

End of Term 3 Coverage - Earth's Rotation and Circular Motion



تم تحميل هذا الملف من موقع المناهج الإماراتية

موقع المناهج ← المناهج الإماراتية ← الصف الحادي عشر المتقدم ← فيزياء ← الفصل الثالث ← ملفات متنوعة ← الملف

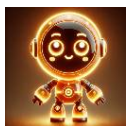
تاريخ إضافة الملف على موقع المناهج: 2026-06-25 11:06:41

ملفات اكتب للمعلم اكتب للطالب | اختبارات الكترونية | اختبارات | حلول | عروض بوربوينت | أوراق عمل
منهج انجليزي | ملخصات وتقارير | مذكرات وبنوك | الامتحان النهائي | للمدرس

المزيد من مادة
فيزياء:

إعداد: عبدالرحمن عصام عيد

التواصل الاجتماعي بحسب الصف الحادي عشر المتقدم



صفحة المناهج
الإماراتية على
فيسبوك

الرياضيات

اللغة الانجليزية

اللغة العربية

التربية الاسلامية

المواد على تلغرام

المزيد من الملفات بحسب الصف الحادي عشر المتقدم والمادة فيزياء في الفصل الثالث

BE READY END OF TERM 3 REVISION - ANSWERS PHYSICS

1

كن مستعدا مراجعة نهاية الفصل 2026م

2

مراجعة هيكل الامتحان كراسة تدريبية

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Einstein_AE PHYSICS END OF TERM 3 COVERAGE

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هيكل اختبار الفيزياء

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EARTH'S ROTATION

DIRECTION AND SIGN

1. VIEW FROM ABOVE THE NORTH POLE



Direction:
When viewed from above the North Pole, Earth rotates **counter-clockwise** from west to east.



Sign:
In physics and mathematics, counter-clockwise is the **positive direction (+)**

2. VIEW FROM ABOVE THE SOUTH POLE



Direction:
When viewed from above the South Pole, the rotation appears **clockwise**.



Sign:
Clockwise is the **negative direction (-)**

It is known that the Earth rotates about its axis.

What **angle** does the Earth rotate through in **6 hours**, as viewed from above the **North Pole**?

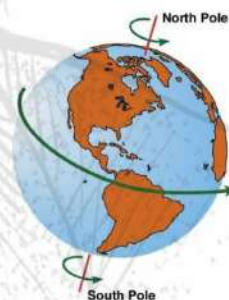
- Ⓐ $-\frac{\pi}{2}$ rad
- Ⓑ $+\frac{\pi}{2}$ rad
- Ⓒ $-\frac{\pi}{6}$ rad
- Ⓓ $+\frac{\pi}{6}$ rad



It is known that the Earth rotates about its axis.

What **angle** does the Earth rotate through in **12 hours**, as viewed from above the **South Pole**?

- Ⓐ $-\pi$ rad
- Ⓑ $+\pi$ rad
- Ⓒ $-\frac{\pi}{2}$ rad
- Ⓓ $+\frac{\pi}{2}$ rad



One radian is approximately equal to:

- Ⓐ 180°
- Ⓑ 90°
- Ⓒ 57.3°
- Ⓓ 360°

A wheel with a radius of 50 cm is rotating. If the wheel completes two full revolutions, how many **radians** has it turned through?

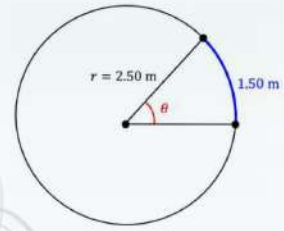
- Ⓐ 4π radians
- Ⓑ 2π radians
- Ⓒ π radians
- Ⓓ 3π radians

A wheel is rotated so that a point on the edge moves through **1.50 m**.

The **radius** of the wheel is **2.50 m**.

What angle, in **radians**, is the wheel rotated?

- (a) 0.60 rad (b) 1.50 rad (c) 2.50 rad (d) 4.00 rad



A steering wheel is rotated through **128°**.

Its **radius** is **22 cm**.

How far would a point on the steering wheel's edge move?

- (a) 24 cm (b) 49 cm (c) 56 cm (d) 128 cm

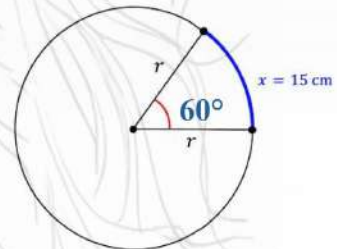


A steering wheel is rotated through **60°**.

A point on its edge moves through an **arc length** of **15 cm**.

What is the **radius** of the steering wheel?

- (a) 18 cm (b) 22 cm (c) 26 cm (d) 30 cm



A rotating toy above a crib makes one complete counterclockwise rotation in 1 min.

What is its **angular velocity** in **rad/min**?

- (a) $+2\pi$ rad/min (b) $+4\pi$ rad/min (c) -2π rad/min (d) -4π rad/min

A rotating toy above a crib makes one complete counterclockwise rotation in 1 min.

What is its **angular displacement** in 3 min?

- (a) $+2\pi$ rad (b) $+4\pi$ rad (c) $+6\pi$ rad (d) $+8\pi$ rad

A motor rotates at **5000 rpm**. What is its **angular speed** in **rad/s**?

- (a) 524 rad/s (b) 420 rad/s (c) 240 rad/s (d) 120 rad/s

A record rotates clockwise at **33.3 rev/min**. What is its **angular velocity** in **rad/s**?

- (a) $+3.49$ rad/s (b) -3.49 rad/s (c) $+0.29$ rad/s (d) -0.29 rad/s

An object completes one full revolution in 2 s. What is its **angular velocity**?

- (a) $+\pi$ rad/s (b) $-\pi$ rad/s (c) $+2\pi$ rad/s (d) -2π rad/s

The minute hand of a clock completes one full revolution in 1 h.

What is its **angular displacement** after 1 h?

- (a) $+2\pi$ rad (b) -2π rad (c) $+\pi$ rad (d) $-\pi$ rad



A blender blade accelerates from rest to 9000 rev/min in 4.5 s.

What is the **angular acceleration** of the blade in rad/s²?

- Ⓐ 209 rad/s² Ⓑ 12.6 rad/s² Ⓒ 2000 rad/s² Ⓓ 756 rad/s²

The Ferris wheel shown rotates clockwise and completes one full revolution every 8.0 s.

What is its **angular velocity**?

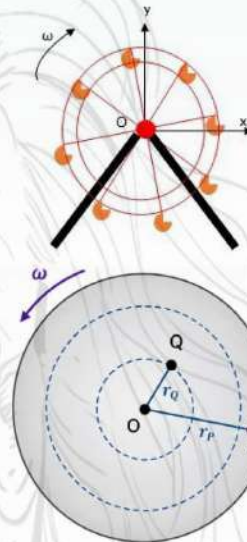
- Ⓐ $+\frac{\pi}{4}$ rad/s Ⓑ $-\frac{\pi}{4}$ rad/s Ⓒ $+\frac{\pi}{2}$ rad/s Ⓓ $-\frac{\pi}{2}$ rad/s

Two points are located on the same rotating disk.

Point P is farther from the center than point Q.

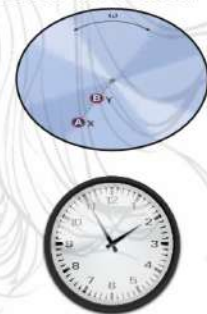
Which statement is correct?

