تجميعة أسئلة وفق الهيكل الوزاري الجديد منهج انسباير

تم تحميل هذا الملف من موقع المناهج الإماراتية
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المزيد من مادة فيزياء:	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
	إعداد: Gargi

التواصل الاجتماعي بحسب الصف العاشر العام

صفحة المناهج الإماراتية على فيسبوك

المواد على تلغرام	التربية الاسلامية	اللغة العربية	اللغة الانجليزية	الرياضيات

المزيد من الملفات بحسب الصف العاشر العام والمادة فيزياء في الفصل الأول

1	تجميعة أسئلة القسم الكتابي وفق الهيكل الوزاري الجديد منهج انسباير
2	مذكرة شاملة الوحدة الأولى مع تدريبات
3	ملخص وتدريبات الدرس الأول motion and Force منهج انسباير
4	أسئلة الامتحان النهائي القسم الورقي منهج بريدج العام 2024-2025
5	حل أسئلة اختبار تجريبي وفق الهيكل الوزاري منهج بريدج

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EOT-1_2025-2026-Review_10 Gen

Multiple Choice Questions

Q.1 Define force and identify the cause of all accelerations. **Figure:1** **Pg:3**

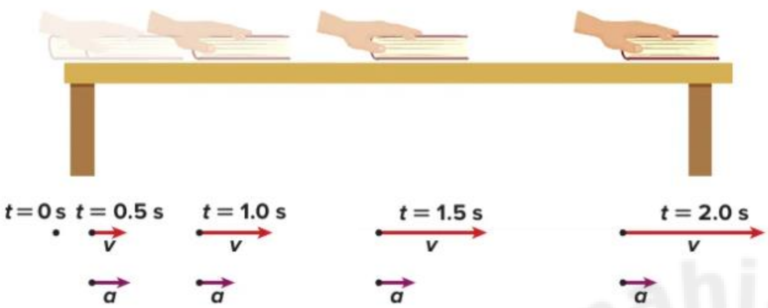


Figure 1 The hand pushing on the book exerts a force that causes the book to accelerate in the direction of the unbalanced force.

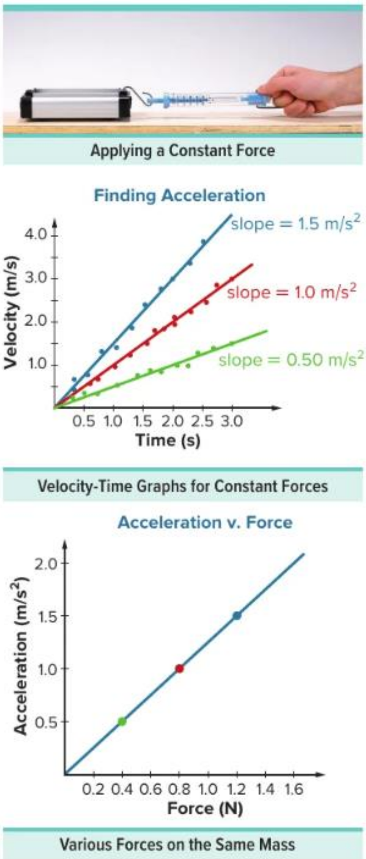


Figure 5 A spring scale exerts a constant unbalanced force on the cart. Repeating the investigation with different forces produces velocity-time graphs with different slopes.

Acceleration and Force

To explore how forces affect an object's motion, think about doing a series of investigations. Consider the simple situation shown in the top photo of **Figure 5** in which we exert one force horizontally on an object. Starting with the horizontal direction is helpful because gravity does not act horizontally. To reduce complications resulting from the object rubbing against the surface, the investigations should be done on a smooth surface, such as a well-polished table. We'll also use a cart with wheels that spin easily.

Apply constant force How can you exert a constant unbalanced force? One way is to use a device called a spring scale. Inside the scale is a spring that stretches proportionally to the magnitude of the applied force. The front of the scale is calibrated to read the force in newtons. If you pull on the scale so that the reading on the front stays constant, the applied force is constant. The top photo in **Figure 5** shows a spring scale pulling a low-resistance cart with a constant unbalanced force.

If you perform this investigation and measure the cart's velocity for a period of time, you could construct a graph like the green line shown in the velocity-time graphs for constant forces in the middle panel of **Figure 5**. The constant slope of the line in the velocity-time graph indicates the cart's velocity increases at a constant rate. The constant rate of change of velocity means the acceleration is constant. This constant acceleration is a result of the constant unbalanced force applied by the spring scale to the cart.

How does acceleration depend on force? Repeat the investigation with a larger constant force. Repeat it again with an even greater force. For each force, plot a velocity-time graph like the red and blue lines in the middle panel of **Figure 5.** Recall that the line's slope is the cart's acceleration. Calculate the slope of each line and plot the results for each force to make an acceleration-force graph, as shown in the bottom panel of **Figure 5**.

The graph indicates the relationship between force and acceleration is linear. Because the relationship is linear, you can apply the equation for a straight line:

$$y = kx + b$$

The y-intercept is 0, so the linear equation simplifies to $y = kx$. The y-variable is acceleration. The x-variable is force. Therefore, acceleration is equal to the slope of the line multiplied by the applied net force.

Q.2 Classify forces as either contact forces or field forces and realize that they result from interactions caused by agents.
Figure:2 **Pg:4**

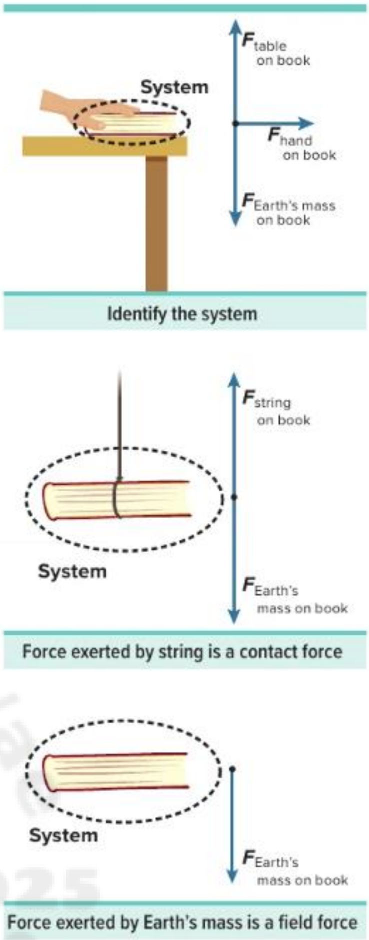


Figure 2 The book is the system in each of these situations.
Classify *each force in the first panel as either a contact force or a field force.*

Q.3 Interpret the graph of net force versus acceleration.
Figure:5 **Pg:7**

Q.4 Define inertia and state Newton's First law of motion)as a law of inertia. **Student textbook** **Pg:11**

Inertia Newton's first law is sometimes called the law of inertia because **inertia** is the tendency of an object to resist changes in velocity. The car and the red block in **Figure 8** demonstrate the law of inertia. In the left panel, both objects are moving to the right. In the right panel, the wooden box applies a force to the car, causing it to stop. The red block does not experience the force applied by the wooden box. It continues to move to the right with the same velocity as in the left panel.

