rock containing the pieces, or the pieces of rock? Explain.

The small pieces of rock are the oldest. The pre-existing parent rock had to form, erode, break into fragments, and then become embedded inside the younger matrix that formed around them later.

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Now, try to interpret this image.

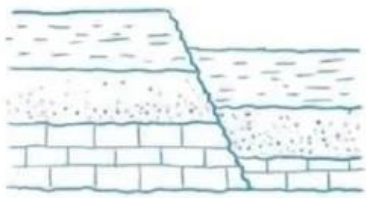


5. Notice the large fault cutting across the rock layers. Do you think the fault and the rock layers are the same age? Why or why not?

No, they are not the same age. A fault cannot break or cut through rock layers that do not exist yet. The rock layers must have already been there and solidified in order to be fractured and shifted by the fault.

6. If you think the fault and the rock formed at different times, which is oldest—the fault or the rocks? Explain.

The rock layers are older, and the fault is younger. According to the Principle of Cross-Cutting Relationships, any geological feature (like a fault or intrusion) that cuts through another must be the younger of the two.



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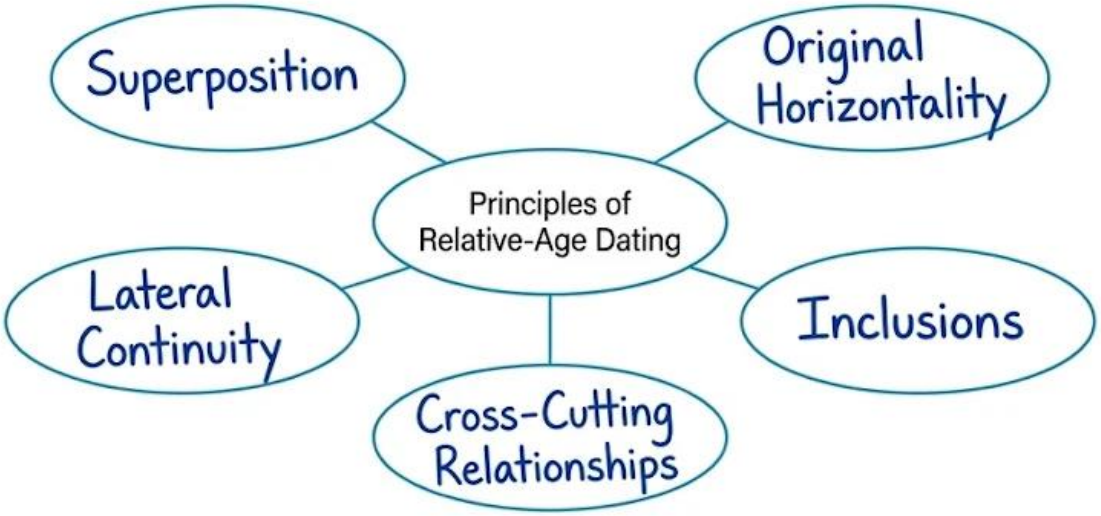
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GO ONLINE Finally, watch the animation *Relative-Age Dating*. Then answer the questions that follow.

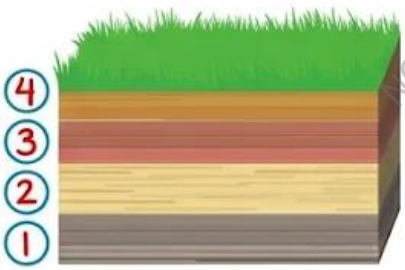
7. What are the principles of relative-age dating?



8. Which principle did you apply in Step 2 of the investigation?

The Principle of Superposition.

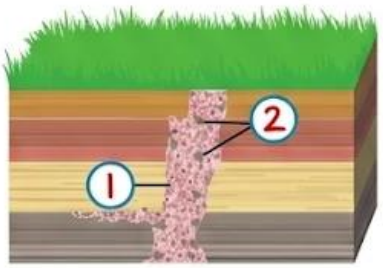
Using this principle, assign the rock layers in the diagram to the right their relative ages from oldest (*1*) to youngest (4).



9. Which principle did you apply in Step 4 of the investigation?

The Principle of Inclusions.

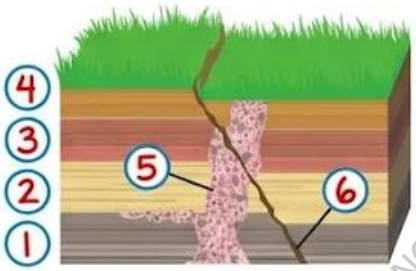
Using this principle, label the older feature *1*, and the younger feature *2* on the diagram to the right.



10. Which principle did you use in Step 6 of the investigation?

The Principle of Cross-Cutting Relationships.

Using this principle, label the rock layers and features from oldest (*1*) to youngest (6).



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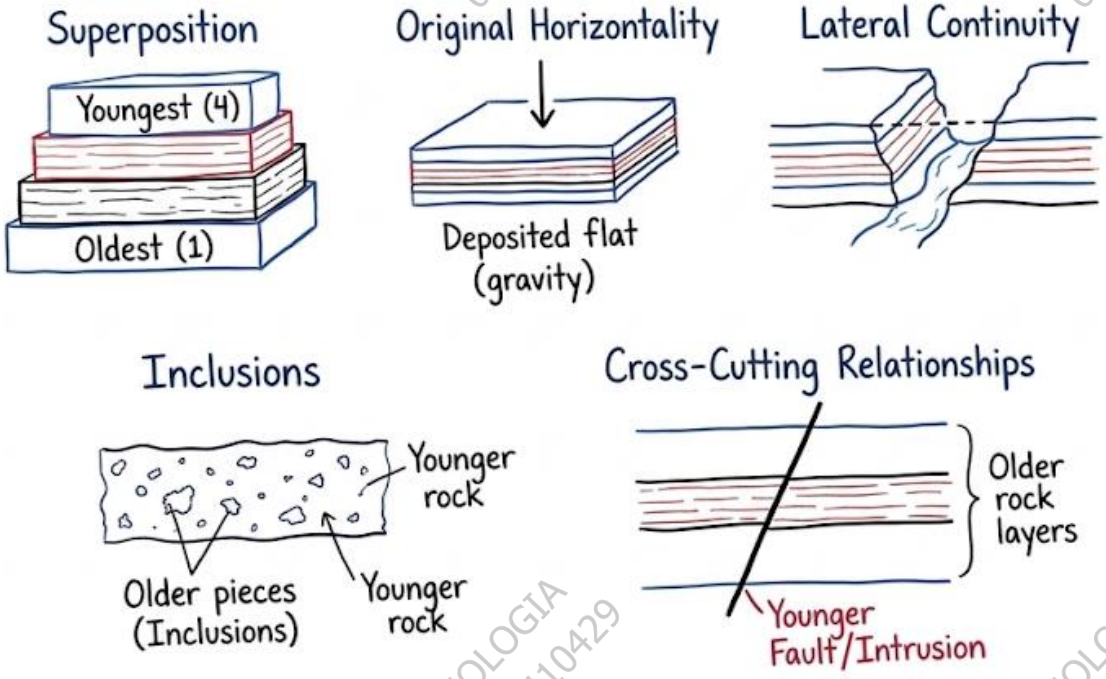
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The Principles of Relative-Age Dating As you just discovered in the *Relatively Speaking* investigation, there are five principles that geologists use to assign relative ages to rocks and features.

- **Superposition** is the principle that in undisturbed rock layers, the oldest rocks are on the bottom.
- According to the principle of **original horizontality**, most rock-forming materials are deposited in horizontal layers.
- **Lateral continuity** is the principle that sediments are deposited in large, continuous sheets in all lateral directions.
- According to the principle of **inclusions**, if one rock contains pieces of another rock, the rock containing the pieces is younger than the pieces.
- According to the principle of **cross-cutting relationships**, if one geologic feature cuts across another feature, the feature that it cuts across is older.

THREE-DIMENSIONAL THINKING

Models are often used to study and represent **large-scale** time and space phenomena. Using what you have learned about the principles of relative-age dating, create a sketch modeling each principle below.



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Questions :

Question 1: In undisturbed rock layers, where are the oldest rocks? Which principle is this?

(A) At the top - Original horizontality	(B) In the middle - Lateral continuity
(C) At the bottom - Superposition	(D) Inside a fault - Cross-cutting relationships

Question 2: A rock contains pieces of another rock. Which rock is younger? Which principle is this?

(A) The pieces inside are younger - Superposition	(B) The rock that contains the pieces is younger (the pieces inside are older) - Inclusions
(C) Both rocks are the exact same age - Lateral continuity	(D) The pieces inside are younger - Original horizontality

Question 3: The principle that says most rock layers are deposited flat is:

(A) superposition	(B) cross-cutting
(C) inclusions	(D) original horizontality

Question 4: Which principle states that sediments are deposited in large, continuous sheets in all lateral directions?

(A) Original horizontality	(B) Lateral continuity
(C) Inclusions	(D) Uniformitarianism

Question 5: Which principle states that a geologic feature that cuts across one or more rock layers is younger than the layers it cuts across?

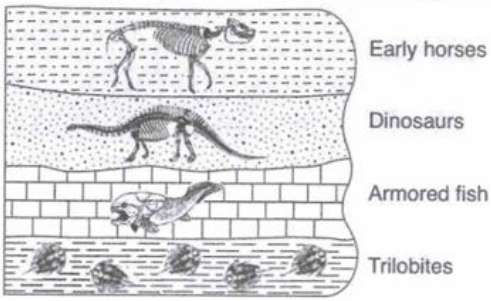
(A) Original horizontality	(B) Superposition
(C) Lateral continuity	(D) Cross-cutting relationships

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Ministry Exam Questions

This question is about Analyzing the Rocks and Fossil Records.

You are part of a young geology team exploring a new canyon. As you walk through the canyon, you see fossils, cracks (faults), and different layers of rocks. Your job is to use these clues to discover the canyon's history.



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Question 1 : Match each geological principle (1-4) with the correct description letter (P, Q, R, or S):

Geological Principle	Description	Correct Letter
Original horizontality (Example)	T: Most rock-forming materials are deposited in horizontal layers.	T (Given)
1. Lateral continuity	S: Sediments are deposited in large, continuous sheets in all lateral directions.	S
2. Inclusions	P: A piece of one rock unit that is contained within another rock unit is older than the rock unit that contains it.	P
3. Cross-cutting relationships	R: A geologic feature that cuts across one or more rock layers is younger than the layers it cuts across.	R
4. Superposition	Q: In an undisturbed sequence of rock layers, the oldest layer is at the bottom and the youngest layer is at the top.	Q

Answer: 1. Lateral continuity → S | 2. Inclusions → P | 3. Cross-cutting relationships → R | 4. Superposition → Q.

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Q17 : Unit 1: Geologic Time

Lesson 1: Analyzing The Rock & Fossil Record

Apply relative-age principles to arrange rock layers and geological features in order.

(Page 24)

Multiple Choice Questions - MCQ

NOLOGIA Study File: Chapter Synthesis

Core Concepts

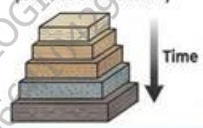
Uniformitarianism: The present is the key to the past.

Relative Age: The sequential order of events.

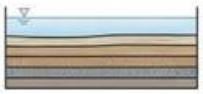
Absolute Age: The exact numerical year.

The 5 Principles of Relative Age

1. **Superposition** (Oldest on bottom)



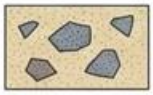
2. **Original Horizontality** (Laid flat)



3. **Lateral Continuity** (Continuous sheets)



4. **Inclusions** (Host rock is younger, pieces are older)

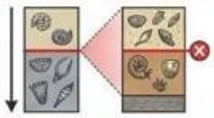


5. **Cross-Cutting** (The cutter is always younger)

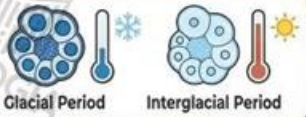


Fossil & Climate Clues

Mass Extinctions: Sudden disappearances in the fossil strata.