- | | Linear Speed | Angular Speed |
|---|--------------|-----------------------|
| Ⓐ | $v_P > v_Q$ | $\omega_P > \omega_Q$ |
| Ⓑ | $v_P > v_Q$ | $\omega_P = \omega_Q$ |
| Ⓒ | $v_P = v_Q$ | $\omega_P > \omega_Q$ |
| Ⓓ | $v_P = v_Q$ | $\omega_P = \omega_Q$ |



The figure shows a rotating disk with two points located at different distances from the center. How can the **angular velocities** of the two points be compared?

- Ⓐ Point B has greater angular velocity
 Ⓑ Point A has greater angular velocity
 Ⓒ Both angular velocities are zero
 Ⓓ Both angular velocities are equal and nonzero



In a clock, all parts of the minute hand are equal in:

- Ⓐ Linear speed Ⓑ Angular speed Ⓒ Linear displacement Ⓓ Tangential acceleration

CD rotates at an angular velocity of 50 rad/s. A point on the edge of the CD is 0.060 m from the center. What is the **linear velocity** of the point?

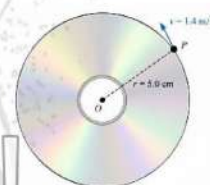
- Ⓐ 1.5 m/s Ⓑ 3.0 m/s Ⓒ 6.0 m/s Ⓓ 12.0 m/s



A CD-ROM rotates so that a point P on the track moves with a constant linear velocity of 1.4 m/s. As shown, point P is 5.0 cm from the center of the disc.

What is the **angular velocity** of the CD-ROM?

- Ⓐ 14 rad/s Ⓑ 28 rad/s Ⓒ 42 rad/s Ⓓ 56 rad/s



An automobile wheel has a radius of 9.00 cm. A point P is located 7.00 cm from the center of the wheel, as shown. The wheel rotates with an angular velocity of 2.50 rad/s.

What is the **linear velocity** of point P?

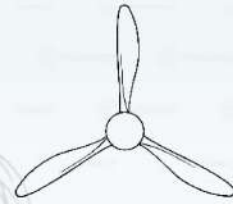
- Ⓐ 7.0 cm/s Ⓑ 15.0 cm/s Ⓒ 17.5 cm/s Ⓓ 22.5 cm/s



A propeller spins at 1880 rev/min.

What is its **angular velocity** in rad/s?

- Ⓐ 98.5 rad/s Ⓑ 157 rad/s Ⓒ 197 rad/s Ⓓ 314 rad/s



A clothes washer drum rotates at an angular speed of 635 rev/min. When the lid is opened, the motor is switched off and the drum comes to rest in 8.0 s.

What is the **angular acceleration** of the drum?

- Ⓐ +8.3 rad/s² Ⓑ -8.3 rad/s² Ⓒ +4.2 rad/s² Ⓓ -4.2 rad/s²



A centrifuge rotor starts from rest and reaches 20,000 rev/min in 30 s.

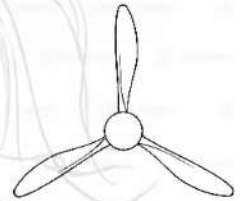
What is the **average angular acceleration** of the rotor?

- Ⓐ 70 rad/s² Ⓑ 111 rad/s² Ⓒ 333 rad/s² Ⓓ 2100 rad/s²

A propeller slows uniformly from 475 rev/min to 187 rev/min in 4.00 s.

What is the **angular acceleration** of the propeller?

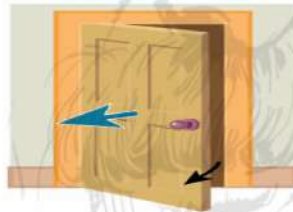
- Ⓐ -7.54 rad/s² Ⓑ -4.80 rad/s² Ⓒ +7.54 rad/s² Ⓓ +4.80 rad/s²



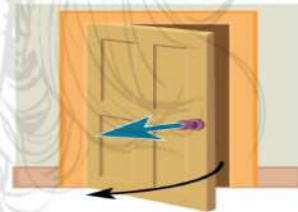
No effect



Some effect



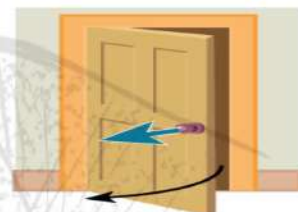
Maximum effect



No effect



Some effect



Maximum effect

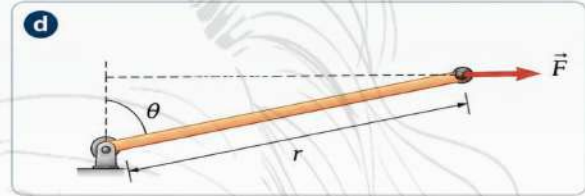
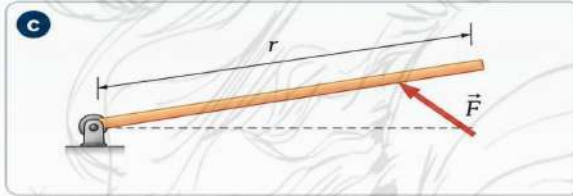
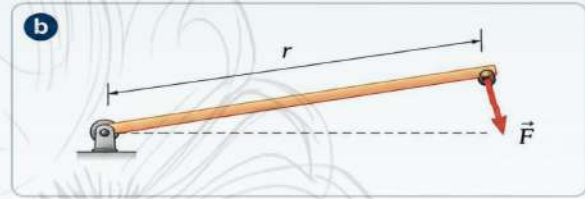
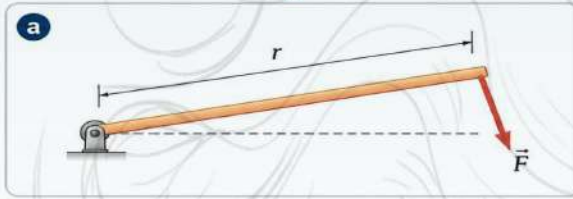
Which of the shapes shown (A–D) produces **the least torque** when the same force is applied at the point indicated on each door?



- Ⓐ (C) & (D) Ⓑ (A) & (C) Ⓒ (B) & (C) Ⓓ (A) & (D)

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The door that has **the greatest** torque on is



(a) a

(b) b

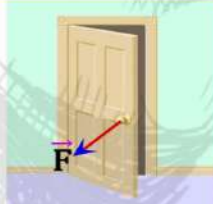
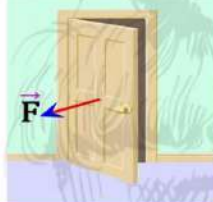
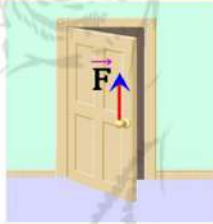
(c) c

(d) d



When a person opens a door, a force $\vec{F}$ is applied to the door producing a torque (τ) about the hinges.

Which of the following situations results in **zero torque** and therefore does not help open the door?



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A force F is applied to a door in six different ways, as shown.

For which pair of positions is the **torque about the hinge** equal to zero?

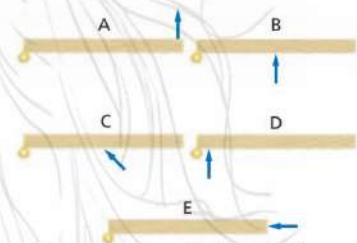
- Ⓐ 1 & 4
- Ⓑ 2 & 3
- Ⓒ 5 & 6
- Ⓓ 2 & 5



The figure shows five doors subjected to forces of equal magnitude.