Is inertia a force? No. Forces are results of interactions between two objects; they are not properties of single objects, so inertia cannot be a force. Remember that because velocity includes both the speed and direction of motion, a net force is required to change either the speed or the direction of motion. If the net force is zero, Newton's first law means the object will continue with the same speed and direction.

Q.5 Define equilibrium. State the conditions for an object to be in equilibrium. **Figure:9** **Pg:12**

Figure 9 An object is in equilibrium if its velocity isn't changing. In both cases pictured here, velocity isn't changing, so the net force must be zero.

Equilibrium According to Newton's first law, a net force causes the velocity of an object to change. If the net force on an object is zero, then the object is in **equilibrium.** An object is in equilibrium if it is moving at a constant velocity. Note that being at rest is simply of the state of constant velocity, $v = 0$. Newton's first law identifies a net force as something that disturbs a state of equilibrium. Thus, if there is no net force acting on the object, then the object does not experience a change in speed or direction and is in equilibrium. **Figure 9** indicates, at least in terms of net forces, there is no difference between lying on a sofa and falling at a constant velocity while skydiving–velocity isn't changing, so the net force is zero.

Keep in mind that the real world is full of forces that resist motion. Newton's ideal, friction-free world is not easy to obtain. If you analyze a situation and find that the result is different from your own experience, ask yourself if this s is because of the presence of frictional forces.

Q.6 Define an object's weight. Relate the mass of an object to it's weight. **Student textbook** **Pg:11**

Weight

From Newton's second law, the fact that the ball in **Figure 10** is accelerating means there must be unbalanced forces acting on the ball. The only force acting on the ball is the gravitational force due to Earth's mass. An object's **weight** is the gravitational force experienced by that object. This gravitational force is a field force whose magnitude is directly proportional to the mass of the object experiencing the force. In equation form, the gravitational force, which equals weight, can be written $F_g = mg$. The mass of the object is m, and g, called the **gravitational field,** is a vector quantity that relates an object's mass to the gravitational force it experiences at a given location.

Near Earth's surface, g is 9.8 N/kg toward Earth's center. Objects near Earth's surface experience 9.8 N of force for every kilogram of mass.

Scales When you stand on a scale as shown in the right panel of **Figure 10**, the scale exerts an upward force on you. Because you are not accelerating, the net force acting on you must be zero. Therefore the magnitude of the force exerted by the scale ($F_{scale\ on\ you}$) pushing up must equal the magnitude of F_g pulling down on you. Inside the scale, springs provide the upward force necessary to make the net force equal zero. The scale is calibrated to convert the stretch of the springs to a weight. If you were on a different planet with a different g, the scale would exert a different force to keep you in equilibrium, and consequently, the scale's reading would be different. Because weight is a force, the proper unit used to measure weight is the newton.

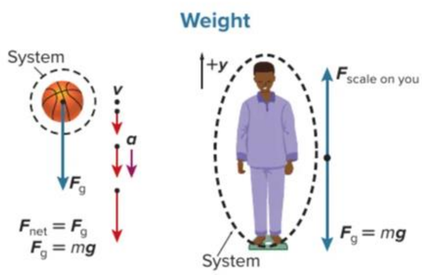


Figure 10 The gravitational force exerted by Earth's mass on an object equals the object's mass times the gravitational field, $F_g = mg$.

Identify *the forces acting on you when you are in equilibrium while standing on a scale.*

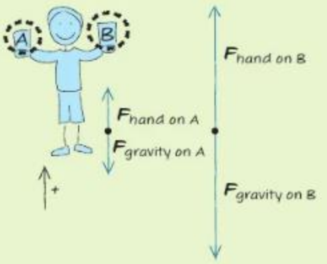
Q.7 Calculate the weight of an object. **Example Problem:2** **Pg:14**

EXAMPLE Problem 2

COMPARING WEIGHTS Kiran holds a brass cylinder in each hand. Cylinder A has a mass of 100.0 g and cylinder B has a mass of 300.0 g. What upward forces do his two hands exert to keep the cylinders at rest? If he then drops the two, with what acceleration do they fall? (Ignore air resistance.)

1 ANALYZE AND SKETCH THE PROBLEM

- Sketch the situation.
- Identify the two cylinders as the systems, and choose the upward direction as positive.
- Draw the free-body diagrams. Label the forces.



KNOWN	**UNKNOWNS**
$m_A = 0.1000$ kg	$F_{\text{Hand on A}} = ?$
$m_B = 0.3000$ kg	$F_{\text{Hand on B}} = ?$
$g = -9.8$ N/kg	$a_A = ?$ $\quad a_B = ?$

2 SOLVE FOR THE UNKNOWNS

For cylinder A:

$$F_{\text{Net on A}} = F_{\text{Hand on A}} + F_{\text{Gravity on A}}$$
$$0 = F_{\text{Hand on A}} + F_{\text{Gravity on A}}$$
$$F_{\text{Hand on A}} = -F_{\text{Gravity on A}}$$
$$F_{\text{Hand on A}} = -m_A g$$
$$= -(0.1000\text{ kg})(-9.8\text{ N/kg})$$
$$= 0.98\text{ N up}$$

For cylinder B:

$$F_{\text{Net on B}} = F_{\text{Hand on B}} + F_{\text{Gravity on B}}$$
$$= F_{\text{Hand on B}} + F_{\text{Gravity on B}}$$
$$F_{\text{Hand on B}} = -F_{\text{Gravity on B}}$$
$$F_{\text{Hand on B}} = m_B g$$
$$= -(0.3000\text{ kg})(-9.8\text{ N/Kg})$$
$$= 2.9\text{ N up}$$

After the cylinders are dropped, the only force on each is the force of gravity. Use Newton's second law.

$$a_A = \frac{F_{\text{Net on A}}}{m_A} \qquad a_B = \frac{F_{\text{Net on B}}}{m_B}$$

$$a_A = \frac{m_A g}{m_A} = g \qquad a_B = \frac{m_B g}{m_B} = g$$

Substitute $F_{\text{Net on A}} = m_A g$ and $F_{\text{Net on B}} = m_B g$

$$= -9.8\text{ m/s}^2 \qquad = -9.8\text{ m/s}^2$$

Substitute $g = -9.8$ N/kg $= -9.8$ m/s².

3 EVALUATE THE ANSWER

- **Are the units correct?** N is the correct unit for force; m/s² is the correct unit for acceleration.
- **Does the sign make sense?** The direction of the fall is downward, the negative direction, and the object is speeding up, so the acceleration should be negative.
- **Is the magnitude realistic?** Forces are 1–5 N, typical of that exerted by objects that have a mass of one kg or less. The accelerations are both equal to free fall acceleration.