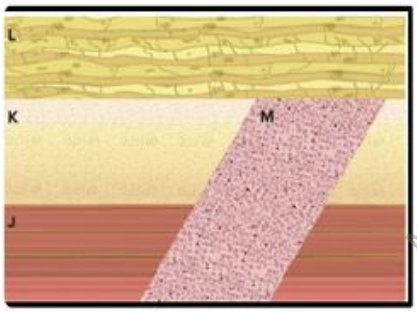


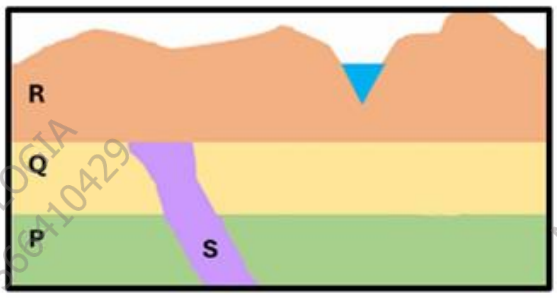
Foraminifera: Shells with high Heavy Oxygen (18O) indicate colder glacial climates.



Summary الملخص

1. **Start at the bottom:** the lowest layer is the **oldest**.
2. **Look for cuts:** a feature is **younger** than every layer it cuts.
3. **Check the top:** a layer on top that is **not cut** is **younger** than the feature.





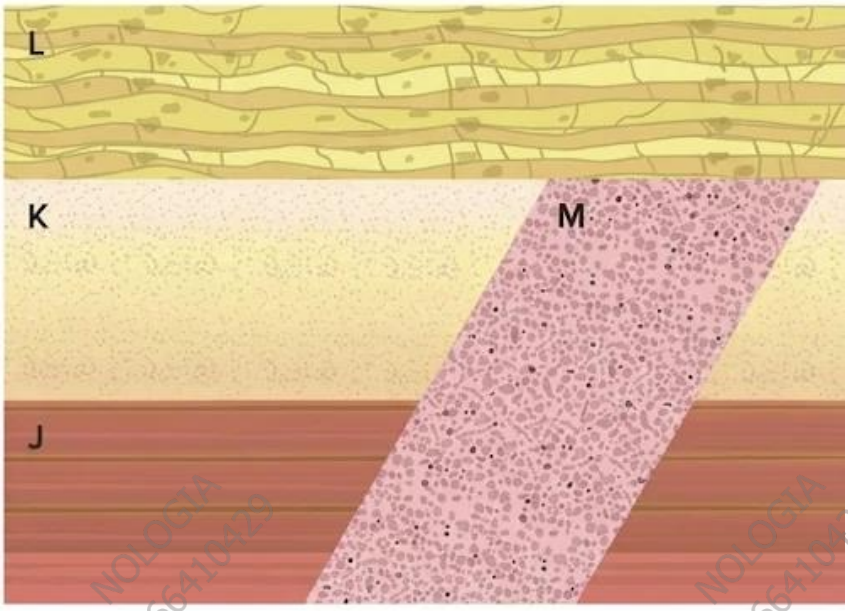
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Three-Dimensional Thinking

Imagine you are a geologist. You have been asked to analyze and interpret the rock sequence below. Your task is to determine the relative ages of the rocks.



2. Order the features in the illustration from oldest to youngest.

A JKLM

B MJKL

C JKML

D MLKJ

3. Which geologic principle must be assumed to determine the relative age of M?

A cross-cutting relationships

B superposition

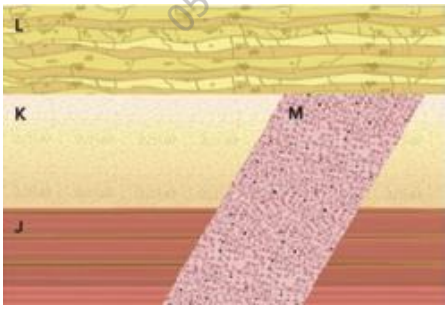
C original horizontality

D inclusions

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احصل على الشرح كاملاً بـ 99 درهم فقط

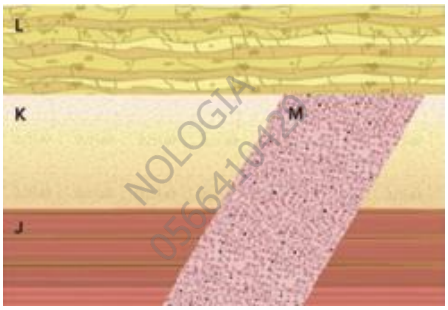
Questions :

Question 1: Order the features in the image below from oldest to youngest.



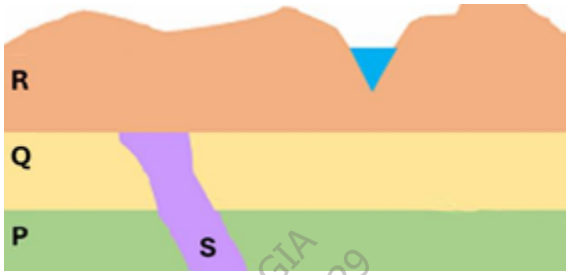
(A) L → M → K → J	(B) J → K → M → L
(C) M → J → K → L	(D) J → L → K → M

Question 2: Order the features in the image below from youngest to oldest.



(A) J → K → M → L	(B) M → L → K → J
(C) K → J → L → M	(D) L → M → K → J

Question 3: Use the P-Q-R-S picture Order the features from oldest to youngest.

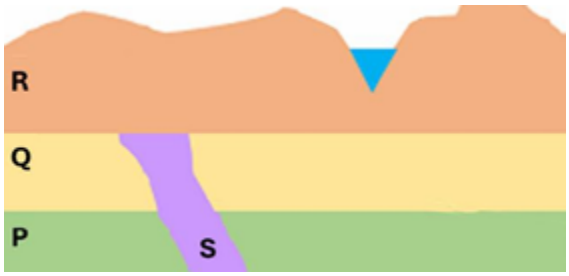


(A) P → Q → S → R → river valley	(B) river valley → R → S → Q → P
(C) S → P → Q → R → river valley	(D) P → R → Q → S → river valley

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Question 4: Use the P-Q-R-S picture (the river valley is cut into the top of R). Order the features from youngest to oldest.



(A) P → Q → S → R → river valley	(B) R → river valley → S → Q → P
(C) river valley → R → S → Q → P	(D) S → R → Q → P → river valley

Question 5: Layers from bottom to top are A, B, C, D. A fault cuts through all four layers. Which is youngest: layer D or the fault? Explain.

(A) Layer A, because it is at the bottom	(B) Layer D, because it is at the top of the layers
(C) Layer D and the fault are the exact same age	(D) The fault, because it cuts through all four layers (cross-cutting relationships)

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Q18 : Unit 1: Geologic Time

Lesson 1: Analyzing The Rock & Fossil Record

Apply the principles of relative-age dating to determine the relative ages of a rock layers and/or a geological feature.

(Page 24 ,)

Multiple Choice Questions - MCQ

NOLOGIA Study File: Chapter Synthesis

Core Concepts

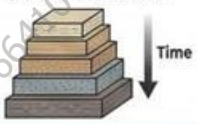
Uniformitarianism: The present is the key to the past.

Relative Age: The sequential order of events.

Absolute Age: The exact numerical year.

The 5 Principles of Relative Age

1. Superposition (Oldest on bottom)



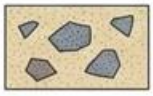
2. Original Horizontality (Laid flat)



3. Lateral Continuity (Continuous sheets)



4. Inclusions (Host rock is younger, pieces are older)

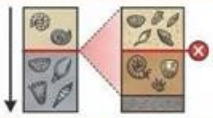


5. Cross-Cutting (The cutter is always younger)



Fossil & Climate Clues

Mass Extinctions: Sudden disappearances in the fossil strata.



Foraminifera: Shells with high Heavy Oxygen (18O) indicate colder glacial climates.



Summary الملخص

What you see	Principle to use
Layers stacked on top of each other	**Superposition**
A feature cutting through layers	**Cross-cutting relationships**
Pieces of one rock inside another	**Inclusions**
Tilted or folded layers	**Original horizontality**
The same layer on both sides of a valley	**Lateral continuity**

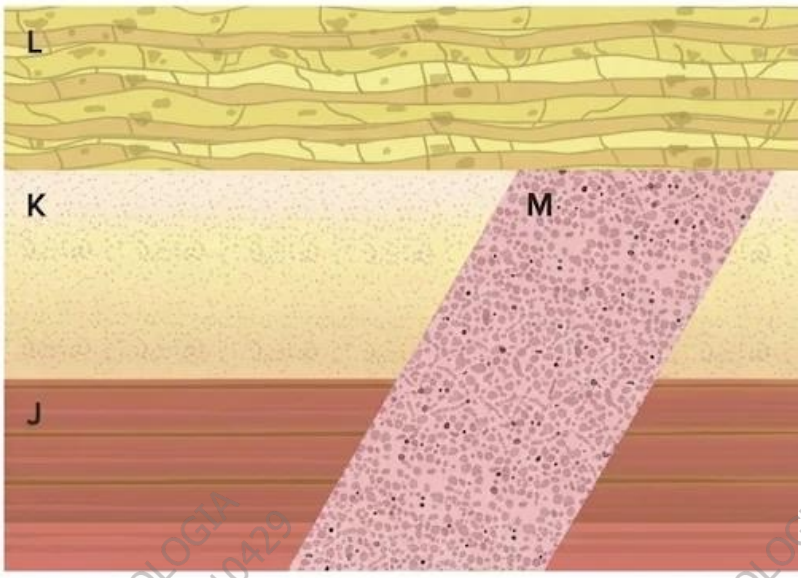
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احصل على الشرح كاملاً بـ 99 درهم فقط

اضغط على الاسم لتحصل على مزيد من الملفات في تلغرام: NOLOGIA
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Three-Dimensional Thinking

Imagine you are a geologist. You have been asked to analyze and interpret the rock sequence below. Your task is to determine the relative ages of the rocks.



2. Order the features in the illustration from oldest to youngest.

A JKLM

B MJKL

C JKML

D MLKJ

3. Which geologic principle must be assumed to determine the relative age of M?

A cross-cutting relationships

B superposition

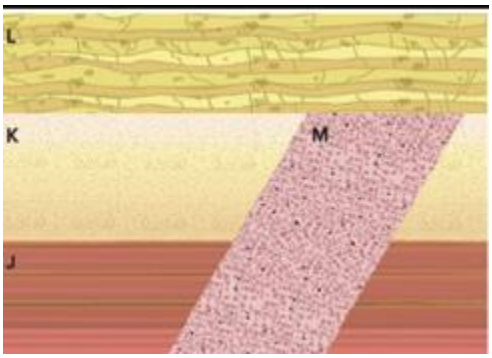
C original horizontality

D inclusions

للتواصل اضغط الرقم: 0566410429
احصل على الشرح كاملاً بـ 99 درهم فقط

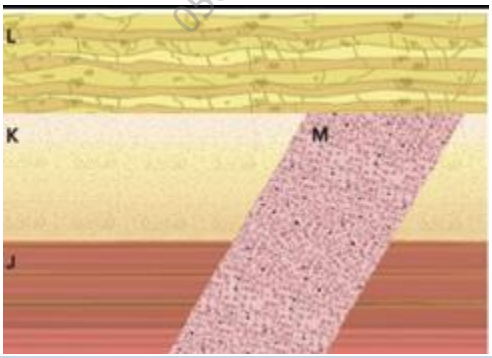
Questions :

Question 1: Which geologic principle must be assumed to determine the relative age of M (or tells us that an intrusion is younger than the layers it cuts)?



(A) Superposition	(B) Original horizontality
(C) Cross-cutting relationships	(D) Lateral continuity

Question 2: Which geologic principle must be assumed to determine the relative age of L (or tells us that the top layer L is the youngest layer)?



(A) Uniformitarianism	(B) Cross-cutting relationships
(C) Inclusions	(D) Superposition

Question 3: A granite rock contains pieces of sandstone. Which principle tells us the granite is younger?