Which of the following correctly ranks the **torques about the hinge** from **least to greatest**?

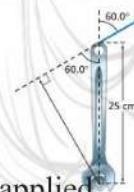
- Ⓐ $E < D < C < B < A$
- Ⓑ $E < C < D < B < A$
- Ⓒ $C < D < E < B < A$
- Ⓓ $E < D < B < A < C$



A bolt on a car engine must be tightened with a torque of $35 \text{ N}\cdot\text{m}$. A **25-cm wrench** is used, and the force is applied at an angle of 60° to the wrench handle.

What magnitude of **force** must be exerted?

- Ⓐ 81 N
- Ⓑ 108 N
- Ⓒ 162 N
- Ⓓ 280 N



A wrench is used to tighten a bolt with a torque of $40 \text{ N}\cdot\text{m}$. The force is applied **perpendicular** to the **0.25 m** wrench.

What force is required? Ⓐ 80 N Ⓑ 120 N Ⓒ 160 N Ⓓ 200 N



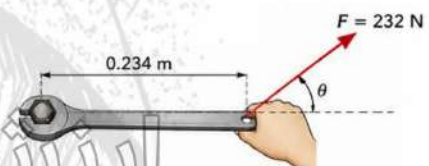
A torque of $55.0 \text{ N}\cdot\text{m}$ is required to turn a bolt. The maximum force that can be exerted is **135 N**. What is the **minimum lever arm length** required?

- Ⓐ 0.22 m
- Ⓑ 0.41 m
- Ⓒ 0.55 m
- Ⓓ 0.74 m



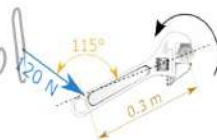
A mechanic uses a **0.234 m** wrench to apply a force of **232 N**. A torque of $32.4 \text{ N}\cdot\text{m}$ is required. What is the **smallest angle** between the force and the wrench that will produce the required torque?

- Ⓐ 30°
- Ⓑ 37°
- Ⓒ 45°
- Ⓓ 60°



A spanner is used to loosen a bolt, as shown. A force of **120 N** is applied at an angle of 115° to the spanner handle. The distance from the pivot to the point of application is **0.30 m**. What is the **torque** exerted on the bolt?

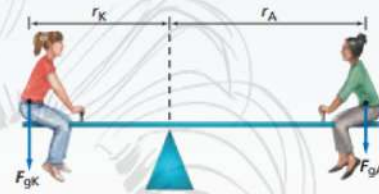
- Ⓐ $32.6 \text{ N}\cdot\text{m}$
- Ⓑ $72.6 \text{ N}\cdot\text{m}$
- Ⓒ $44.8 \text{ N}\cdot\text{m}$
- Ⓓ $55.2 \text{ N}\cdot\text{m}$



A massless seesaw is 1.75 m long. Two students, Karim (56 kg) and Aysha (43 kg), sit on opposite sides of the pivot as shown.

Where should the **pivot** be placed so that the seesaw remains in **rotational equilibrium**?

- Ⓐ 0.75 m from Karim and 1.00 m from Aysha
- Ⓑ 0.85 m from Karim and 0.90 m from Aysha
- Ⓒ 0.99 m from Karim and 0.76 m from Aysha
- Ⓓ 1.10 m from Karim and 0.65 m from Aysha



Fatimah has a **mass of 56 kg**, and Aisha has a **mass of 43 kg**.

Aisha sits **1.5 m** from the pivot.

At what distance should Fatimah sit to **balance the seesaw**?

- Ⓐ 1.5 m
- Ⓑ 0.85 m
- Ⓒ 1.0 m
- Ⓓ 1.15 m

A system consists of **two pulleys** fixed together and rotating about a common axis.

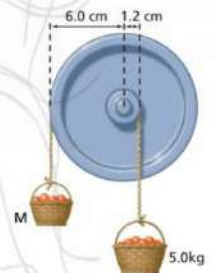
The system is in **equilibrium**.

The right bucket has a **mass of 5.0 kg** and hangs at a **radius of 1.2 cm**.

The left bucket has an unknown **mass M** and hangs at a **radius of 6.0 cm**.

What is the value of **mass M**?

- Ⓐ 25 kg
- Ⓑ 5.0 kg
- Ⓒ 2.5 kg
- Ⓓ 1.0 kg



Two **fruit baskets** are suspended from two ropes as shown.

The left basket has **mass m** and hangs **0.28 m** from the support.

The right basket has **mass 0.8 kg** and hangs **0.16 m** from the support.

What value of **m** makes the baskets balance **without rotation**?

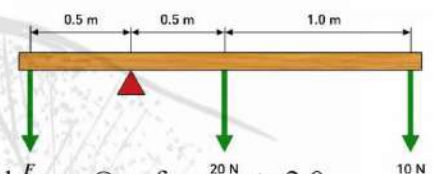
- Ⓐ 1.40 kg
- Ⓑ 0.60 kg
- Ⓒ 0.46 kg
- Ⓓ 1.26 kg



The beam shown in the illustration below is **2.0 m** long and has a weight of **20 N**. It is pivoted as shown. A force **F** acts downward at one end, and a force of **10 N** acts downward at the other end.

What force **F** must be applied downward to balance the beam?

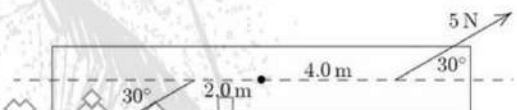
- Ⓐ 25 N
- Ⓑ 40 N
- Ⓒ 50 N
- Ⓓ 75 N



A rod is pivoted about its center. Two forces of 5 N are applied as shown. One force acts 2.0 m from the pivot, and the other acts 4.0 m from the pivot. Each force makes an angle of 30° with the rod.

What is the **net torque** about the pivot?

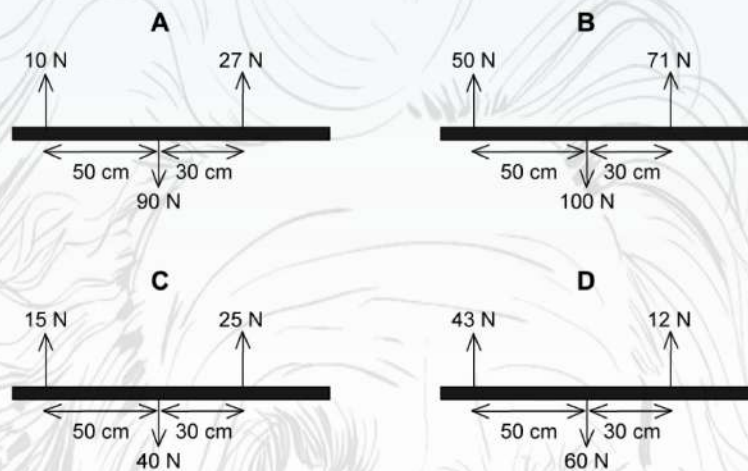
- Ⓐ 15 N·m clockwise
- Ⓑ 15 N·m counterclockwise
- Ⓒ 0 N·m
- Ⓓ 10 N·m clockwise



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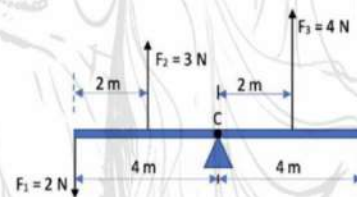
Four beams of the same length each have three forces acting on them and pivot about their center of mass.