Q.8 Describe forces in nature as a type of interaction between two bodies.State and explain Newton's third law of motion. **Student textbook** **Pg:19**

Interaction Pairs

Figure 14 illustrates the idea of forces as interaction pairs. There is a force from the woman on the dog's toy, and there is a force from the dog's toy on the woman. Forces always come in pairs similar to this example. Consider the woman (A) as one system and the toy (B) as another. What forces act on each of the two systems? Looking at the force diagrams in **Figure 14**, you can see that each system exerts a force on the other. The two forces, $F_{\text{A on B}}$ and $F_{\text{B on A}}$, are an example of an **interaction pair,** which is a set of two forces that are in opposite directions, have equal magnitudes, and act on different objects. Sometimes, an interaction pair is called an action-reaction pair. This might suggest that one causes the other; however, this is not true. For example, the force of the woman pulling on the toy doesn't cause the toy to pull on the woman. The two forces either exist together or not at all.

Q.9 Apply the mathematical representation of Newton's Third Law in numerical problems. List the characteristics of the interaction pair and identify the action-reaction pairs for different situations. Define the tension force and explain how Newton's Third Law applies to forces on strings and ropes.
Figure:15/17 Pg:20/22

Definition of Newton's third law In **Figure 14**, the force exerted by the woman on the toy is equal in magnitude and opposite in direction to the force exerted by the toy on the woman. Such an interaction pair is an example of **Newton's third law,** which states that all forces come in pairs. The two forces in a pair act on different objects and are equal in strength and opposite in direction.

Figure 14 The force that the toy exerts on the woman and the force that the woman exerts on the toy are an interaction pair.

Tension

Tension is simply a specific name for the force that a string or rope exerts. A simplification within this textbook is the assumption that all strings and ropes are massless. In **Figure 17**, the rope is about to break in the middle. If the rope breaks, the bucket will fall; before it breaks, there must be forces holding the rope together. The force that the top part of the rope exerts on the bottom part is $F_{\text{top on bottom}}$. Newton's third law states that this force must be part of an interaction pair. The other member of the pair is the force that the bottom part of the rope exerts on the top, $F_{\text{bottom on top}}$. These forces, equal in magnitude but opposite in direction, also are shown in **Figure 17**.

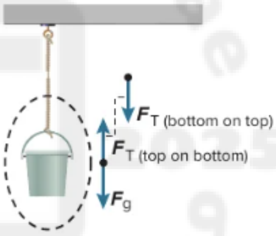


Figure 17 The tension in the rope is equal to the weight of all the objects hanging from it.

Think about this situation in another way. Before the rope breaks, the bucket is in equilibrium. This means that the force of its weight downward must be equal in magnitude but opposite in direction to the tension in the rope upward. Similarly, if you look at the point in the rope just above the bucket, it also is in equilibrium. Therefore, the tension of the rope below it pulling down must be equal to the tension of the rope above it pulling up. You can move up the rope, considering any point in the rope, and see that the tension forces at any point in the rope are pulling equally in both directions. Thus, the tension in the rope equals the weight of all objects below it.

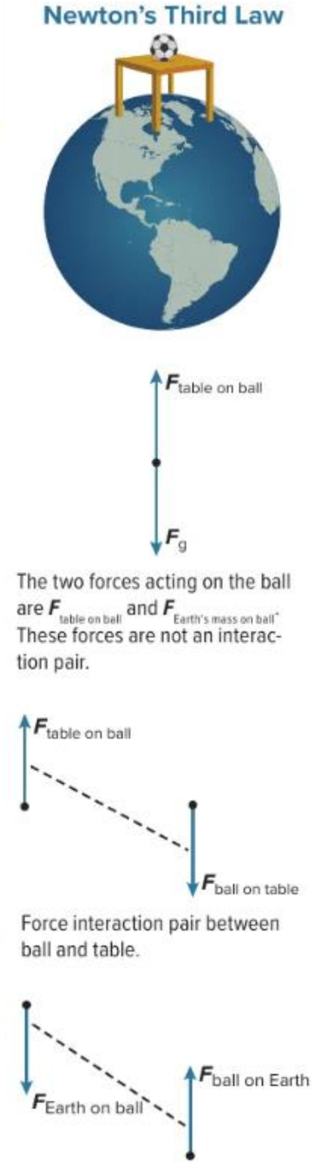


Figure 15 A ball resting on a table is part of two interaction pairs.

Q.10 Distinguish between static and kinetic friction.Identify the factors that friction force depends on.

Figure:10 Pg:38

Kinetic and Static Friction

You push a book across your desk. When you stop pushing, the book stops due to friction.

Types of friction
When you pushed your book across the desk, the book experienced a type of friction that acts on moving objects—**kinetic friction** is exerted on one surface by another when the two surfaces rub against each other because one or both surfaces are moving.

Now imagine trying to push a couch across the floor, as shown on the left in **Figure 10.** You push on it with a small force, but it does not move. Newton's laws tell you that the net force on the couch must be zero. There must be a second horizontal force acting on the couch that opposes your force and is equal in size. This force is **static friction,** which is the force exerted on one surface by another when there is no motion between the two surfaces.

You push harder, and the couch still does not move. The static friction force is increasing in response to your applied force. When you push hard enough, the couch begins to move as in the right side of **Figure 10.** There is a limit to how large the static friction force can be. Once your force is greater than this maximum static friction, the couch moves and kinetic friction acts on it.

Figure 10 An applied force is balanced by static friction up to a maximum limit. When this limit is exceeded, the object begins to move.

Identify *the type of friction force acting on the couch when it begins to move.*

Q.11 Define the coefficients of kinetic and static friction. **Student Textbook** **Pg:39/40**

magnitude of the resulting friction force. The slope of the line on a kinetic friction force v. normal force graph, designated μ_k, is called the **coefficient of kinetic friction** and relates the friction force to the normal force.

Kinetic Friction Force

The kinetic friction force equals the product of the coefficient of kinetic friction and the normal force.

$$F_{\text{f, kinetic}} = \mu_k F_N$$

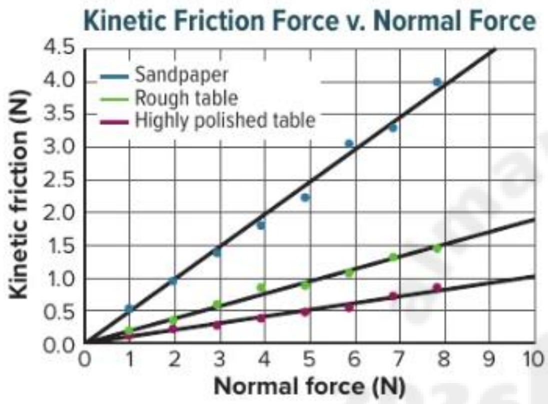


Figure 12 A plot of kinetic friction v. normal force for a block pulled along different surfaces shows a linear relationship between the two forces for each surface. The slope of the line is μ_k.