(A) superposition	(B) inclusions
(C) original horizontality	(D) lateral continuity

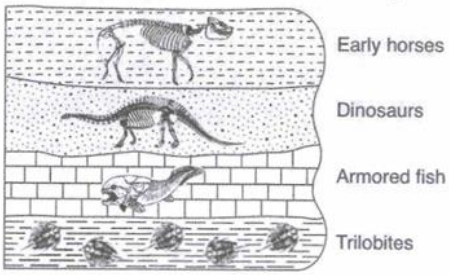
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احصل على الشرح كاملاً بـ 99 درهم فقط

Ministry Exam Questions

This question is about Analyzing the Rocks and Fossil Records.

You are part of a young geology team exploring a new canyon. As you walk through the canyon, you see fossils, cracks (faults), and different layers of rocks. Your job is to use these clues to discover the canyon's history.



B. You notice a fault cutting through several horizontal rock layers.

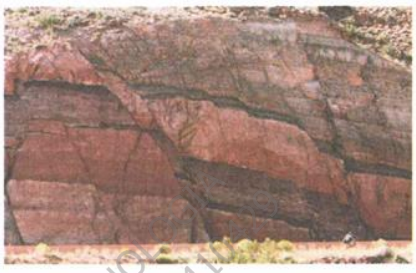


Image Source: https://dr282zn36sxxg.cloudfront.net

Fill in the blanks using words from the **word bank** below with the **correct term**. Each word can be used only **once** or **not at all**.

2026-2025

Question 1 : The fault is _____ than the rock layers it cuts through. ii. According to the principle of _____ most rock layers are originally deposited horizontally.

Item	Sentence	Correct Word from Bank
i.	The fault is _____ than the rock layers it cuts through.	younger
ii.	According to the principle of _____ most rock layers are originally deposited horizontally.	original horizontality

Answer: i. younger | ii. original horizontality.

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احصل على الشرح كاملاً بـ 99 درهم فقط

Q19 : Unit 1: Geologic Time

Lesson 1: Analyzing The Rock & Fossil Record

Interpret fossil sequences in sedimentary rock layers to determine the relative ages of rocks and fossils.

(Page 18)

Multiple Choice Questions - MCQ

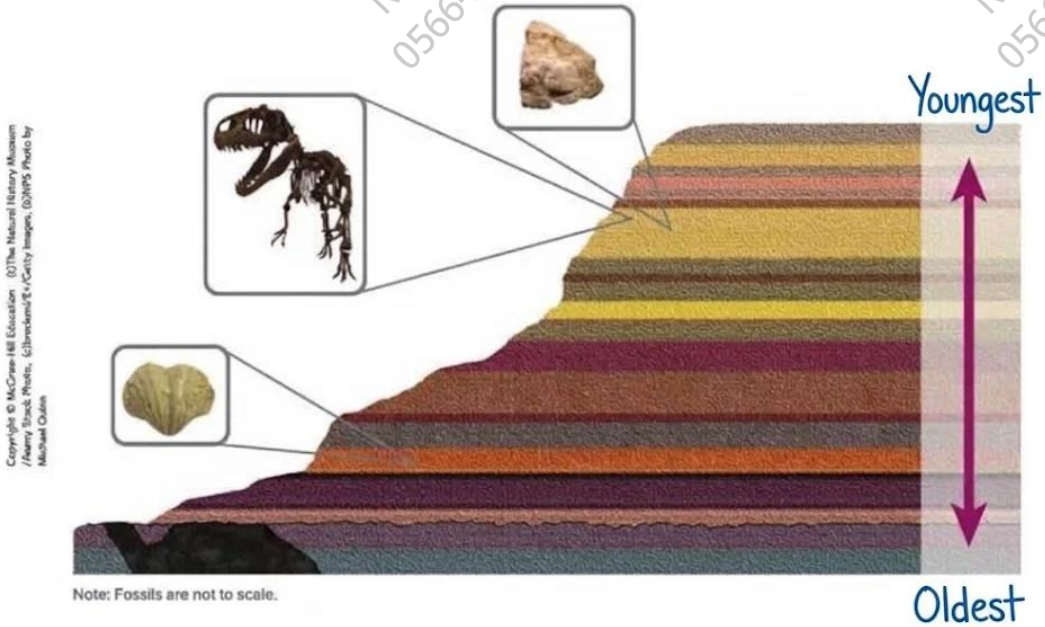
Summary الملخص

- Fossils are found in **sedimentary rock** layers.
- A fossil is the **same age** as the layer it is in.
- Lower layers → **older** fossils. Higher layers → **younger** fossils.
- Two places with the **same fossils** → layers of about the **same age**.

INVESTIGATION

Clues to Earth's Past

Analyze the image below. Then answer the questions that follow.



Note: Fossils are not to scale.

1. Using the principle of superposition, determine which rock layers are the oldest, and which rock layers are the youngest. Label the space above and below the arrow heads *Oldest* and *Youngest* accordingly.

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Questions :

Question 1: A cliff has three layers: a. Which fossil is the oldest, and why?

Layer	Position	Fossil
Z	top	leaf
Y	middle	fish
X	bottom	shell

(A) Leaf, because it is in the top layer Z	(B) Fish, because it is in the middle layer Y
(C) Shell, because it is in the lowest layer X (superposition)	(D) All three fossils are the exact same age

b . which fossil is the youngest?

(A) Leaf	(B) Fish
(C) Shell	(D) None of them

c . order the fossils from oldest to youngest.

(A) leaf → fish → shell	(B) fish → shell → leaf
(C) shell → fish → leaf	(D) shell → leaf → fish

d .In the cliff, Layer Y contains fish fossils. If the same fish fossils are found in a cliff in another city, what can you say about the age of that layer?

(A) It is about the same age as layer Y	(B) It must be much younger than layer Z
(C) It has no relationship to any layer in the first cliff	(D) It is an igneous intrusion

Question 2: How does the fossil record in sedimentary rock layers provide evidence of change over geologic time?

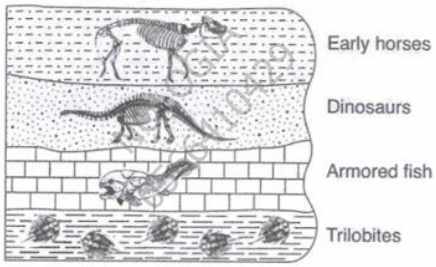
(A) Older rock layers always lie on top of younger rock layers	(B) Every rock layer on Earth contains the exact same fossils
(C) Fossils only form in modern volcanic lava flows	(D) Fossils in different rock layers show that different organisms lived at different times and species changed over time

Ministry Exam Questions

2026-2025

This question is about Analyzing the Rocks and Fossil Records.

You are part of a young geology team exploring a new canyon. As you walk through the canyon, you see fossils, cracks (faults), and different layers of rocks. Your job is to use these clues to discover the canyon's history.



Question 1 : i. Which fossil is older? [Trilobite | Dinosaur | Both are the same age]

ii. Which principle of geology helps you make this conclusion? Tick the correct answer. [Cross-cutting relationships | Superposition | Inclusions | Fossil complexity]

Sub-Question	Question Prompt	Correct Answer
i.	Which fossil is older?	Trilobite
ii.	Which principle of geology helps you make this conclusion?	Superposition

Answer: i. Trilobite | ii. Superposition.

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احصل على الشرح كاملاً بـ 99 درهم فقط

اضغط على الاسم لتحصل على مزيد من الملفات في تلغرام: NOLOGIA

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Q20 : Unit 1: Geologic Time

Lesson 2: Building a Timeline

Understand the characteristics of index fossils and their importance in determining the relative ages of rock layers.

(Page 35)

Multiple Choice Questions - MCQ

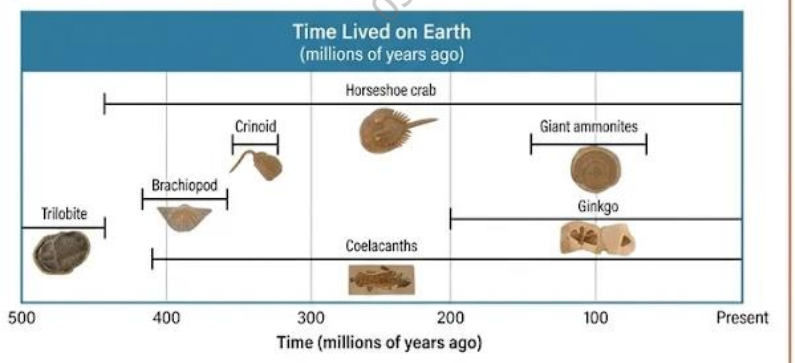


Correlation As you just explored in the *It's a Match* investigation, geologists fill gaps in the rock record through **correlation** (kor uh LAY shun)—the matching of rock layers or fossils exposed in one geographic region to similar layers or fossils exposed in other geographic regions. If the rock formations are very far apart or even on different continents, geologists often rely on fossils. It two or more rock formations contain fossils of about the same age, scientists can infer that the formations are also about the same age.

Not all fossils are useful in determining the relative ages of rock layers. The most useful fossils represent species that existed on Earth for a short length of time, were abundant, and inhabited many locations. These fossils are called **index fossils.**

THREE-DIMENSIONAL THINKING

Analyze the time scales for the following fossils.



Which fossils could be index fossils? Explain your choices.

Trilobites, Brachiopods, Crinoids, and Giant ammonites.

Explanation: According to the timeline, these fossils have very short horizontal bars, meaning they existed on Earth for only a short length of geologic time, which is a key requirement for index fossils. In contrast, horseshoe crabs, coelacanths, and ginkgo have very long bars (hundreds of millions of years), so they are not useful.

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The correlation of fossils and rock layers aids in the relative dating of rock sequences and helps geologists understand the history of larger geographic regions. It is largely through correlation that geologists have constructed Earth's time line.

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Summary الملخص

- **Correlation** = matching rock layers or fossils in one place with similar layers or fossils in another place.
- Rock formations far apart with fossils of the **same age** are about the **same age**.
- **Index fossils** are the most useful fossils for finding relative age.

⏱	🔢	🌍
Short time	**Abundant**	**Widespread**
lived on Earth for a short time	there were many of them	lived in many places

Questions :

Question 2: What is correlation?

(A) Matching rock layers or fossils in one place with similar layers or fossils in another place	(B) The breaking of rock layers along a fault line
(C) The melting of sedimentary rock into magma	(D) The tilting of horizontal layers by mountain building

Question 3: What are the three characteristics of an index fossil?

(A) Lived for a long time, was rare, and lived in only one place	(B) Found in every layer of a canyon from bottom to top
(C) Found only in igneous rocks, microscopic, and still alive today	(D) Lived for a short time, was abundant, and lived in many places (geographically widespread)

Question 4: Which fossil would make the best index fossil?

(A) a species that lived for a long time in one small area	(B) a species that lived a short time, was abundant and lived in many places
(C) a species that was very rare and lived in only one ocean trench	(D) a species that existed unchanged for 500 million years

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Question 5: If two sedimentary rock layers located in different cities contain the same index fossil, what can geologists conclude about the two layers?

(A) The two rock layers formed at approximately the same geologic time	(B) One layer is igneous and the other is metamorphic
(C) The two layers have completely different ages	(D) A fault moved the fossils from one city to the other

Question 6: Why is a fossil organism that appears in every single rock layer of an outcrop NOT useful as an index fossil?

(A) Because index fossils can only be plants, not animals	(B) Because organisms that lived a long time never form fossils
(C) Because its time range is too long to pinpoint the specific age of a single rock layer	(D) Because it is too easy to find in sedimentary rocks

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الملفات في تلغرام: NOLOGIA

Q21 : Unit 2: Energy and Motion

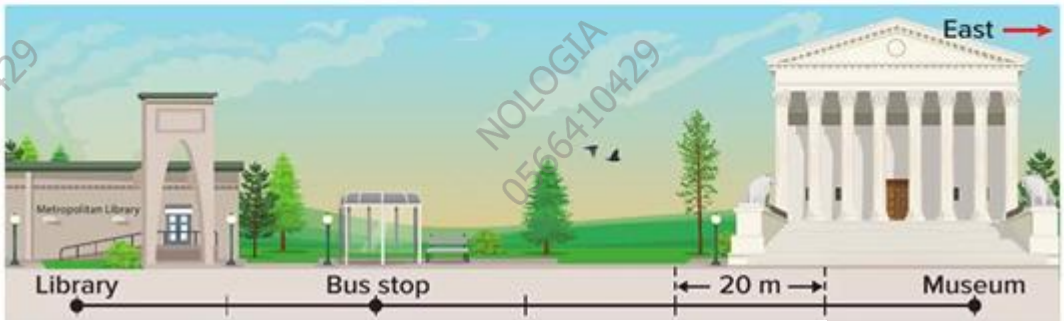
Module 1: Forces and Motion · Lesson 1: Position and Motion

- Determine and explain distances travelled, directions of motion, and displacement.
- Calculate the average speed of an object using distance travelled and elapsed time.