Which of the following beams is in **rotational equilibrium**?



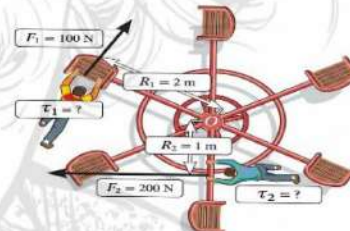
The figure shows a uniform seesaw pivoted at point C. Three forces act on the seesaw as shown. What is **the net torque** about point C, and in which direction will the seesaw rotate?

- Ⓐ 10 N·m counterclockwise
- Ⓑ 10 N·m clockwise
- Ⓒ 0 N·m
- Ⓓ 6 N·m counterclockwise



The figure shows two workers applying forces to a rotating wheel-like device. The forces act perpendicular to the radius. What is the net torque on the system about the axis of rotation and what is the direction of rotation?

- Ⓐ 200 N·m clockwise
- Ⓑ 200 N·m counterclockwise
- Ⓒ 400 N·m clockwise
- Ⓓ 400 N·m counterclockwise



A uniform rod of length **4.0 m** is acted upon by three forces as shown in the figure.

What is the **net torque** on the rod about an axis passing through point C and perpendicular to the page?

- Ⓐ 23.6 N·m, clockwise
- Ⓑ 29.6 N·m, counterclockwise
- Ⓒ 35.6 N·m, counterclockwise
- Ⓓ 42.4 N·m, clockwise



Which of the following physical quantities represents an object's **resistance to rotation**?

- Ⓐ Torque
- Ⓑ Angular acceleration
- Ⓒ Moment of inertia
- Ⓓ Angular momentum

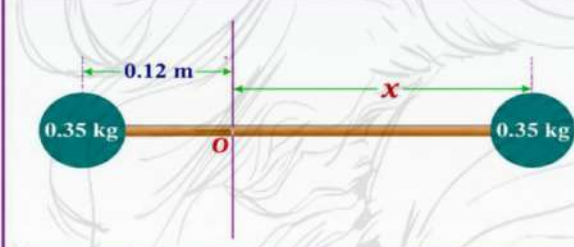
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Two balls, each of mass 0.45 kg , are attached to the ends of a light rod of length 0.46 m , as shown.

What is the **moment of inertia** of the system about the center of the rod?

- Ⓐ $0.024 \text{ kg}\cdot\text{m}^2$ Ⓑ $0.048 \text{ kg}\cdot\text{m}^2$ Ⓒ $0.095 \text{ kg}\cdot\text{m}^2$ Ⓓ $0.190 \text{ kg}\cdot\text{m}^2$



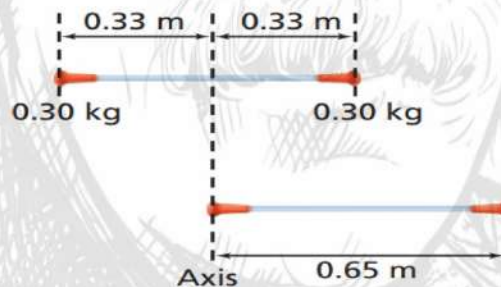


A toy consists of two spheres, each with a mass of 0.35 kg , connected by a light (massless) rod. Two vertical marks are drawn on the figure. The left mark is a distance of 0.12 m from point O . The moment of inertia of the system about the axis perpendicular to the page and passing through O is $0.048 \text{ kg}\cdot\text{m}^2$.

What is the value of x , as shown in the figure?

1.
2.
3.
4.

A simplified model of a **twirling baton** consists of a thin rod with **two round objects** at each end. The **length of the baton** is 0.66 m , and the **mass of each object** is 0.30 kg . Assume the **mass of the rod** is **negligible**.



The baton rotates about an axis passing through the **midpoint between the two masses** and **perpendicular to the rod**.

What is the **moment of inertia** of the baton?

- Ⓐ $0.033 \text{ kg}\cdot\text{m}^2$ Ⓑ $0.066 \text{ kg}\cdot\text{m}^2$ Ⓒ $0.130 \text{ kg}\cdot\text{m}^2$ Ⓓ $0.260 \text{ kg}\cdot\text{m}^2$

The axis of rotation is moved to **one end of the rod**.

What is the **moment of inertia** of the baton?

- Ⓐ $0.033 \text{ kg}\cdot\text{m}^2$ Ⓑ $0.066 \text{ kg}\cdot\text{m}^2$ Ⓒ $0.130 \text{ kg}\cdot\text{m}^2$ Ⓓ $0.260 \text{ kg}\cdot\text{m}^2$

A particle of mass 8.0 kg rotates in a circle of radius 2.0 m about a fixed axis.

What is the **moment of inertia** of the particle about the axis of rotation?

- Ⓐ $16 \text{ kg}\cdot\text{m}^2$ Ⓑ $32 \text{ kg}\cdot\text{m}^2$ Ⓒ $64 \text{ kg}\cdot\text{m}^2$ Ⓓ $128 \text{ kg}\cdot\text{m}^2$

Two children of equal mass sit 0.30 m from the center of a seesaw. They then move to positions 0.60 m from the center. Assume the mass of the seesaw is negligible compared with the mass of the children.

By what factor does the **moment of inertia** of the system increase?

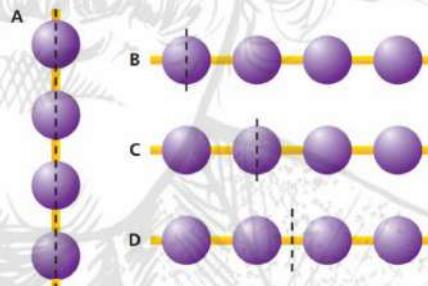
- Ⓐ It doubles Ⓑ It triples Ⓒ It quadruples Ⓓ It remains unchanged

Table: Moments of Inertia of Common Objects

Object	Location of Axis	Diagram	Moment of Inertia
Thin hoop of radius r	through central diameter		mr^2
Solid, uniform cylinder of radius r	through center		$\left(\frac{1}{2}\right)mr^2$
Uniform sphere of radius r	through center		$\left(\frac{2}{5}\right)mr^2$
Long, uniform rod of length l	through center		$\left(\frac{1}{12}\right)ml^2$
Long, uniform rod of length l	through end		$\left(\frac{1}{3}\right)ml^2$
Thin, rectangular plate of length l and width w	through center		$\left(\frac{1}{12}\right)m(l^2 + w^2)$

Four rotating systems **A, B, C, and D** are shown in the figure. Each system consists of **four identical masses** connected by a lightweight rod and rotating about the indicated axis. Based on the distribution of mass relative to the axis of rotation, arrange the systems in order of **increasing moment of inertia**.

- Ⓐ $I_B < I_C < I_D < I_A$
 Ⓑ $I_A < I_D < I_C < I_B$
 Ⓒ $I_C < I_A < I_D < I_B$
 Ⓓ $I_A < I_C < I_D < I_B$



A **thin hoop** and a **solid cylinder** have equal **mass and radius**.

Which has the **greater resistance to rotation**?