Static Friction Force

The static friction force is less than or equal to the product of the coefficient of static friction and the normal force.

$$F_{\text{f, static}} \le \mu_s F_N$$

In the equation for the maximum static friction force, μ_s is the **coefficient of static friction** between the two surfaces. The maximum static friction force that must be overcome before motion can begin is $\mu_s F_N$. In the example of pushing the couch in **Figure 10,** the maximum force of static friction balances the force of the person pushing on the couch the instant before the couch begins to move.

Q.12 Relate graphically the frictional force to the normal force and find the coefficient of kinetic Friction. **Figure:12**
Pg:39

Q.13 Identify work as a scalar quantity measured in Nm or Joule (J). **Student Textbook** **Pg:55**

The left side of the equation describes an action that was done to the system by the external world. Recall that a system is the object or objects of interest and the external world is everything else. A force (F) was exerted on a system while the point of contact moved. When a force is applied through a displacement, **work** (W) is done on the system.

The SI unit of work is called a **joule** (J). One joule is equal to 1 N·m. One joule of work is done when a force of 1 N acts on a system over a displacement of 1 m. An apple weighs about 1 N, so it takes roughly 1 N of force to lift the apple at a constant velocity. Thus, when you lift an apple 1 m at a constant velocity, you do 1 J of work on it.

Q.14 Show that work is done when a force is applied through a displacement. **Student Textbook Pg:56**

Q.15 Explain that the work done by a force acting in a direction perpendicular to the direction of motion is zero.Explain that work done by a force is positive when the force acts in the direction of motion and negative when the force acts in the opposite direction of motion with suitable examples. **Figure:2** **Pg:56**

Work done by a constant force In the book bag example, F is a constant force exerted in the direction in which the object is moving. In this case, work (W) is the product of the force and the system's displacement. That is,

$$W = Fd.$$

What happens if the exerted force is perpendicular to the direction of motion? For example, for a planet in a circular orbit, the force is always perpendicular to the direction of motion, as shown in **Figure 1.** Recall that a perpendicular force only changes the direction. The speed of the planet doesn't change, so the right side of the equation, $\frac{1}{2}mv_f^2 - \frac{1}{2}mv_i^2$, is zero. Therefore, the work done is also zero.

Constant force exerted at an angle What work does a force exerted at an angle do? For example, what work does the person pushing the car in **Figure 2** do? Recall that any force can be replaced by its components. If you use the coordinate system shown in **Figure 2,** the 125-N force (F) exerted in the direction of the person's arm has two components.

The magnitude of the horizontal component (F_x) is related to the magnitude of the applied force (F) by $\cos 25.0° = \frac{F_x}{F}$. By solving for F_x, you obtain

$$F_x = F\cos 25.0° = (125\text{ N})(\cos 25.0°) = 113\text{ N}.$$

Using the same method, the vertical component is

$$F_y = -F\sin 25.0°$$

$$F_y = -(125\text{ N})(\sin 25.0°) = -52.8\text{ N}.$$

The negative sign shows that the force is downward. Because the displacement is in the x direction, only the x-component does work. The y-component does no work. The work you do when you exert a force on a system at an angle to the direction of motion is equal to the component of the force in the direction of the displacement multiplied by the displacement.

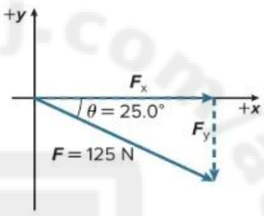


Figure 2 Only the horizontal component of the force that the man exerts on the car does work because the car's displacement is horizontal.

$F_x = F\cos\theta$. Thus, the work done is represented by the following equation.

Work

Work is equal to the product of the magnitude of the force and magnitude of displacement times the cosine of the angle between them.

$$W = Fd\cos\theta$$

Get It?

Determine the work you do when you exert a force of 3 N at an angle of 45° from the direction of motion for 1 m.

The equation above agrees with our expectations for constant forces exerted in the direction of displacement and for constant forces perpendicular to the displace-

Q.16 Define power and specify its unit (Watt). **Student Textbook** **Pg:63**

Power

Suppose you had a stack of books to move to a shelf. You could lift the stack at once, or you could move the books one at a time. Since the total force applied and the displacement are the same in both cases, the work is the same. However, the time needed is different. Recall that work causes a change in energy. The rate at which energy is transformed is **power.**

Power

Power is equal to the change in energy divided by the time required for the change.

$$P = \frac{\Delta E}{t}$$

When work causes the change in energy, power is equal to the work done divided by the time taken to do the work: $P = \frac{W}{t}$.

Consider the two forklifts in **Figure 9.** The left forklift raises its load in 5 seconds, and the right forklift raises the same load in 10 seconds. The left forklift is more powerful than the right forklift. Even though the same work is accomplished by both forklifts, the left forklift accomplishes the work in less time and thus develops more power.

Power is measured in watts (W). One **watt** is 1 J of energy transformed in 1 s. That is, 1 W = 1 J/s.

A watt is a relatively small unit of power. For example, a glass of water weighs about 2 N. If you lift it 0.5 m to your mouth at a constant speed, you do 1 J of work. If you lift it in 1 s, you are doing work at the rate of 1 W. Because a watt is such a small unit, power often is measured in kilowatts (kW). One kilowatt is equal to 1000 W.

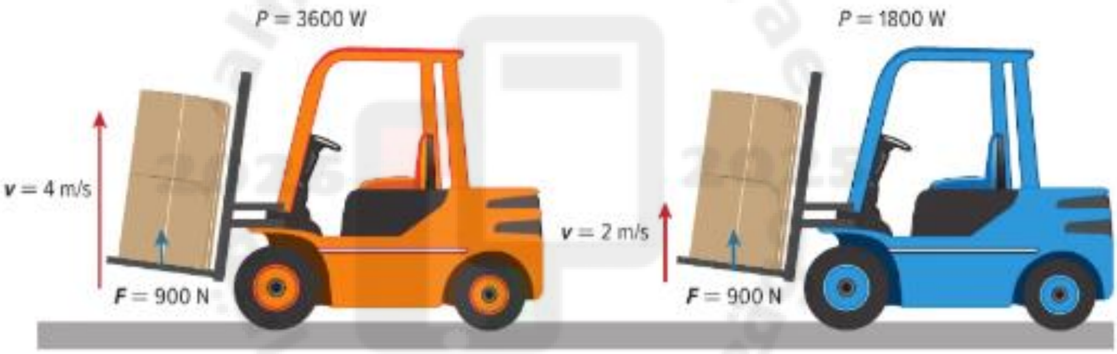


Figure 9 The forklift on the left develops more power than the forklift on the right because it lifts the load at a faster rate.