(Page 13, 14, 19, 22)

Free Response Questions - FRQ

The Reference Direction When you describe an object's position, you compare its location to a reference direction. The reference direction is the positive (+) direction. In the first part of the Investigation *Start From Here*, any number greater than 50 cm was in the positive direction. The opposite direction is the negative (–) direction. As with the reference positon, reference direction is arbitrary. You decide which direction is positive and which is negative. Suppose you specify east as the reference direction in the figure below. You could say the museum's entrance is +80 m from the bus stop. The library's entrance is −40 m from the bus stop.



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Moving in Two Dimensions You now know that position can be describe with a reference point, distance, and direction. So far you've only experienced this in one dimension—a straight line. Let's explore how to describe position in two dimensions.

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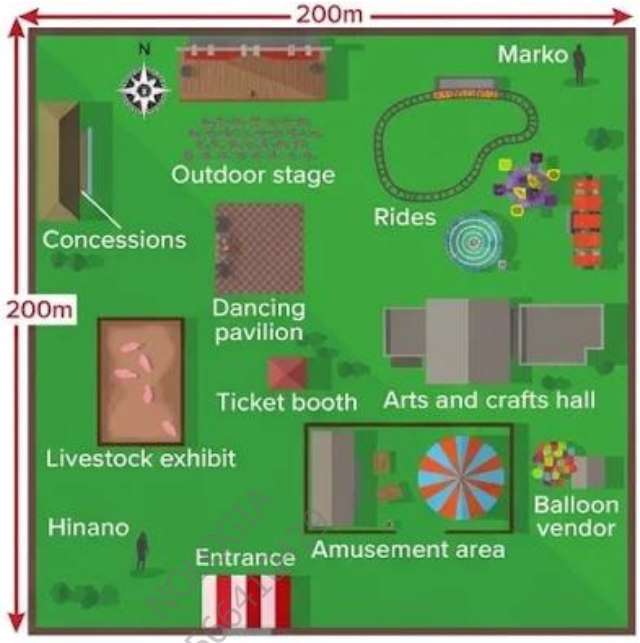
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اضغط على الاسم لتحصل على مزيد من الملفات في تلغرام: NOLOGIA
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See You Soon

Hinano and Marko agree to meet at the state fair. Hinano arrives at the entrance. Marko gives Hinano two-part instructions explaining how to find him. His instructions use three reference points (including her starting point), two directions, and two approximate distances. The instructions describe the shortest walking distance between them. Study the diagram and then answer the questions.



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1. What instructions do you think Marko gave Hinano?

From the entrance, walk northeast about 50 m to the ticket booth. From the ticket booth, walk northeast about 130 m m past the rides to find Marko in the northeast corner.

2. What is an alternative route for Hinano to find Marko? Walk north about 180 m along the west side past the livestock exhibit and concessions to the northwest corner, then walk east about 160 m past the outdoor stage to Marko.

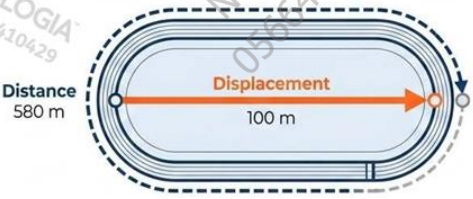
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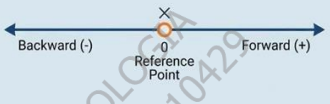
Distance vs. Displacement



Distance	Displacement
The total length of the actual path traveled	The shortest straight-line difference between initial and final position.
Highly dependent on the exact route taken	Completely independent of the route; only cares about Start and Finish.
Cannot be zero if the object moves	Is exactly zero if the object finishes exactly where it started (e.g., completing one full lap on a race track).

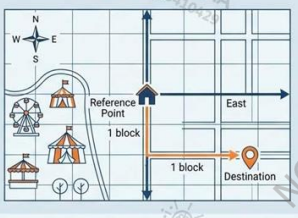
From One Dimension to Two

1D Navigation:



1D Navigation: Movement along a single straight line. Requires only one distance and one direction (e.g., positive or negative).

2D Navigation:



2D Navigation: Finding position on a plane. Requires a reference point, two reference directions (e.g., South and East), and distances along both directions.

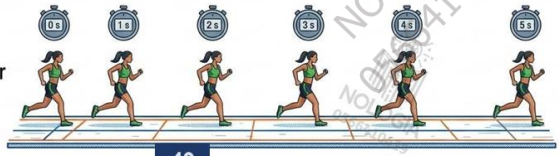
Note: Scientists use SI (International System of Units) meters to eliminate confusion in all measurements.

Constant vs. Changing Speed

Constant Speed:
The object covers the exact same distance during each equal time interval.



Changing Speed:
The distance traveled each second gets larger (or smaller). Speed is actively changing.



Average Speed The speed of most moving objects is not constant, which is why the speedometer in a car is always changing slightly. Therefore, when you describe your speed over an entire trip to someone, you are describing average speed. Average speed is equal to the total distance traveled divided by the total time. Average speed can be modeled mathematically using the equation below.

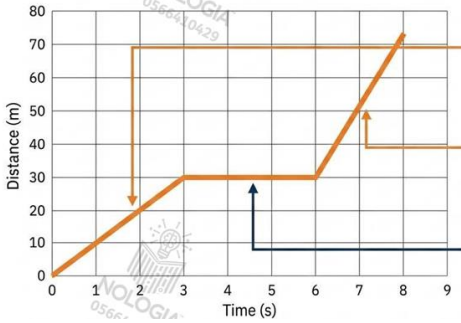
Average Speed Equation

$$\text{average speed (in m/s)} = \frac{\text{total distance (in m)}}{\text{total time (in s)}}$$

$$\bar{v} = \frac{d}{t}$$

The symbol $\bar{v}$ represents the term "average velocity." You will read more about velocity, and how it relates to speed, later in the lesson. At this point $\bar{v}$ is simply used as the symbol for "average speed." Imagine the girl above traveled 25 m from second 1 to second 7 on the stopwatch. Therefore, her average speed is 25 m/6.0 s or 4.2 m/s.

Decoding Distance-Time Graphs



Straight Line = Constant Speed.
The object is moving at a steady rate.

Steeper Line = Greater Speed.
The object is covering more distance in less time.

Flat Line = Zero Speed.
Position is not changing as time passes; the object is stopped.

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اضغط على الاسم لتحصل على مزيد من الملفات في تلغرام: NOLOGIA
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MATH Connection The motion of a person or object can be explained by examining how the position changes over time. Practice using the mathematical model, the average speed equation.



1. A truck driver makes a trip that covers 2,380 km in 28 hours. What is the driver's average speed in km/h?

Average speed = distance ÷ time

= 2,380 km ÷ 28 h

Average speed = 85 km/h

2. What is the average speed of a soccer ball that travels 34 m in 2.0 s?

Average speed = distance ÷ time

= 34 m ÷ 2.0 s

Average speed = 17 m/s

3. How long would it take a bus traveling at 52 km/h to travel 130 km?

Time = distance ÷ average speed

= 130 km ÷ 52 km/h

Time = 2.5 h

Summary الملخص

	Distance	Displacement
Meaning	the **total length of the path**	the **straight line** from start to end, with direction
How to draw	follow every arrow	**one** straight arrow start → finish

Directions: up = north · down = south · right = east · left = west. **Average speed** = total distance ÷ total time.

EXAMPLE 21c: 300 m **north**, then 300 m **east** → distance = **600 m**; time 150 s → speed = 600 ÷ 150 = **4 m/s**.

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احصل على الشرح كاملاً بـ 99 درهم فقط

Questions :

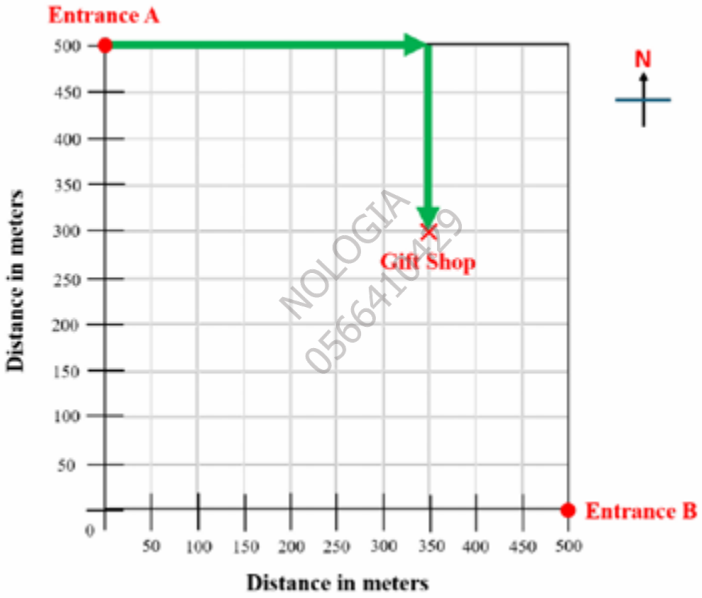
Question 1: The arrows show the path followed by a student to reach the Gift Shop

(i) State the two directions in which the student walked.

(ii) Calculate the total distance travelled by the student to reach the gift shop.

(iii) Calculate the student's average speed, given that it takes them 200 seconds to reach the gift shop.

(iv) Draw an arrow to show the student's displacement.



Answer: (i) East and south.
(ii) Total distance = 350 + 200 = 550 m.
(iii) Average speed = 550 ÷ 200 = 2.75 m/s.
(iv) One straight arrow drawn directly from Entrance A to the Gift Shop.

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احصل على الشرح كاملاً بـ 99 درهم فقط

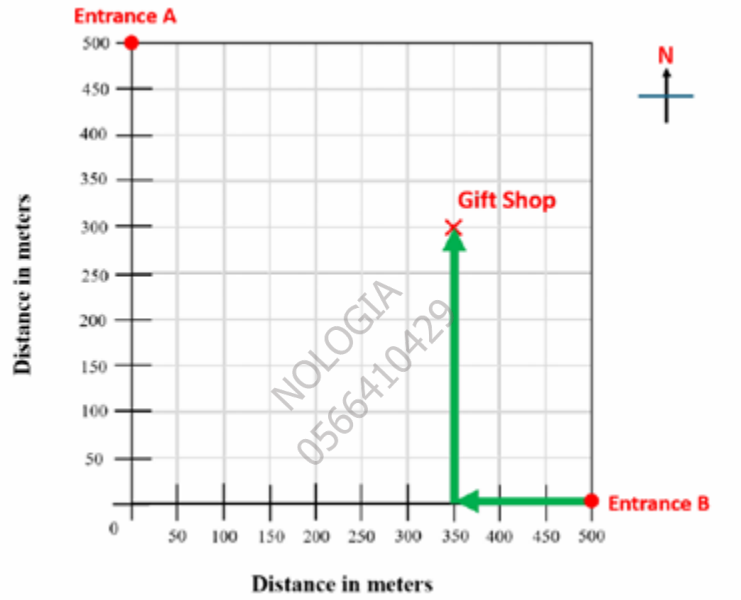
Question 2: The arrows show the path followed by a student to reach the Gift Shop.

(i) State the two directions in which the student walked.

(ii) Calculate the total distance travelled by the student to reach the gift shop.

(iii) Calculate the student's average speed, given that it takes them 225 seconds to reach the gift shop.

(iv) Draw an arrow to show the student's displacement.



Answer: (i) West and north.

(ii) Total distance = 150 + 300 = 450 m.

(iii) Average speed = 450 ÷ 225 = 2 m/s.