- Ⓐ Hoop Ⓑ Cylinder Ⓒ Equal Ⓓ Depends on angular velocity

What is the **moment of inertia** of a **solid uniform cylinder** of mass **m** and radius **r**?

- Ⓐ $I = mr^2$ Ⓑ $I = \frac{1}{2}mr^2$ Ⓒ $I = \frac{2}{5}mr^2$ Ⓓ $I = \frac{1}{12}ml^2$

What is the **moment of inertia** of a **uniform solid sphere**?

- Ⓐ $I = mr^2$ Ⓑ $I = \frac{1}{2}mr^2$ Ⓒ $I = \frac{2}{5}mr^2$ Ⓓ $I = \frac{1}{3}ml^2$

استاذ عبدالرحمن عصام عيد

A **long uniform rod** rotates about its **center**.

Its moment of inertia is:

- (a) $I = 1/12 ml^2$ (b) $I = 1/3 ml^2$ (c) $I = mr^2$ (d) $I = 1/2 mr^2$

A **long uniform rod** rotates about **one end**.

Its moment of inertia is:

- (a) $I = 1/12 ml^2$ (b) $I = 1/3 ml^2$ (c) $I = 2/5 mr^2$ (d) $I = mr^2$

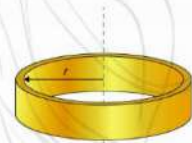
Which object has the **greatest moment of inertia** for the same **mass and radius**?

- (a) Solid sphere (b) Solid cylinder (c) Thin hoop (d) All are equal

A **thin hoop** has a mass of **12.0 kg** and a radius of **3.00 m**.

What is the **moment of inertia** of the hoop about its center of rotation?

- (A) $36 \text{ kg}\cdot\text{m}^2$ (B) $72 \text{ kg}\cdot\text{m}^2$ (C) $108 \text{ kg}\cdot\text{m}^2$ (D) $216 \text{ kg}\cdot\text{m}^2$



A uniform sphere has a radius of 2.0 m. Its moment of inertia about its axis of rotation is $32 \text{ kg}\cdot\text{m}^2$.

Hint:

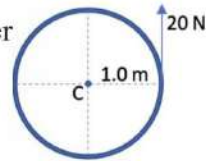
For a uniform sphere: $I = \frac{2}{5} mr^2$ What is the **mass** of the sphere?

- (A) **20 kg** (B) **40 kg** (C) **10 kg** (D) **3.2 kg**

A thin hoop of radius 1.0 m and mass 4.0 kg rotates about an axis passing through its center and perpendicular to its plane. A tangential force of 20 N is applied to the hoop, as shown.

What is the **angular acceleration** of the hoop?

- (A) 10.0 rad/s^2 (B) 3.0 rad/s^2 (C) 5.0 rad/s^2 (D) 8.0 rad/s^2



A rope is wrapped around a pulley and pulled with a constant force of 13.0 N. The pulley has a radius of 0.150 m. If the rotational speed of the pulley increases from rest to 14.0 rev/min in 4.50 s, what is the **moment of inertia** of the pulley?

- (A) $0.10 \text{ kg}\cdot\text{m}^2$ (B) $1.47 \text{ kg}\cdot\text{m}^2$ (C) $5.99 \text{ kg}\cdot\text{m}^2$ (D) $8.78 \text{ kg}\cdot\text{m}^2$

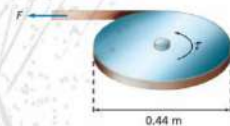
A solid steel wheel with a mass of 15 kg and a diameter of 0.44 m starts rotating from rest about its central axis. A strap is wrapped around the outside of the wheel and used to increase its rotation to 8.0 rev/s in 15 s.

How much **force** must be exerted on the strap?

Hint:

the wheel as a **solid disk**: $I = \frac{1}{2} mr^2$

- (A) 1.22 N (B) 2.78 N (C) 5.55 N (D) 11.1 N



According to Newton's second law for rotational motion:

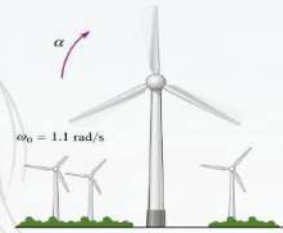
If

then **X** represents:

- (A) Net torque (B) Moment of inertia (C) Angular acceleration (D) Angular velocity

$$\tau_{\text{net}} = IX$$

A wind turbine has blades of radius $r = 37 \text{ m}$ and a moment of inertia of $I = 8.4 \times 10^6 \text{ kgm}^2$. The turbine initially rotates with an angular velocity of $\omega_0 = 1.1 \text{ rad/s}$. As the wind speed increases, the turbine experiences a constant torque of $\tau = 1.6 \times 10^5 \text{ Nm}$. What is the angular velocity ω of the turbine blades after 27 s of wind action?



- (a) 8.4 rad/s
- (b) 0.019 rad/s
- (c) 1.6 rad/s
- (d) 59.2 rad/s

Which of the following statements is NOT true?

- (A) Angular acceleration increases when the torque increases.
- (B) Angular acceleration increases when the moment of inertia decreases.
- (C) Angular acceleration decreases when the moment of inertia increases.
- (D) Angular acceleration decreases when the torque increases.

Which point on an object moves in the same way that a point particle would move?

- (A) The center of mass
- (B) The inertia
- (C) The moment of inertia
- (D) The center of rotation

Center of- Notes

- ◇ **Regular symmetric objects** → is at the **geometric center**.
- ◇ **Irregular objects** → is found by **suspending the object from different points**.
- ◇ **non-uniform objects** → is closer to the **heavier side**.

Which of the following is a condition for **static equilibrium** of an object?

- (A) The net force acting on the object is zero.
- (B) The net torque acting on the object is zero.
- (C) The angular acceleration is zero.
- (D) The angular velocity is constant.

Which of the following is a condition for **rotational equilibrium** of an object?

- (A) The net force acting on the object is zero.
- (B) The net torque acting on the object is zero.
- (C) The linear acceleration is zero.
- (D) The linear velocity is constant.

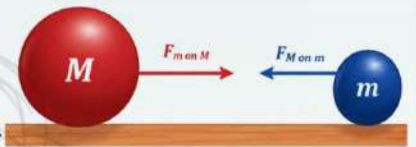
Which of the following is a condition for static equilibrium of an object?

- (A) The object moves with a constant angular acceleration.
- (B) The net torque acting on the object is zero.
- (C) The angular velocity of the object equals its linear velocity.
- (D) The object moves with a constant linear acceleration.

استاذ عبدالرحمن عصام عيد

When two spheres collide, if one of them has more mass than the other, which of the following is correct in terms of the force that each exerts on the other?

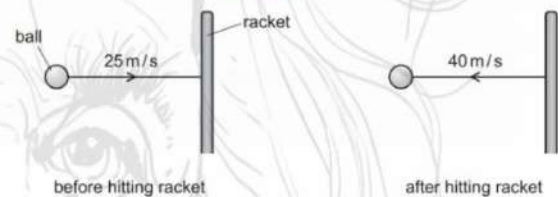
- (a) The larger mass exerts a greater force.
- (b) The forces depend on the velocities of the balls before the collision.
- (c) The smaller mass exerts a greater force.
- (d) The forces are equal in magnitude and opposite in direction.



A tennis ball of mass **0.060 kg** travels horizontally at a speed of **25 m/s**. The ball hits a tennis racket and rebounds horizontally at a speed of **40 m/s**, as shown.