Q.17 Define periodic motion and the quantities associated with it like period and amplitude.Define the simple harmonic motion.
Student Textbook
Pg:98

The bobbing of a mass on a spring or the swaying of a pendulum are examples of **periodic motion.** In each example, at one position the net force on the object is zero and the object is in equilibrium. When the object moves away from its equilibrium position, the net force on the system becomes nonzero. This net force acts to bring the object back toward equilibrium. The **period** (T) is the time needed for one full cycle of the motion. The **amplitude** of the motion is the maximum distance the object moves from the equilibrium position.

Simple harmonic motion In **Figure 1,** the force exerted by the spring is directly proportional to the distance it is stretched. When pulled down and released, the mass bobs up and down through equilibrium. Any system where the force acting to restore an object to its equilibrium position is directly proportional to the object's displacement shows **simple harmonic motion.**

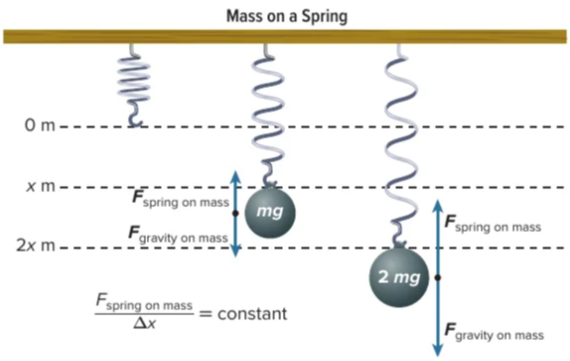


Figure 1 The force exerted on the mass by the spring is directly proportional to the mass's displacement.
Determine *the displacement if the mass is 0.5 mg.*

Q. 18 Differentiate between transverse, longitudinal and surface waves with examples. Figure:6 Pg:104

Mechanical Waves

A **wave** is a disturbance that carries energy through matter or space without transferring matter. You have learned how Newton's laws of motion and the law of conservation of energy govern the behavior of particles. These laws also govern the behavior of waves. Water waves, sound waves, and the waves that travel along a rope or a spring are mechanical waves. Mechanical waves pass through a physical medium, such as water, air, or a rope.

Transverse waves A **wave pulse** is a single bump or disturbance that passes through a medium. In the left panel of **Figure 6,** the wave pulse disturbs the rope in the vertical direction, but the pulse travels horizontally. A wave that disturbs the particles in the medium perpendicular to the direction of the wave's travel is called a **transverse wave.** If the disturbances continue at a constant rate, a **periodic wave** is generated.

Longitudinal waves In a coiled spring toy, you can produce another type of wave. If you squeeze together several turns of the coiled spring toy and then suddenly release them, pulses will move away in both directions. The result is called a **longitudinal wave** because the disturbance is parallel to the direction of the wave's travel. Sound waves are longitudinal waves in which the molecules are alternately compressed or decompressed along the path of the wave.

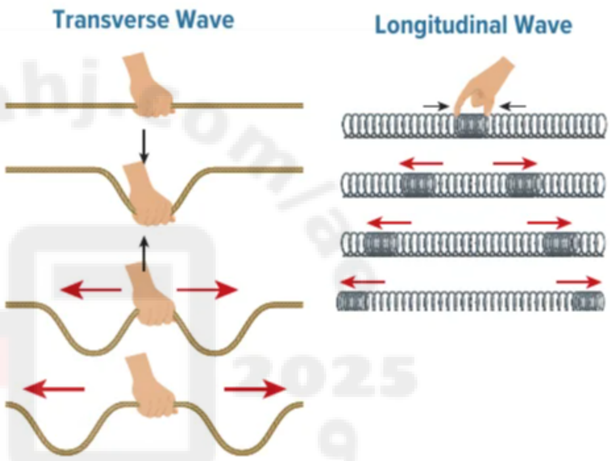


Figure 6 Shaking a rope up and down produces transverse wave pulses traveling in both directions. Squeezing and releasing the coils of a spring produces longitudinal wave pulses in both directions.

Surface waves Waves that are deep in a lake or an ocean are longitudinal. In a **surface wave,** however, the medium's particles follow a circular path that is at times parallel to the direction of travel and at other times perpendicular to the direction of wave travel, as shown in **Figure 7.** Surface waves set particles in the medium, in this case water, moving in a circular pattern. At the top and bottom of the circular path, particles are moving parallel to the direction of the wave's travel. This is similar to a longitudinal wave. At the left and right sides of each circle, particles are moving up or down. This up-and-down motion is perpendicular to the wave's direction, similar to a transverse wave.

> Real-World Physics
>
> **Tsunamis**
>
> On March 11, 2011, a wall of water estimated to be ten meters high hit areas on the east coast of Japan—tsunami! A tsunami is a series of ocean waves that can have wavelengths over 100 km, periods of one hour, and wave speeds of 500–1000 km/h.

Q. 19 Describe the wave properties like amplitude, energy of a wave, wavelength, speed, phase, period and frequency. Student Textbook Pg:105

Wave Properties

Many types of waves share a common set of wave properties. Some wave properties depend on how the wave is produced, whereas others depend on the medium through which the wave is passing.

Amplitude How does the pulse generated by gently shaking a rope differ from the pulse produced by a violent shake? The difference is similar to the difference between a ripple in a pond and an ocean breaker—they have different amplitudes. You read earlier that the amplitude of periodic motion is the greatest distance from equilibrium. Similarly, as shown in **Figure 8,** a transverse wave's amplitude is the maximum distance of the wave from equilibrium. Since amplitude is a distance, it is always positive. You will learn more about measuring the amplitude of longitudinal waves when you study sound.

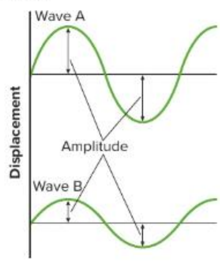


Figure 8 A wave's amplitude is measured from the equilibrium position to the highest or lowest point on the wave.

Energy of a wave Waves, including water waves, are examples of the many ways that energy manifests at the macroscopic scale. The energy of a wave is related to its amplitude, and a wave's amplitude depends on how the wave is generated. More energy must be added to the system to generate a wave with a greater amplitude. For example, strong winds produce larger water waves than those formed by gentle breezes. Waves with greater amplitudes transfer more energy. Whereas a wave with a small amplitude might move sand on a beach a few centimeters, a giant wave can uproot and move a tree.

For waves that move at the same speed, the rate at which energy is transferred is proportional to the square of the amplitude. Thus, doubling the amplitude of a wave increases the amount of energy that wave transfers each second by a factor of four.

Period Although wave speed and amplitude can describe both wave pulses and periodic waves, period (T) applies only to periodic waves. You have learned that the period of simple harmonic motion, such as the motion of a simple pendulum, is the time it takes for the motion to complete one cycle. Such motion is usually the source, or cause, of a periodic wave. The period of a wave is equal to the period of the source. In **Figure 9** the period (T) equals 0.04 s, which is the time it takes the source to complete one cycle. The same time is taken by P, a point on the rope, to return to its initial position and velocity.