(iv) One straight arrow drawn directly from Entrance B to the Gift Shop.

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Question 3: The arrows show the path followed by a student to reach the Gift Shop

(i) State the two directions in which the student walked.

(ii) Calculate the total distance travelled by the student to reach the gift shop.

(iii) Calculate the student's average speed, given that it takes them 150 seconds to reach the gift shop.

(iv) Draw an arrow to show the student's displacement.



Answer: (i) North and east.
(ii) Total distance = 300 + 300 = 600 m.
(iii) Average speed = 600 ÷ 150 = 4 m/s.
(iv) One straight arrow drawn directly from Entrance A to the Gift Shop.

Question 4: Ahmed walks 400 m east from his house to the shop, then 100 m north to the mosque, in 250 s. Calculate his total distance and average speed.

Answer: Total distance = 400 + 100 = 500 m.
Average speed = 500 ÷ 250 = 2 m/s.

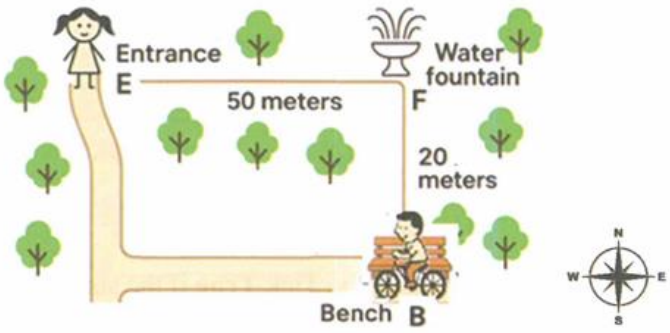
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Ministry Exam Questions

This question is about Position and Motion.

Hamad is riding his bicycle in a park. He starts at the entrance (Point E), rides 50 meters east to a water fountain (Point F), then turns and rides 20 meters south to a bench (Point B). His sister Laila watches him from the entrance.



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Question 1 : Calculate the total distance Hamad travels from the entrance to the bench.

Answer: 50 + 20 = 70 m.

Question 2 : According to the figure below, what is Hamad's displacement from point E to point B?

Answer: 54 meters southeast.

Question 3 : If Hamad returns to the entrance after reaching the bench, what is his total displacement? Explain your answer.

Answer: 0 m, because his starting point and ending point are the same.

Question 4 : Hamad's father drives 120 kilometers from his office to the park in 2 hours to pick him up. What is his father's average speed during his journey? Give your answer in kilometers per hour.

Answer: Average speed = 120 ÷ 2 = 60 km/h.

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Q22 : Unit 2: Energy and Motion

Module 1: Forces and Motion· Lesson 2 : Force and Acceleration & Lesson 4 : Gravitational Force

- Recall the definition of a force.
- Classify forces as contact or non-contact forces.
- Interpret models to compare the masses of objects and explain the relationship between mass and gravitational force.
- Calculate the weight of an object using its mass and gravitational field strength.

(Page 43, 81, 89, 93)

Free Response Questions - FRQ

Forces What have you pushed or pulled today? You might have pushed open the classroom door or pulled the zipper on your backpack. A **force** is a push or a pull on an object. There are two ways a force can affect an object. A force can change an object's speed. It also can change the direction in which the object is moving. For a plane to make a turn, a force is required to change the motion in the direction of that turn. In other words, a force can cause acceleration. All acceleration is due to forces. In the Lab *Up to Speed*, your feet were pushing on the floor. They were using force to accelerate you across the floor. Because acceleration is a vector with a direction, force also is a vector with a magnitude and direction.



In the PhET interactive simulation *Forces and Motion: Basics*, a mannequin pushed the skateboard to accelerate it. Think back to the water tube. A boat pulled the rope which pulled the water tube. In each case, an object applied a force to an object that it touched. A **contact force** is a push or a pull on one object by another object that is touching it.

EARTH SCIENCE Connection Contact forces can be weak, like when you press the keys on a computer keyboard. They also can be strong, such as when large sections of underground rock suddenly move, resulting in an earthquake. The large sections of Earth's crust called plates also apply strong contact forces against each other. Over long periods of time, these forces can create mountain ranges if one plate pushes another plate upward.

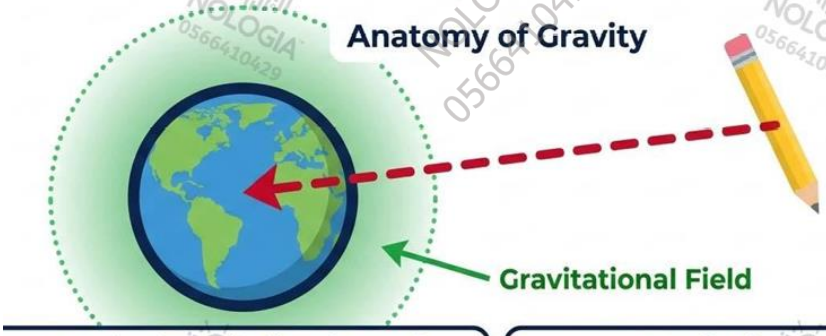


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The Core Concept: What is Gravity?



Gravity (Gravitational Force)
An attractive force that exists between all objects that have mass.

Gravitational Field
A region of space that has a physical quantity (such as a force) at every point.

KEY INSIGHT: Because of the gravitational field, an object does not have to touch Earth for gravity to act on it. **y acts through space.**

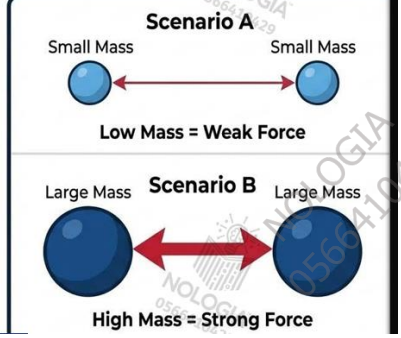
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Factor 1: The Role of Mass

Direct Proportional Relationship.

When the mass of one or both objects increases, the gravitational force between them also increases.

Newton's Third Law: Each object exerts the exactly same attraction on the other object, regardless of their individual mass differences.

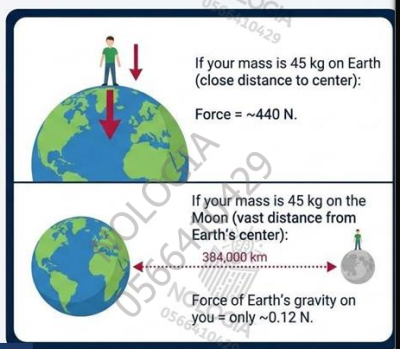


Factor 2: The Role of Distance

nverse Proportional Relationship.

s the distance between objects increases, the attraction between them decreases.





The Weight Equation Breakdown

$$W = m \times g$$

Weight (Measured in Newtons, N)

Mass (Measured in Kilograms, kg)

Gravitational Acceleration (9.8 m/s² on Earth)

Mini-Calculation Example

Example: If a book has a mass of 2 kg on Earth...
$W = 2 \times 9.8 = 19.6$ N

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اضغط على الاسم لتحصل على مزيد من
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Noncontact Forces A force must have been acting on the pencil to pull it down. The source of this force did not need to physically touch an object to cause it to fall. This force is different from the forces you have learned about previously because it is a noncontact force. A **noncontact force** is a force that one object can apply to another object without touching it. Electric forces can cause someone's hair to change direction when a charged balloon is brought near the hair as shown in the figure on the right. The balloon does not have to touch the hair to cause it to move. Magnets can move paper clips even though the magnet is not in contact with the paper clip.



What pulls things down?

In the Lab *Use the Forces*, you may have moved the paper clips with the magnet. Or using the wool cloth and the balloon, you may have created an electric force that caused the packing peanuts to move. The source of a force must be an object. What object created the force that caused the pencil to fall down?

Weight Even though the washers were not falling, the force due to Earth's gravity still was pulling them downward. **Weight** is the gravitational force exerted on an object. Near Earth's surface, an object's weight is the gravitational force exerted on the object by Earth. Because weight is a force, it is measured in newtons (N). Near Earth's surface, the weight of an object in newtons is about ten times its mass in kilograms. The weight of an object can be calculated by using the following equation.

Weight Equation

weight (N) = mass (kg) × gravitational acceleration (m/s²)

$$W = mg$$

Normal Force A pencil sitting on a table is acted on by gravity. This force in the downward direction is equal to its weight. Because gravity is acting on the pencil, the pencil is pushing down on the table. Recall, Newton's third law of motion states that for every force there is an opposite equal force. The table pushes up on the pencil with an equal but opposite force. The force of the table on the pencil is referred to as the normal force.



Summary الملخص

- A **force** is a **push or a pull**. It can change an object's **speed** or its **direction** → it can cause **acceleration**.
- A **noncontact force** acts **without touching** the object.

Contact (must touch)	Noncontact (no touching)
friction	gravity (weight)
normal force	magnetic force
push / pull	electric force

- In a model, **bigger object = more mass** → **bigger** gravitational pull. **Closer** to Earth → **bigger** pull.
- **W = m × g** (g = 9.8 N/kg) · to find mass: **m = W ÷ g**.

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احصل على الشرح كاملاً بـ 99 درهم فقط

اضغط على الاسم لتحصل على مزيد من الملفات في تلغرام: NOLOGIA
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MATH Connection For each of the systems below, calculate the weight of the object. Then, apply scientific understanding to draw a free-body diagram of the system.

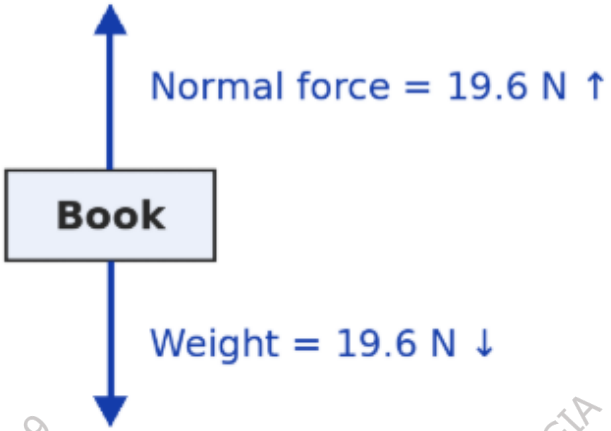
A. A book with a mass of 2 kg is at rest on top of a desk.

Weight = mass × g

= 2 kg × 9.8 m/s²

Weight = 19.6 N

At rest → forces are balanced (net force = 0)



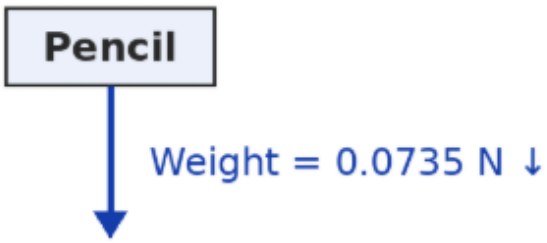
B. A pencil with a mass of 0.0075 kg is falling toward the floor.

Weight = mass × g

= 0.0075 kg × 9.8 m/s²

Weight = 0.0735 N

Falling → only weight acts (air resistance is ignored)



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Three-Dimensional Thinking

The model below represents a star orbited by two planets—Planet A and Planet B. The star is also orbited by a mysterious object, Object X, which entered into the star's gravitational field. The star is the most massive object, followed by Planet B, Planet A, and Object X. Use the model to answer questions 3–4.



3. In the model above, how is the mass of the objects represented?

A The mass is represented by the size of the objects. ✓ **Answer: A**

B The mass is represented by the distance between the objects.

C The mass is represented by the color of the objects.

D The mass is not represented.

4. The gravitational force from Planet A on the star is shown in the model. How should the arrow that represents the gravitational force from the star on Planet A be represented?

A It should point from Planet A toward the star and will be longer because the star has more mass.

B It should point from Planet A toward the star and will be the same size because it is an equal and opposite force. ✓ **Answer: B**

C It should point from Planet A toward the star and will be shorter because Planet A has less mass.

D There is no arrow to represent because gravitational force is only in one direction.

Q3: In the model, a bigger object = a bigger mass (the star is the largest, Object X is the smallest).