The ball is in contact with the racket for **50 ms**.

What **force** does the racket exert on the ball?



- (a) 78 N
- (b) 18 N
- (c) 0.078 N
- (d) 0.018 N

A ball has a mass of **0.30 kg**. It moves horizontally with a speed of **3.0 m/s** in the direction shown. The ball hits a wall. After hitting the wall, the ball rebounds with a horizontal speed of **2.0 m/s**. What is **the change in momentum of the ball**?

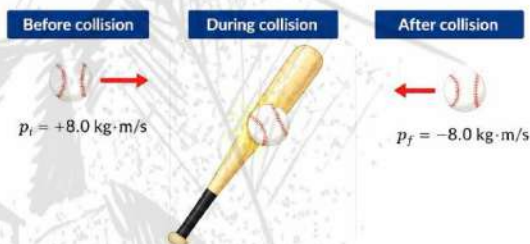
- (a) 0.30 kg m/s
- (b) 1.5 kg m/s
- (c) 1.0 kg m/s
- (d) 5.0 kg m/s



A 0.50 kg ball is moving to the right with a velocity of 8.0 m/s. It strikes a wall and rebounds with the same speed in the opposite direction.

What is the **change in momentum** of the ball?

- (A) 0 kg·m/s
- (B) -4 kg·m/s
- (C) -8 kg·m/s
- (D) 16 kg·m/s



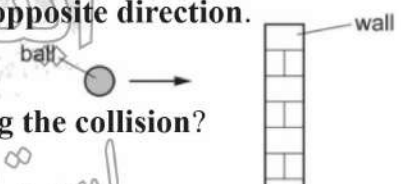
A moving ball with a momentum of **25 kg m/s** collides head-on with a wall, as shown.

The ball rebounds from the wall with the **same speed but in the opposite direction**.

The time of collision is **50 ms**.

What is **the average force** exerted on the wall by the ball during the collision?

- (a) 1000 N
- (b) 500 N
- (c) 1.00 N
- (d) 0.50 N



An object of mass **1.2 kg** is moving with a velocity of **2.0 m/s** when it is acted on by a force of **4.0 N**. The velocity of the object increases to **5.0 m/s**.

For what **period of time** does the force act on the object?

- (a) 3.6 s (b) 1.5 s (c) 1.1 s (d) 0.90 s

A tennis player hits a tennis ball with an average force of 125 N.
The ball remains in contact with the racket for 0.0400 s.
What is **the change in momentum** of the tennis ball?



- (A) 5.00 kg·m/s (B) 4.50 kg·m/s (C) 3.94 kg·m/s (D) 1.30 kg·m/s

A car with a mass of 1100 kg is brought to a stop by a force of 124 N acting for 0.150 s.
What is the **impulse** on the car?

- (A) 18.6 N·s (B) 8.87 N·s (C) 18.6 N·s (D) 827 N·s



The momentum of a **3000 kg** truck is 6.36×10^4 kg m/s

At what speed is the truck traveling?

- (a) 18.2 m/s (b) 21.2 m/s (c) 24.2 m/s (d) 27.2 m/s

A **1300 kg** race car is traveling at **80 m/s**, while a **15,000 kg** truck is traveling at **20 m/s**.
Which object has the greater momentum?

- (a) The race car
(b) The truck
(c) Both have the same momentum
(d) Cannot be determined

A **300 kg** snowmobile is traveling at **30 m/s**.

How fast would a **200 kg** snowmobile need to travel to have the same momentum?

- (a) 30 m/s (b) 40 m/s (c) 45 m/s (d) 60 m/s

A loaded delivery truck has a mass of 5000 kg and is moving at 8 m/s

The truck is unloaded and then travels at 12 m/s

If the truck has the same momentum in each case, what is the mass of the empty truck?

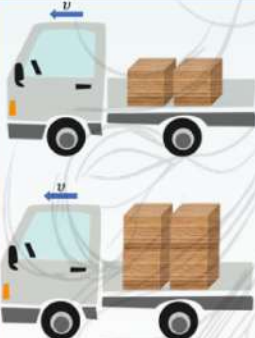
- (a) 2500 kg (b) 3000 kg (c) 3333 kg (d) 3750 kg

A meteor moving through Earth's atmosphere has a momentum of 1.154 kg m/s

As it falls, friction with the atmosphere slows it to $\frac{1}{4}$ of its original speed, while its mass decreases to $\frac{2}{9}$ of its original mass.

What is its new momentum?

- (a) 0.064 kg·m/s (b) 0.128 kg·m/s (c) 0.256 kg·m/s (d) 0.512 kg·m/s



تتحرك عربة بسرعة ثابتة؛ حيث كان مقدار زخمها الخطي يساوي $(12 \text{ kg} \cdot \text{m/s})$. إذا تم إضافة أثقالاً إلى العربة بحيث تضاعفت كتلتها مرتين مع بقاء سرعتها ثابتة. فكم يصبح مقدار زخمها الخطي؟

A cart moves at a constant speed; Its linear momentum was equal to $(12 \text{ kg} \cdot \text{m/s})$. If weights are added to the cart such that its mass is doubled while its velocity remains constant.

What is the **magnitude of its linear momentum**?

$(12 \text{ kg} \cdot \text{m/s})$

$(24 \text{ kg} \cdot \text{m/s})$

$(6 \text{ kg} \cdot \text{m/s})$

To give an answer must know the velocity magnitude

لإعطاء إجابة يجب معرفة مقدار السرعة

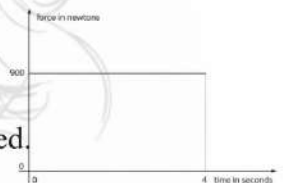
An object of mass 4 kg is initially at rest. A constant force acts on the object over a period of time, as shown in the force–time graph.

What is the magnitude of the change in momentum (Δp) given to the object?

- Ⓐ 225 kg·m/s Ⓑ 900 kg·m/s Ⓒ 3600 kg·m/s Ⓓ 14400 kg·m/s

Determine the final speed (v_f) of the object immediately after the force is applied.

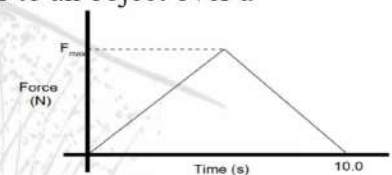
- Ⓐ 225 m/s Ⓑ 900 m/s Ⓒ 1440 m/s Ⓓ 3600 m/s



The graph below shows the result of applying an impulse of 500 kg·m/s to an object over a time interval of 10.0 s.

Determine the maximum force ($F_{\max}$) exerted on the object.

- Ⓐ 25.0 N Ⓑ 50.0 N Ⓒ 100 N Ⓓ 5000 N

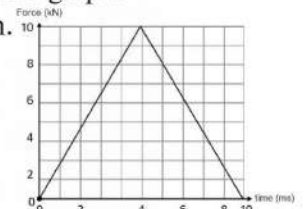


During a crash test, the force acting on a dummy is recorded and displayed on the force–time graph.

Determine the **magnitude of the impulse** given to the dummy during the collision.

- Ⓐ 50 N·s Ⓑ 100 N·s

- Ⓒ 50,000 N·s Ⓓ 100,000 N·s

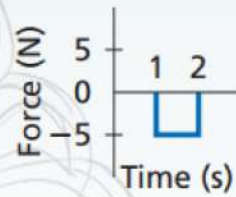


Calculate the **average force** (F_{avg}) exerted on the dummy during the 10 ms collision interval.