Calculating frequency The **frequency** of a wave (f) is the number of complete oscillations a point on that wave makes each second. Frequency is measured in hertz (Hz). One hertz is one oscillation per second and is equal to 1/s or s^{-1}. The frequency and the period of a wave are related by the following equation.

Frequency of a Wave

The frequency of a wave is equal to the reciprocal of the period.

$$f = \frac{1}{T}$$

Both the period and the frequency of a wave depend only on the wave's source. They do not depend on the wave's speed or the medium.

Calculating wavelength You can directly measure a wave's wavelength by measuring the distance between adjacent crests or troughs. You can also calculate it because the wavelength and frequency of a wave are related to one another by the speed of travel of the wave, which depends on the type of wave and the medium through which it is passing. In the time interval of one period, a wave moves one wavelength. Therefore, the wavelength of a wave is the speed multiplied by the period, $\lambda = vT$. Using the relation that $f = \frac{1}{T}$, the wavelength equation is very often written in the following way.

Wavelength

The wavelength of a wave is equal to the velocity divided by the frequency.

$$\lambda = \frac{v}{f}$$

WRITING PART

Q.1 Explain that a net force applied to an object causes the object to accelerate.Combine forces to find the net force acting on an object.Relate the direction of the acceleration to the direction of the net force.Apply Newton's Second Law to solve numerical problems. Student Textbook/ Figure:4 Pg:6 – 14

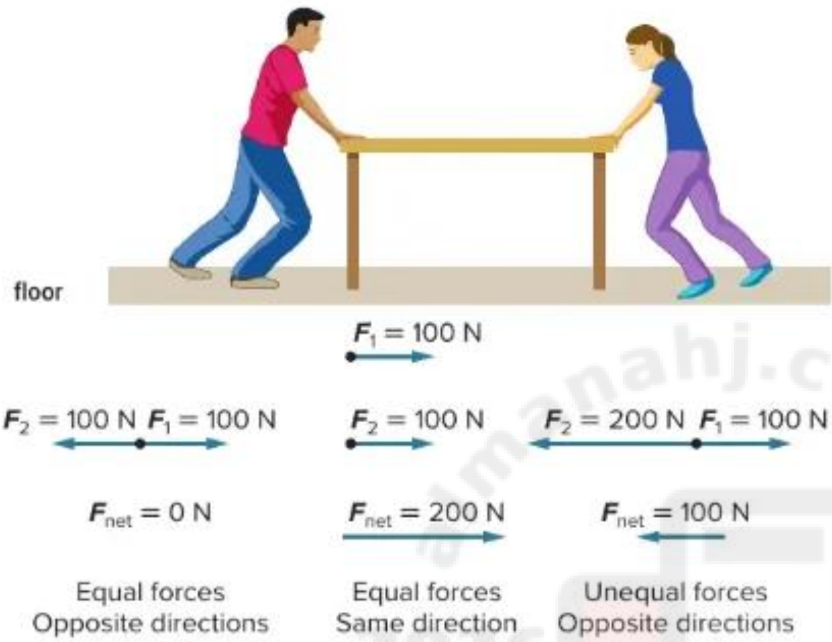
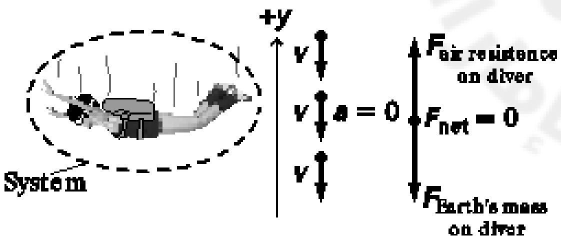
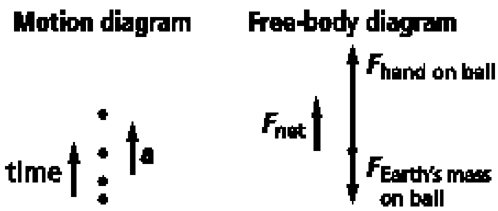


Figure 4 The net force acting on the table is the vector sum of all the forces acting on the table. This case only considers the horizontal forces acting on the table.

1. A skydiver falls downward through the air at constant velocity. (The air exerts an upward force on the person.)

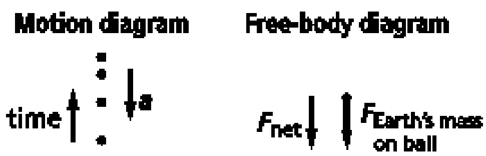


2. You hold a softball in the palm of your hand and toss it up. Draw the diagrams while the ball is still touching your hand.



3. After the softball leaves your hand, it rises, slowing down.

4. After the softball reaches its maximum height, it falls down, speeding up.



5. **CHALLENGE** You catch the ball in your hand and bring it to rest.

Newton's second law states that the acceleration of an object is proportional to the net force and inversely proportional to the mass of the object being accelerated. This law is based on observations of how forces affect masses and is represented by the following equation. Newton's second law accurately predicts changes in the motion of macroscopic objects.

Newton's Second Law

The acceleration of an object is equal to the sum of the forces acting on the object divided by the mass of the object.

$$a = \frac{F_{net}}{m}$$

Solving problems using Newton's second law One of the most important steps in correctly applying Newton's second law is determining the net force acting on the object. Often, more than one force acts on an object, so you must add the force vectors to determine the net force. Draw a free-body diagram showing the direction and relative strength of each force acting on the system. Then, add the force vectors to find the net force. Next, use Newton's second law to calculate the acceleration. Finally, if necessary, you can use what you know about accelerated motion to find the velocity or position of the object.

6. Two horizontal forces, 225 N and 165 N, are exerted on a canoe. If these forces are applied in the same direction, find the net horizontal force on the canoe.

   $F_{net} = 225\ \text{N} + 165\ \text{N} = 3.90 \times 10^2\ \text{N}$
   in the direction of the two forces

7. If the same two forces as in the previous problem are exerted on the canoe in opposite directions, what is the net horizontal force on the canoe? Be sure to indicate the direction of the net force.

   $F_{net} = 225\ \text{N} - 165\ \text{N} = 6.0 \times 10^1\ \text{N}$
   in the direction of the larger force

8. **CHALLENGE** Three confused sled dogs are trying to pull a sled across the Alaskan snow. Alutia pulls east with a force of 35 N, Seward also pulls east but with a force of 42 N, and big Kodiak pulls west with a force of 53 N. What is the net force on the
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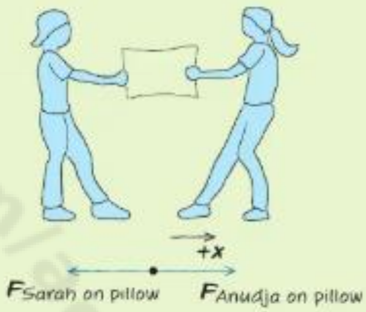
ne sled

EXAMPLE Problem 1

FIGHTING OVER A PILLOW Anudja is holding a pillow with a mass of 0.30 kg when Sarah decides that she wants it and tries to pull it away from Anudja. If Sarah pulls horizontally on the pillow with a force of 10.0 N and Anudja pulls with a horizontal force of 11.0 N, what is the horizontal acceleration of the pillow?