Q4: Newton's 3rd law: the star pulls on Planet A and Planet A pulls on the star with equal, opposite forces.

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Questions :

Question 1: Read the Section Forces.

1. What is a force?

2. What are the two ways in which a force can affect an object? 3. A force can cause _____.

Answer: 1. A push or a pull on an object.
2. It can change an object's speed or change its direction.
3. A force can cause acceleration.

Question 2: Read the Section Noncontact Forces.

1. What is a noncontact force?

2. A pencil falls under the effect of gravity. Is gravity a contact force or noncontact force? Explain your answer.

Answer: 1. A force that one object can apply to another object without touching it.
2. Noncontact force – because Earth pulls the pencil downward without touching it.

Question 3: Classify the following forces as contact or non-contact forces:

1. Weight 2. Friction 3. Normal

Force	Classification (Contact or Non-Contact)
1. Weight (and Gravity)	Non-contact force
2. Friction	Contact force
3. Normal force	Contact force

Answer: 1. Weight: non-contact force | 2. Friction: contact force | 3. Normal: contact force.

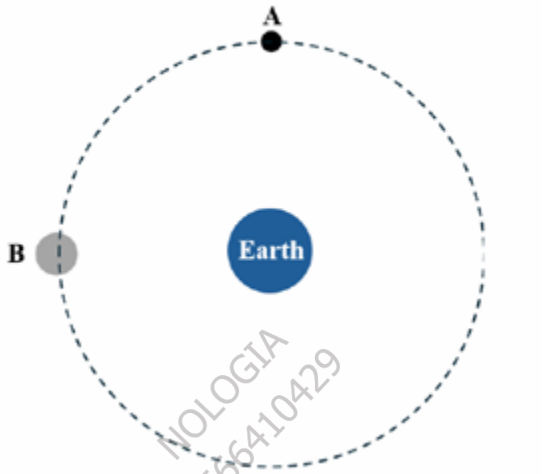
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Question 4: In the model shown below, the mass of each object is represented by its size.

(i) Which object has largest mass?

(ii) Which object has the smallest mass?

(iii) Which object, A or B, experiences the greatest gravitational pull of the Earth?



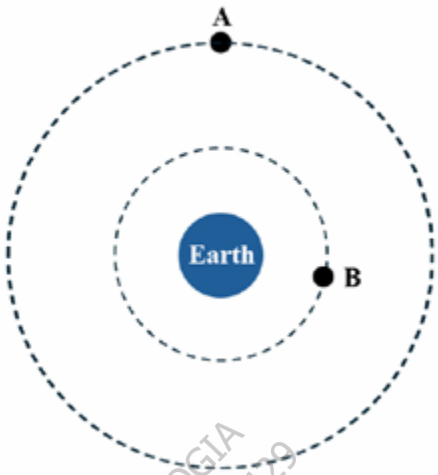
Answer: (i) Earth.
(ii) Object A.
(iii) Object B (because Object B has more mass than Object A at the same distance from Earth).

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Question 5: In the model shown below, the mass of each object is represented by its.

(i) Which object has largest mass?

(ii) Objects A and B have the same mass. Which object experiences the greatest gravitational pull of the Earth?



Answer: (i) Earth.
(ii) Object B (because Object B is closer to Earth than Object A).

Question 6: A book has a mass of 1 kg. Calculate its weight .

Answer: $W = m \times g = 1\ kg \times 9.8\ N/kg = 9.8\ N$.

Question 7: The weight of a school bag is 49 N. What is the mass of the school bag ?

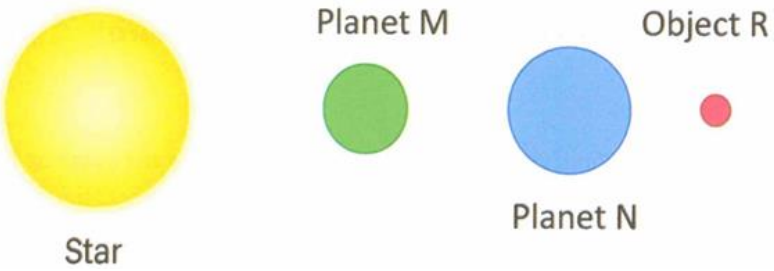
Answer: $m = W \div g = 49\ N \div 9.8\ N/kg = 5\ kg$.

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Ministry Exam Questions

This question is about the Gravitational Force.

You are helping a space research team understand how gravity affects objects in space and on Earth. They have given you the diagram below showing a star, two planets (Planet M and Planet N), and a small object (Object R) in space. **(The mass is represented by the size of the objects.)**



2026-2025

Question 1 : Which of the following is likely to exert the strongest gravitational pull?

A) Planet M	B) Star
C) Planet N	D)Object R

Question 2 : Which of the following will be pulled the least by the star and why?

A) Planet M - It has a large mass and is close to the star	B) Object R - It has the smallest mass and is farther away from the star
C) Planet N - It has the largest mass and is farther away from the star	

Answer: Object R - It has the smallest mass and is farther away from the star.

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Q23 : Unit 2: Energy and Motion

Module 2: Mechanical Energy · Lesson 1: Kinetic Energy & Lesson 2: Potential Energy

- Analyze how changes in mass and speed affect the kinetic energy of an object.
- Represent and interpret the relationships between kinetic energy, mass and speed graphically.
- Identify elastic potential energy stored in objects undergoing elastic deformation.
- Explain how the gravitational potential energy of an object changes with its position in a gravitational field.

(Pages 116, 120, 122, 123, 131, 132, 135)

Free Response Questions - FRQ

Kinetic Energy The change in motion of the cup occurred because the sphere had a form of energy. This form is called kinetic energy. **Kinetic energy** (KE) is the energy due to motion. When the baseball flies across the field, it also has kinetic energy associated with its motion. All moving objects have kinetic energy. You may have changed how much speed the sphere had before it hit the cup or you may have used a sphere with a different mass. You will investigate how these factors affect the kinetic energy of an object.

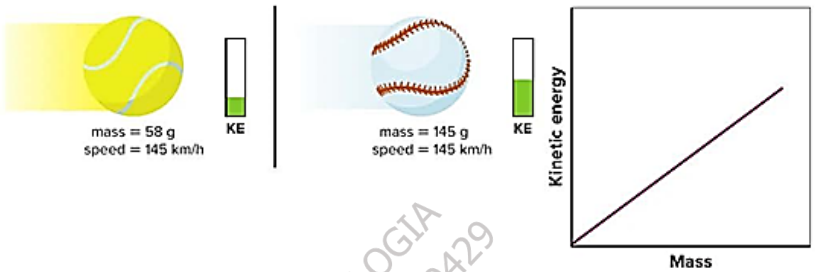


How are kinetic energy and mass related?

Have you ever thrown a baseball or a tennis ball? A baseball has a lot more mass than a tennis ball. How does this affect the amount of kinetic energy the ball has? Let's investigate!

Kinetic Energy and Mass Did you notice in the Lab *Mass Matters* that the sphere with the largest mass created the largest crater? As it fell it had kinetic energy. When it hit the clay it created a larger crater because it had more kinetic energy than the spheres with less mass. A moving object's kinetic energy depends on its mass. If a baseball and a tennis ball move at the same speed, the ball with more mass has more kinetic energy.

Look at the figure below. Note the vertical bars. These are energy bars. Energy bars show relative amounts of energy. The more full the bar, the more energy the object has. The tennis ball and the baseball are traveling at the same speed, but the baseball has a greater mass. For objects traveling at the same speed, the more mass an object has, the greater its kinetic energy.



The relationship between mass and kinetic energy is a proportional, linear relationship that can be described mathematically.

$KE \propto m$

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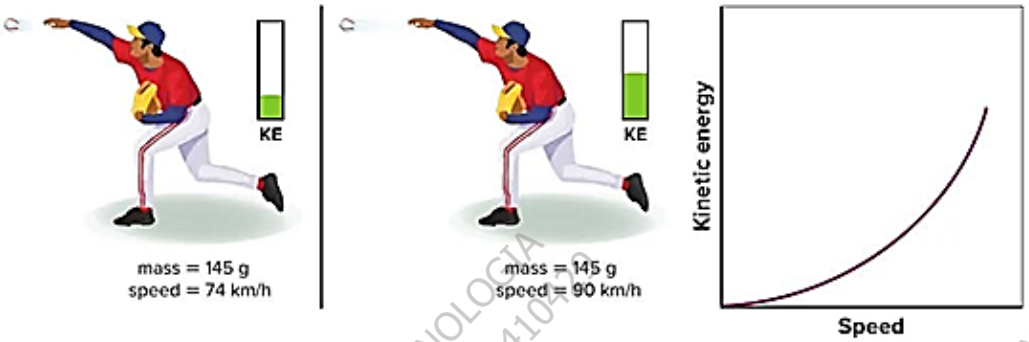
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THREE-DIMENSIONAL THINKING

For each system determine how the quantity of kinetic energy would increase or decrease.

1. If the mass of an object is increased by a factor of 4, kinetic energy increases by a factor of 4.
2. If the mass of an object is decreased by a factor of $\frac{1}{2}$, kinetic energy decreases by a factor of ½.

Kinetic Energy and Speed In the Lab *Picking Up Speed*, you observed that an object's kinetic energy also depends on its speed. The faster an object moves, the more kinetic energy it has. Look at the figure below. The pitcher used the same softball, but the speed was different for the two pitches. The faster pitch has more kinetic energy. This is represented in the energy bars.



There is a proportional relationship between kinetic energy and speed. Did you notice that the speed-volume graph in the Lab *Picking Up Speed* was different from the mass-volume graph in the Lab *Mass Matters*? This is because even though both are proportional relationships, they are not the same type of proportional relationship.

When you increase the mass of an object, the kinetic energy increases by the same factor. When you increase the speed of an object, the kinetic energy increases by the square of the factor. This is a square, nonlinear relationship, which is shown in the graph above. A ball gains kinetic energy when thrown. If a pitcher throws the ball twice as fast, this quadruples its kinetic energy. This relationship can be expressed mathematically by the following expression:

$$KE \propto v^2$$

THREE-DIMENSIONAL THINKING

A horse galloped at 40 km/h, then it began to slow down. **Construct an explanation** about what happens to its kinetic energy as the horse slowed to 20 km/h. Explain using evidence.

KE = ½mv². The speed was cut in half (40 → 20 km/h),

so the KE became (½)² = ¼ of its original value.

The kinetic energy decreased by a factor of 4.