- Ⓐ 2.5 kN Ⓑ 5.0 kN Ⓒ 10 kN Ⓓ 50 kN

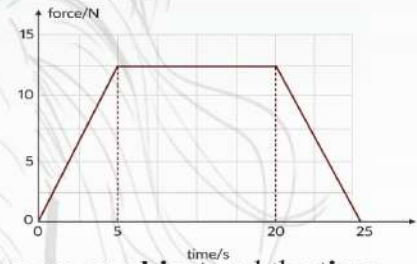
A 7.0 kg bowling ball is moving at 2.0 m/s. A constant force of -5.0 N acts on the ball for 1.0 s. What is the resulting velocity of the ball?

- Ⓐ 0.71 m/s opposite to the original direction
- Ⓑ 1.3 m/s opposite to the original direction
- Ⓒ 1.3 m/s in the same direction as the original direction
- Ⓓ 2.7 m/s in the same direction as the original direction



The sketch graph shows how the force acting on an object varies with time. The mass of the object is 50 kg, and its initial speed is zero. Based on the force-time graph, calculate the final speed of the object at $t = 25$ s.

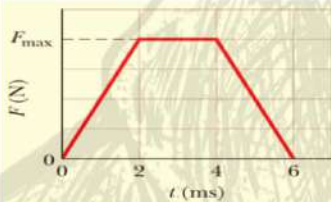
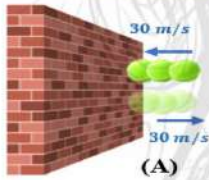
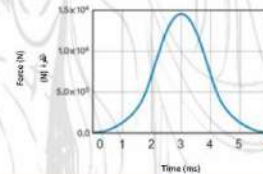
- Ⓐ 2.5 m/s
- Ⓑ 4.5 m/s
- Ⓒ 5.0 m/s
- Ⓓ 225 m/s



The graph below shows the relationship between the force acting on an object and the time interval during which the force acts.

What physical quantity is represented by the area under the force-time graph?

- Ⓐ Impulse
- Ⓑ Momentum
- Ⓒ Torque (Moment of Force)
- Ⓓ Acceleration



(B)

كرة تنس أرضي كتلتها 58 g تصطدم عمودياً بحائط بسرعة مقدارها 30 m/s. فتتد بالسرعة نفسها تقريباً، كما هو موضح بالشكل (A). إن مقدار القوة التي يؤثر بها الجدار على الكرة تستمر في التزايد حتى تصل إلى أقصى قيمة لها F_{max} . تم تمثيل العلاقة بين مقدار القوة F التي أثربها الجدار على الكرة وزمن التأثير (الاصطدام) t بالرسم البياني الموضح بالشكل (B).

ما مقدار أقصى قيمة للقوة التي يؤثر بها الجدار على الكرة F_{max} أثناء الاصطدام؟

A tennis ball with a mass of 58 g collides vertically with a wall at a speed of 30 m/s, and bounces back at approximately the same speed, as shown in Figure (A). The amount of force exerted by the wall on the ball continues to increase until it reaches its maximum value, F_{max} . The relationship between the amount of force exerted by the wall on the ball, F , and the impact (collision) time, t , is represented by a graph shown in Figure (B).

What is the maximum value of the force exerted by the wall on the ball, F_{max} , during the collision?

0 N

435 N

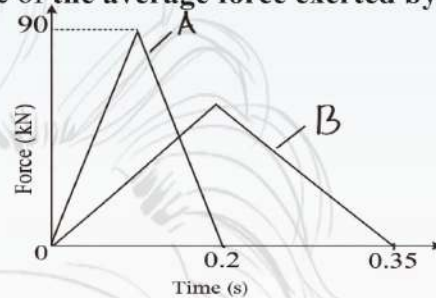
870 N

The force is variable, so the maximum force cannot be found

القوة متغيرة لهذا لا يمكن إيجاد القوة القصوى

During a crash test investigation, two cars, A and B, collide head-on with a wall at the same speed. The change in momentum of car A is equal to the change in momentum of car B. Based on the force–time graph, what is the magnitude of **the average force exerted by the wall on car B?**

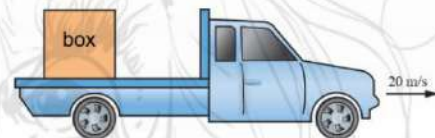
- Ⓐ 25.7 kN
- Ⓑ 45.0 kN
- Ⓒ 51.4 kN
- Ⓓ 90 kN



A box of mass 100 kg is placed on a truck moving eastwards at a constant speed of 20 m/s. The driver applies the brakes, and the truck comes to rest uniformly in 5.0 s from the instant the brakes are applied.

Calculate the **average frictional force** (F_{avg}) acting on the box that is required to prevent it from slipping during this time interval.

- Ⓐ 400 N westwards
- Ⓑ 400 N eastwards
- Ⓒ 2000 N westwards
- Ⓓ 10000 N westwards

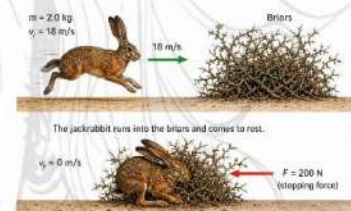


A 2.0 kg jackrabbit is running at a speed of 18 m/s.

It runs into some briars and experiences a constant stopping force of 200 N until it comes to rest.

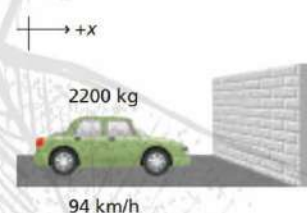
For how **long** does the stopping force act on the jackrabbit?

- Ⓐ 0.18 s
- Ⓑ 0.36 s
- Ⓒ 5.56 s
- Ⓓ 11.1 s



A 2200 kg vehicle is traveling at a speed of **94 km/h**. If the vehicle crashes into a concrete wall and is brought to a complete stop in a time interval of 0.22 s, what is the magnitude of the **average force** exerted on the vehicle during the collision?

- Ⓐ 2.7×10^3 N
- Ⓑ 1.5×10^4 N
- Ⓒ 2.6×10^5 N
- Ⓓ 5.7×10^4 N



Question

Which row correctly describes the changes in the diver's:

- **moment of inertia, and angular velocity**

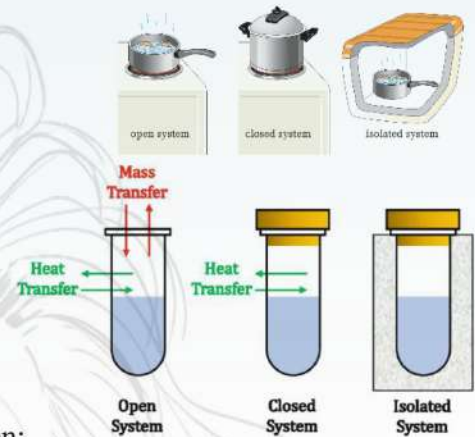
as the diver brings the limbs closer to the body?