1 ANALYZE AND SKETCH THE PROBLEM

- Sketch the situation.
- Identify the pillow as the system, and the direction in which Anudja pulls as positive.
- Draw the free-body diagram. Label the forces.



KNOWN	UNKNOWN
$m = 0.30$ kg	$a = ?$
$F_{\text{Anudja on pillow}} = 11.0$ N	
$F_{\text{Sarah on pillow}} = 10.0$ N	

2 SOLVE FOR THE UNKNOWN

$$F_{\text{net}} = F_{\text{Anudja on pillow}} + (-F_{\text{Sarah on pillow}})$$

Use Newton's second law.

$$a = \frac{F_{\text{net}}}{m}$$

$$= \frac{F_{\text{Anudja on pillow}} + (-F_{\text{Sarah on pillow}})}{m}$$

$$= \frac{11.0\text{ N} - 10.0\text{ N}}{0.30\text{ kg}}$$ Substitute $F_{\text{Anudja on pillow}} = 11.0$ N, $F_{\text{Sarah on pillow}} = 10.0$ N, $m = 0.30$ kg.

$$= 3.3\text{ m/s}^2$$

$\boldsymbol{a} = 3.3\text{ m/s}^2$ toward Anudja

3 EVALUATE THE ANSWER

- **Are the units correct?** m/s² is the correct unit for acceleration.
- **Does the sign make sense?** The acceleration is toward Anudja because Anudja is pulling toward herself with a greater force than Sarah is pulling in the opposite direction.
- **Is the magnitude realistic?** The net force is 1 N and the mass is 0.3 kg, so the acceleration is realistic.

9. A spring scale is used to exert a net force of 2.7 N on a cart. If the cart's mass is 0.64 kg, what is the cart's acceleration?

$$F_{net} = ma$$

$$a = \frac{F_{net}}{m} = \frac{2.7\ \text{N}}{0.64\ \text{kg}} = 4.2\ \text{m/s}^2$$

10. Kamaria is learning how to ice skate. She wants her mother to pull her along so that she has an acceleration of 0.80 m/s^2. If Kamaria's mass is 27.2 kg, with what force does her mother need to pull her? (Neglect any resistance between the ice and Kamaria's skates.)

$$F_{net} = ma = (27.2\ \text{kg})(0.80\ \text{m/s}^2) = 22\ \text{N}$$

11. **CHALLENGE** Two horizontal forces are exerted on a large crate. The first force is 317 N to the right. The second force is 173 N to the left.

a. Draw a force diagram for the horizontal forces acting on the crate.

b. What is the net force acting on the crate?

$$F_{net} = F_{right} - F_{left} = 317\ \text{N} - 173\ \text{N} = 144\ \text{N}$$

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12. **Forces** Identify each of the following as either **a, b,** or **c:** mass, inertia, the push of a hand, friction, air resistance, spring force, gravity, and acceleration.

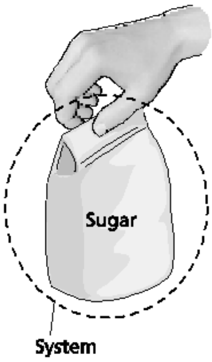
a. a contact force

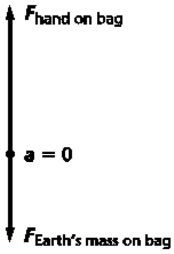
b. a field force

c. not a force

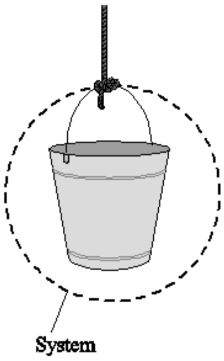
mass (c), inertia (c), push of a hand (a), friction (a), air resistance (a), spring force (a), gravity (b), acceleration (c)

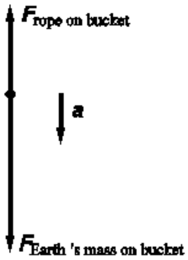
13. **Free-Body Diagram** Draw a free-body diagram of a bag of sugar being lifted by your hand at an increasing speed. Specifically identify the system. Use subscripts to label all forces with their agents. Remember to make the arrows the correct lengths.





14. **Free-Body Diagram** Draw a free-body diagram of a water bucket being lifted by a rope at a decreasing speed. Specifically identify the system. Label all forces with their agents and make the arrows the correct lengths.





15. Critical Thinking A force of 1 N is the only horizontal force exerted on a block, and the horizontal acceleration of the block is measured. When the same horizontal force is the only force exerted on a second block, the horizontal acceleration is three times as large. What can you conclude about the masses of the two blocks?

Answer: Because m = F/a and the forces are the same, the mass of the second block is one-third the mass of the first.

16. You place a 4.0-kg watermelon on a spring scale that measures in newtons. What is the scale's reading?

The scale reads the weight of the watermelon:

$F_g = mg = (4.0\text{ kg})(9.8\text{ N/kg}) = 39\text{ N}$

17. You place a 22.50-kg television on a spring scale. If the scale reads 235.2 N, what is the gravitational field?

$F_g = mg$

$$g = \frac{F_g}{m}$$

$$= \frac{235.2\text{ N}}{22.50\text{ kg}}$$

$$= 10.5\text{ N/kg}$$

18. A 0.50-kg guinea pig is lifted up from the ground. What is the smallest force needed to lift it? Describe the particular motion resulting from this minimum force.

$F_{\text{lift}} = F_g$

$= mg$

$= (0.50\text{ kg})(9.8\text{ N/kg})$

$= 4.9\text{ N}$

It would move at a constant speed.

19. **CHALLENGE** A grocery sack can withstand a maximum of 230 N before it rips. Will a bag holding 15 kg of groceries that is lifted from the checkout counter at an acceleration of 7.0 m/s² hold?

Use Newton's second law $F_{net} = ma$. If $F_{\text{bag on groceries}} > 230$ N, then the bag rips.

$F_{net} = F_{\text{bag on groceries}} + F_g$

$F_{\text{bag on groceries}} = F_{net} - F_g$

$= (15\text{ kg})(7.0\text{ m/s}^2)$

$- (15\text{ kg})(-9.8\text{ N/kg})$

$= 105\text{ N} + 147\text{ N}$

$= 252\text{ N}$

The bag does not hold.