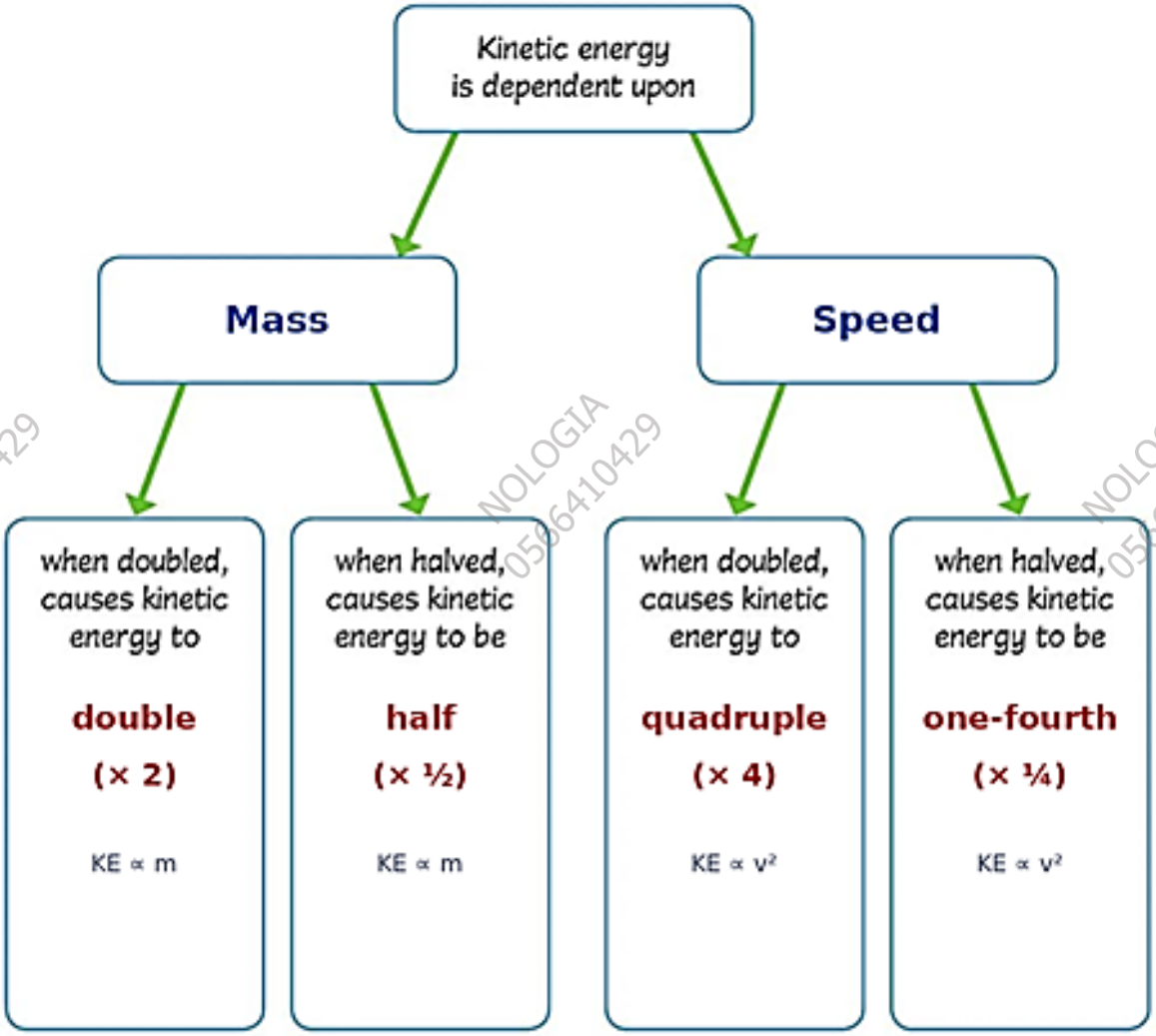
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Summarize It!

1. **Organize** Complete the graphic organizer below to describe the relationships of the variables that result in kinetic energy.



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Three-Dimensional Thinking

2. Aiden collected canned goods for a neighborhood service project. He pulled a plastic wagon behind him to put the items in. From the time Aiden began until he finished collecting, the mass of the wagon tripled. The walk back to Aiden's house was downhill and the speed of the wagon tripled. What happened to the kinetic energy when the mass tripled? What happened to the kinetic energy when the speed tripled?

A When the mass tripled, the kinetic energy increased by a factor of 3. When the speed tripled, the kinetic energy increased by a factor of 3.

B When the mass tripled, the kinetic energy increased by a factor of 3. When the speed tripled, the kinetic energy increased by a factor of 9. ✓ Answer: B

C When the mass tripled, the kinetic energy increased by a factor of 9. When the speed tripled, the kinetic energy increased by a factor of 3.

D When the mass tripled, the kinetic energy increased by a factor of 9. When the speed tripled, the kinetic energy increased by a factor of 9.

The figure below shows mass and relative kinetic energy in energy bars for three vehicles.



3. What can you determine about the speed of the blue car?

A The blue car's speed is the same as the red car's speed.

B The blue car's speed is less than the truck's speed.

C The blue car's speed is equal to the truck's speed.

D The blue car's speed is greater than the red car's speed. ✓ Answer: D

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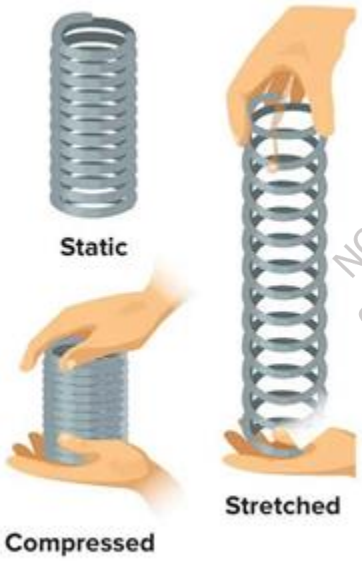
اضغط على الاسم لتحصل على مزيد من الملفات في تلغرام: NOLOGIA
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Potential Energy If the rubber band was not stretched back and released the nickel would not have moved. Somehow the rubber band gave energy to the nickel so the nickel could move. To be able to pass energy to the nickel, the rubber band must have contained energy when it was stretched. The energy contained in the rubber band is called potential energy. **Potential energy** is the energy due to interactions between objects or particles when distance changes. The amount of potential energy an object has depends on the positions of objects or particles.



When you stretch a rubber band, you are increasing a form of potential energy called elastic (ih LAS tik) potential energy. **Elastic potential energy** is energy stored in objects that are compressed or stretched, such as springs and rubber bands.

Springs When you stretch a spring like a rubber band, or compress it, you change its shape. This can be seen in the figure on the right. The spring will always try to return to its original resting, or static, shape. The more you change its shape, the greater the elastic potential energy the spring will contain.



Systems and Energy The rubber band and nickel in the *Slingshot Physics* lab represent a system. Recall there are two types of systems, open and closed. If the focus is just on the rubber band and the nickel, it is considered a closed system. When the environment surrounding the objects is involved, the system is now an open system. When looking at the energy in a system it is important to identify the components of the system, and how those components change. Did you notice that the farther back the rubber band was stretched the farther the nickel moved? The rubber band contained more potential energy as it was stretched farther back. The larger the change in position between the objects, the greater the potential energy.

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Gravitational Potential Energy You have seen that an object can have energy even if it is not moving. If you hold a ball 1 m above the ground and let it go, you know that the ball will fall. The ball falls because the ball is in Earth's gravitational field. There is gravitational attraction between the ball and Earth. To increase the energy of an object in relation to Earth's gravitational field a force must be applied to move these two objects farther apart. This type of energy is called gravitational potential energy. **Gravitational potential energy** is stored energy due to the interactions of objects in a gravitational field. Gravitational potential energy exists between all objects but is only significant when at least one very large object is involved, such as Earth.

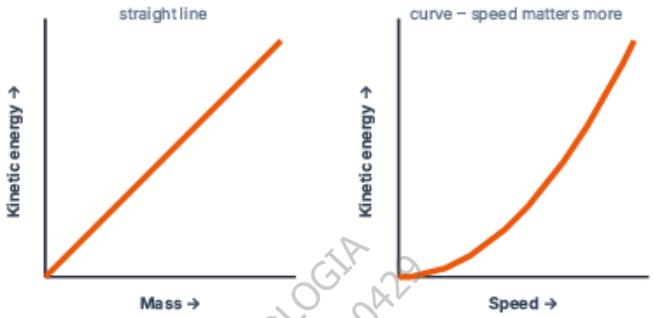
Recall that objects can be located anywhere inside a gravitational field. The farther away the object is from the center of the gravitational field, the more gravitational potential energy the object has in relation to the field. The difference in gravitational potential energy depends on the change in position of the object and the object's mass.

Change in Position Examine the figure of the girl and the backpack on the right. The girl in the figure increases the gravitational potential energy between her backpack and Earth by lifting the backpack. To increase the gravitational potential energy of the backpack, she exerts a force on the backpack that opposes the force of gravity. When she applies this force, she increases the energy of the backpack. The potential energy of the backpack increases as its height increases.



Summary الملخص

Energy	What it is	Increases when...
Kinetic	energy of motion	mass ↑ or speed ↑
Elastic potential	stored in objects that are **stretched or compressed** (spring, rubber band)	stretch or squeeze more
Gravitational potential	stored because of interaction of objects in a **gravitational field**	height ↑



EXAMPLE A girl lifts her backpack from the floor to her shoulder → its **height increases** → its **GPE increases**.

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Questions :

Question 1: Read the Section Potential Energy.

What is elastic potential energy?

Answer: Energy stored in objects that are compressed or stretched, such as springs and rubber bands.

Question 2: Read the Section Gravitational Potential Energy.

What is gravitational potential energy?

Answer: Stored energy due to the interactions of objects in a gravitational field.

Question 3: Read the Section Change in Position.

1. At which position does the backpack have more gravitational potential energy? Why?

2. At which position does the backpack have the less gravitational potential energy? Why?

Answer: 1. On the higher shelf – because it is higher above the floor.
2. On the lower shelf (or on the floor) – because its height above the floor is smaller.

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Question 4: 1. Define: (a) kinetic energy, (b) gravitational potential energy, (c) elastic potential energy.

2. State two ways to increase the kinetic energy of a moving cart.

3. State two ways to increase the gravitational potential energy of a backpack.

5. A student stretches a rubber band 5 cm and then 10 cm. In which case does it have more elastic potential energy?

Answer: 1. (a) Kinetic energy: energy due to motion; (b) Gravitational potential energy: stored energy due to height and mass in a gravitational field; (c) Elastic potential energy: energy stored in stretched or compressed objects.

2. Increase its mass; increase its speed.

3. Lift it to a higher shelf; add more mass/books to it.

5. When stretched 10 cm.

Question 5: Compare the three balls:

(a) Which ball has more gravitational potential energy: A or B? Why?

(b) Which ball has more gravitational potential energy: B or C? Why?

(c) Which ball has the greatest gravitational potential energy overall?

Ball	Mass	Height
Ball A	1 kg	2 m
Ball B	2 kg	2 m
Ball C	2 kg	4 m

Answer: (a) Ball B – because it has more mass at the same height.

(b) Ball C – because it has a greater height with the same mass.

(c) Ball C.

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Q24 : Unit 1: Geologic Time

Lesson 1: Analyzing The Rock & Fossil Record & Lesson 2 : Building a Timeline

-Name the principles of relative-age dating.

-Analyze geological representations to distinguish between different types of unconformities.

(Page 17, 31, 32)

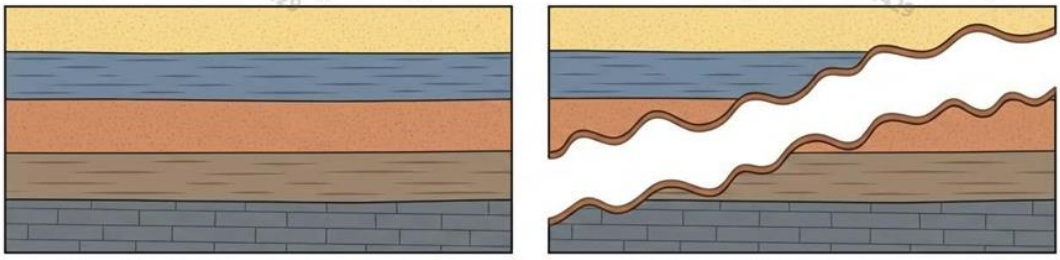
Free Response Questions - FRQ

The Principles of Relative-Age Dating As you just discovered in the *Relatively Speaking* investigation, there are five principles that geologists use to assign relative ages to rocks and features.

- **Superposition** is the principle that in undisturbed rock layers, the oldest rocks are on the bottom.
- According to the principle of **original horizontality,** most rock-forming materials are deposited in horizontal layers.
- **Lateral continuity** is the principle that sediments are deposited in large, continuous sheets in all lateral directions.
- According to the principle of **inclusions,** if one rock contains pieces of another rock, the rock containing the pieces is younger than the pieces.
- According to the principle of **cross-cutting relationships,** if one geologic feature cuts across another feature, the feature that it cuts across is older.

The Missing Pages: Gaps in the Rock Record

The Ideal Record (Theory) | The Reality (Unconformities)

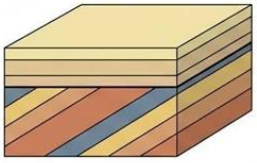
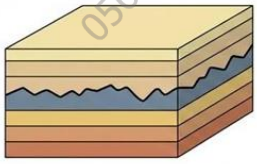
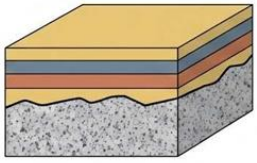


The Ideal Record (Theory) | The Reality (Unconformities)

Earth's history is constantly erased. Weathering, erosion, and volcanism destroy rock layers, creating massive gaps in the geological timeline known as **unconformities**. A complete rock record in one place does not exist.

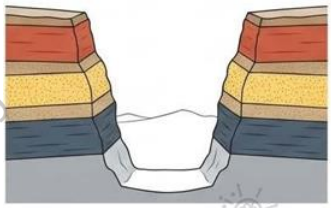
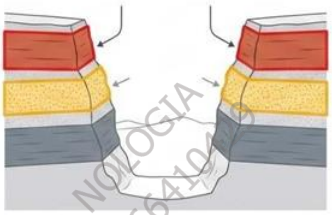
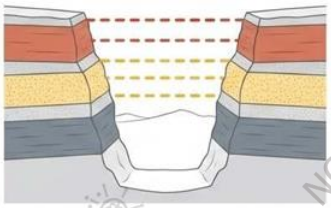
THE GEOLOGICAL PROBLEM: How do we read a history book when millions of years of pages have been washed away?

Field Guide to Unconformities

1. Angular Unconformity	2. Disconformity	3. Nonconformity
		
Visual Tell: Tilted underneath horizontal.	**Visual Tell:** Horizontal over horizontal with a jagged gap.	**Visual Tell:** Sedimentary over igneous or metamorphic.
Definition: Horizontal sedimentary layers are deposited over older, uplifted, and tilted layers.	**Definition:** Horizontal sedimentary rock overlies another horizontal layer that has been eroded. The missing time is hidden in the jagged gap.	**Definition:** Sedimentary rock overlies a layer of igneous or metamorphic rock. Represents massive tectonic uplift and erosion.

NOLOGIA STUDY NOTE: The eroded surface in all three types always represents a gap in time—from hundreds to billions of years.

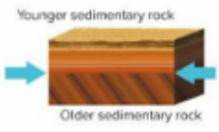
The Primary Tool: Rock Correlation

Step 1: Observe Isolated Sequences	Step 2: Identify Matching Types	Step 3: Connect the Gaps
		

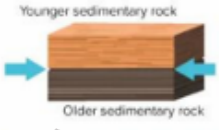
DEFINITION: Correlation is the matching of rock layers or fossils exposed in one geographic region to similar layers in other regions to fill gaps in the rock record.

Summary الملخص

An **unconformity** is a surface where rock was **eroded away**, leaving a **gap** in the rock record.



Angular unconformity
Tilted layers below, **flat** layers on top



Disconformity
Flat layers below and on top – the eroded surface can be hard to see



Nonconformity
Igneous or metamorphic rock (granite, marble) below, sedimentary on top

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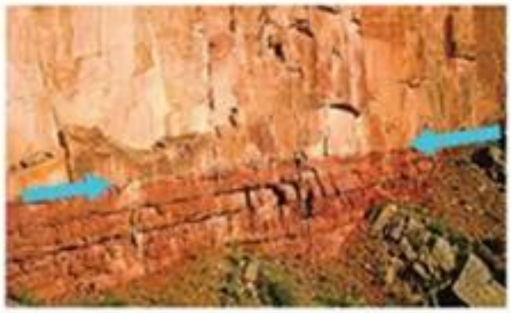
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Gaps in the Rock Record

1. Analyze the three photos below. Notice how the arrows point to a line between different rocks. How would you describe the rock below the arrows versus the rock above? Write your descriptions next to each image.

A



Below the arrows: thin, flat, red layers of sedimentary rock. Above: a thick, massive orange cliff. The boundary is wavy and uneven, and the layers above and below are both horizontal.

B



Below the arrows: tilted (slanted) layers of rock that were eroded. Above: flat, horizontal layers lying on top. The boundary cuts across the tilted layers at an angle.

C



Below the arrows: light-colored, massive rock with no layers (igneous or metamorphic). Above: dark, layered sedimentary rock resting on top of it, with an uneven boundary.

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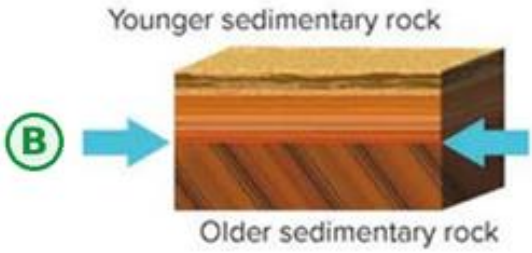
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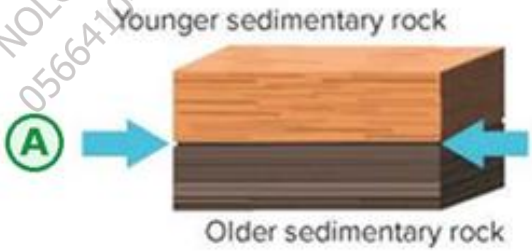
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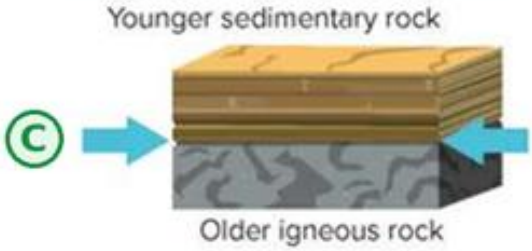
2. The arrows in the images on the previous page point to the surfaces where rock has eroded away, producing breaks, or gaps, in the rock record, called **unconformities** (un kun FOR muh tees). There are three types of unconformities, described below. Can you identify which photo from the previous page each type of unconformity describes? Label the figures *A*, *B*, or *C* to correspond with the matching photos.



- When horizontal layers of sedimentary rock are deformed during mountain building or other geologic events, they are usually uplifted and tilted. During this process, the layers are exposed to weathering and erosion. If horizontal layers of sedimentary rock are later laid down on top of the tilted, eroded layers, the resulting unconformity is called an angular unconformity.



- When a horizontal layer of sedimentary rock overlies another horizontal layer of sedimentary rock that has been eroded, the eroded surface is called a disconformity. Disconformities can be easy to identify when the eroded surface is uneven. When the eroded surface is smooth, disconformities are often hard to see.



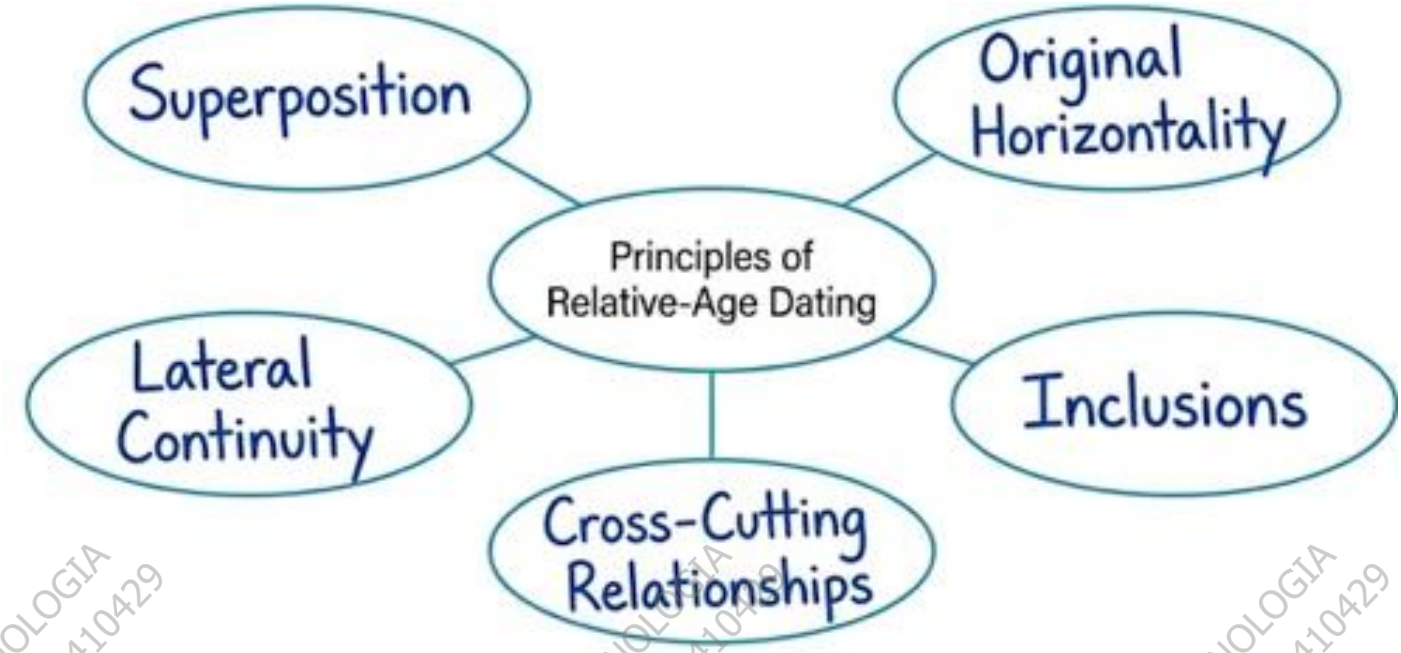
- When a layer of sedimentary rock overlies a layer of igneous or metamorphic rock, such as granite or marble, the eroded surface is easier to identify. This kind of eroded surface is called a nonconformity. A nonconformity indicates a gap in the rock record during which igneous or metamorphic rock layers were uplifted, eroded at Earth's surface, and new layers of sedimentary rock formed on top.

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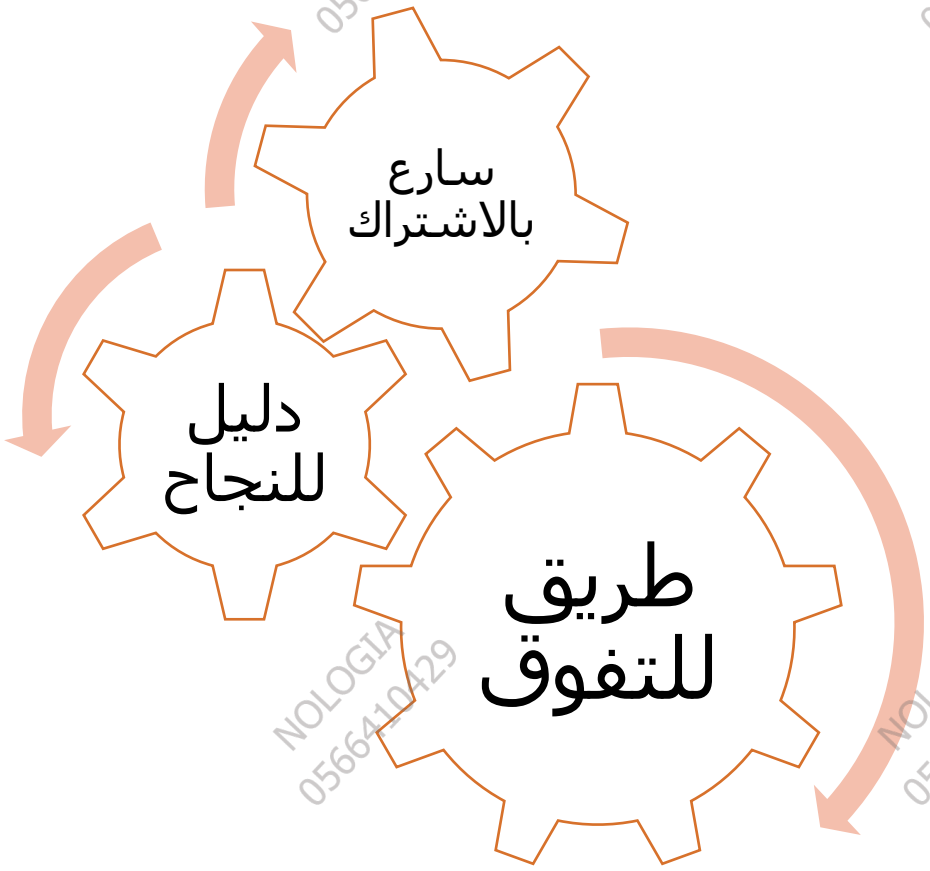
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Questions :

Question 1: What are the Principles of Relative-Age Dating ?



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مع أطيب التمنيات بالنجاح والتوفيق ...

النهاية...