Q.2 Apply the relationships that relate the normal force to maximum static friction and to kinetic friction to calculate unknown parameters like friction force, coefficient of friction or the normal force.Solve problems related to friction. Student Textbook/ Example Problem:3 Pg:38 – 40/41

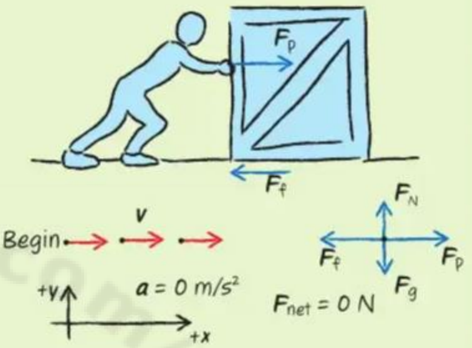
Information from Pgs 38-40 is already summarized MCQ section.

EXAMPLE Problem 3

BALANCED FRICTION FORCES You push a 25.0-kg wooden box across a wooden floor at a constant speed of 1.0 m/s. The coefficient of kinetic friction is 0.20. How large is the force that you exert on the box?

1 ANALYZE AND SKETCH THE PROBLEM

- Identify the forces, and establish a coordinate system.
- Draw a motion diagram indicating constant v and $a = 0$.
- Draw the free-body diagram.



Known		Unknown
$m = 25.0$ kg	$v = 1.0$ m/s	$F_{\text{person on box}} = ?$
$a = 0.0$ m/s²	$\mu_k = 0.20$	

2 SOLVE FOR THE UNKNOWN

The normal force is in the y-direction, and the box does not accelerate in that direction.

$$F_N = -F_g$$
$$= -mg \quad \text{Substitute } F_g = -mg$$
$$= -(25.0\text{ kg})(-9.8\text{ N/kg}) \quad \text{Substitute } m = 25.0\text{ kg},\ g = -9.8\text{ N/kg}$$
$$= +245\text{ N}$$

The pushing force is in the x-direction; v is constant; thus the box does not accelerate.

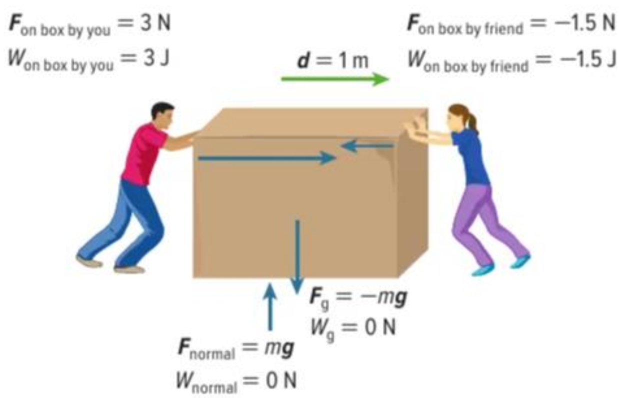
$$F_{\text{person on box}} = \mu_k F_N$$
$$= (0.20)(245\text{ N}) \quad \text{Substitute } \mu_k = 0.20,\ F_N = 245\text{ N}$$
$$= 49\text{ N}$$
$$F_{\text{person on box}} = 49\text{ N, to the right}$$

3 EVALUATE THE ANSWER

- **Are the units correct?** Force is measured in newtons.
- **Do the signs make sense?** The positive sign agrees with the sketch.
- **Is the magnitude realistic?** The pushing force is $\frac{1}{5}$ the weight of the box. This corresponds with $\mu_k = 0.20 = \frac{1}{5}$.

Q.3 Apply the relationships that relate the normal force to maximum static friction and to kinetic friction to calculate unknown parameters like friction force, coefficient of friction or the normal force.Solve problems related to friction. Student Textbook/ Example Problem:3 Pg:38 – 40/41

Information from Pgs 55, 57 & 63 is already summarized MCQ section.



The total work done on the box is

$$W = F_{\text{on box by you}}d - F_{\text{on box by friend}}d.$$

Q.4 Define periodic motion and the quantities associated with it like period, wave length and amplitude.Relate the period of a wave to its frequency.Relate the wavelength of a wave to its speed and frequency in a medium.Use the wave equation to solve related numerical problems.
Student Textbook/ Figure:10 Pg:98, 104-107/107

Information from Pgs 98, 104-107 is already summarized MCQ section.

Graphing waves If you took a snapshot of a transverse wave on a coiled spring toy, it might look like one of the waves shown in **Figure 9.** This snapshot could be placed on a graph grid to show more information about the wave, as in the left panel of **Figure 10.** Measuring from peak to peak or trough to trough on such a snapshot provides the wavelength. Now consider recording the motion of a single particle, such as point P in **Figure 9.** That motion can be plotted on a displacement v. time graph, as in the graph on the right in **Figure 10.** Measuring from peak to peak or trough to trough in this graph provides the wave's period.

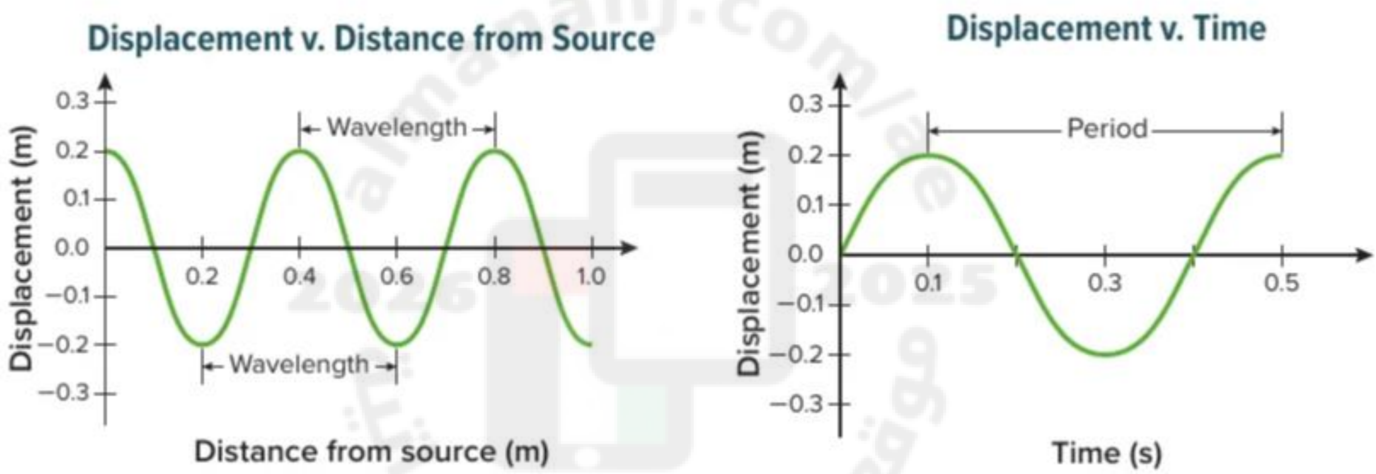


Figure 10 Graphing waves on different axes provides different kinds of information.
Determine *the period of the wave shown in the displacement v. time graph.*

---------------------- All The Best ----------------