	Moment of Inertia	Angular Velocity
A	Increases	Increases
B	Decreases	Increases
C	Increases	Decreases
D	Decreases	Decreases



Types of Systems

- **Isolated System**
 - ❖ No energy or matter enters or leaves
 - ❖ Only internal forces act
- **Closed System**
 - ❖ Energy may transfer
 - ❖ Matter cannot enter or leave
- **Open System**
 - ❖ Both energy and matter can enter or leave

⚠ **Important Note**

You can apply the **law of conservation of momentum** only when:

- The system is **closed**
- The system is **isolated**
- External forces are **negligible**

⚠ **Warning**

Conservation of momentum can ONLY be used in isolated systems.

non-conservative forces such as **friction**, **air resistance**, or **external pushes** must **NOT** be acting on the objects.

Which of the following statements about a **closed system** and an **isolated system** is **incorrect**?

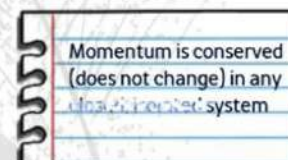
- The momentum of any closed and isolated system remains constant.
- No system on the Earth's surface can be considered completely isolated.
- The net external force acting on an isolated system is not equal to zero.
- A closed system is a system that neither gains nor loses mass.

Mr. Abdulrahman Esam was studying for his Grade 11 Physics final exam. While reviewing the **Law of Conservation of Momentum**, he found that part of his notes was unclear and unreadable, as shown in the figure.

Help Mohammed complete the missing statement and answer the following question:

What is the missing phrase that describes the conditions under which a system's momentum is conserved?

- Closed and isolated
- Closed but not isolated
- Open and isolated
- Open and not isolated



Which type of system allows energy transfer but does not allow matter to enter or leave?

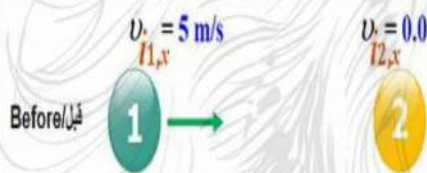
- Isolated System
- Closed System
- Open System
- Uniform System

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A ball of mass **0.16 kg** is moving forwards at a speed of **0.50 m/s**. A second ball, of mass **0.10 kg**, is stationary. The first ball strikes the second ball. The second ball moves forwards at a speed of **0.50 m/s**.

What is the **speed** of the first ball after the collision?

- (a) 0.50 m/s (b) 0.31 m/s (c) 0.19 m/s (d) 0.0 m/s



اصطدمت كرة بلياردو تتحرك بسرعة **5.0 m/s** نحو اليمين بكرة بلياردو مماثلة لها تماماً وساكنة تصادماً تام المرونة. بعد التصادم، أي مما يلي **صحيح**؟

A billiard ball moving with velocity **5.0 m/s** to the right collided with a stationary identical billiard ball in an elastic head-on collision.

After the collision, which of the following is **correct**?

- (a) $v_{f(1,x)} = 0.0 \text{ m/s}$, $v_{f(2,x)} = +5.0 \text{ m/s}$ (b) $v_{f(1,x)} = +5.0 \text{ m/s}$, $v_{f(2,x)} = -5.0 \text{ m/s}$
 (c) $v_{f(1,x)} = -5.0 \text{ m/s}$, $v_{f(2,x)} = 0.0 \text{ m/s}$ (d) $v_{f(1,x)} = -2.5 \text{ m/s}$, $v_{f(2,x)} = +2.5 \text{ m/s}$

Two objects **X** and **Y** move directly towards each other. The objects have the **same mass**.

Object **X** has a velocity of **5.0 m/s to the right**.

Object **Y** has a velocity of **3.0 m/s to the left**.



Objects **X** and **Y** collide and **stick together**.

What is their **velocity after the collision**?

- (a) 4.0 m/s to the right (b) 4.0 m/s to the left (c) 1.0 m/s to the right (d) 1.0 m/s to the left

A car of mass **1000 kg** travelling at **8.0 m/s** collides with a lorry of mass **3000 kg** travelling at **2.0 m/s in the same direction**.

After the collision, the two vehicles stick together.

What is their **speed after the collision**?

- (a) 5.0 m/s (b) 3.5 m/s (c) 2.5 m/s (d) 2.0 m/s

An object of mass **3.0 kg**, travelling at a speed of **6.0 m/s**, collides with an object of mass **2.0 kg**, travelling in the **opposite direction** at a speed of **2.0 m/s**.



The objects stick together during the collision.

What is the **speed and direction** of the combined mass after the collision?

- (a) 2.8 m/s to the right (b) 2.8 m/s to the left (c) 4.4 m/s to the right (d) 4.4 m/s to the left

A bullet of mass **0.10 kg** travels horizontally at a speed of **600 m/s**.

It strikes a **stationary** wooden block of mass **1.90 kg** resting on a **frictionless horizontal surface**. The bullet **stays in the block**.

What is the **speed** of the bullet and the block immediately after the impact?

- (a) 134 m/s (b) 60 m/s (c) 32 m/s (d) 30 m/s

A trolley of mass **4.0 kg** is moving with a velocity of **4.0 m/s**. It collides with another trolley of mass **2.0 kg** that is moving in the **same direction** with a velocity of **2.0 m/s**. After the collision, **the velocity of the 4.0 kg trolley is reduced to 3.0 m/s**.

What is the **velocity** of the **2.0 kg** trolley after the collision?



- (a) 0.25 m/s (b) 4.0 m/s (c) 5.0 m/s (d) 16 m/s

A **2000 kg** car traveling at **20 m/s** toward the east rear-ends a **1000 kg** car traveling at **10 m/s** toward the east.

The two cars stick together after the collision.

What is the speed of the combined cars immediately after the collision?

- (a) 16.7 m/s (b) 15.0 m/s (c) 8.3 m/s (d) 17.3 m/s

استاذ عبدالرحمن عصام عيد



يقفز رجل كتلته (80 kg) ، من قارب ساكن كتلته (400 kg) إلى الشاطئ، فيتحرك القارب مُبتعدًا عن الشاطئ بسرعة أفقية مقدارها (1.0 m/s) .

ما مقدار سرعة حركة الرجل؟ وما اتجاهها؟

A man with a mass of (80 kg) jumps from a stationary boat with a mass of (400 kg) to the shore. The boat moves away from the shore with a horizontal speed of 1.0 m/s .

What is the speed of the man's movement? What is its direction?

0.2 m/s , (Towards the shore نحو الشاطئ)

0.2 m/s , (Away from the shore بعيدًا عن الشاطئ)

5.0 m/s , (Away from the shore بعيدًا عن الشاطئ)

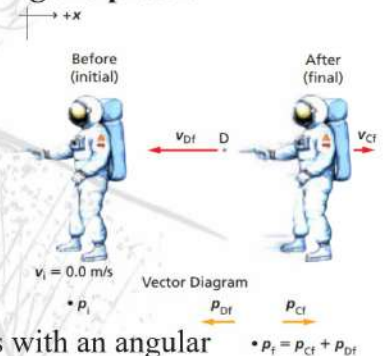
5.0 m/s , (Towards the shore نحو الشاطئ)

An astronaut **at rest** in space fires a thruster pistol that expels a **quick burst of 35 g** of hot gas at a speed of 875 m/s .

The **combined mass** of the astronaut and the pistol is 84 kg .

How fast and in what direction does the astronaut move after firing the pistol?

- (a) 0.36 m/s to the left
- (b) 364.6 m/s to the right
- (c) 364.6 m/s to the left
- (d) 0.36 m/s to the right



A spinning top has a moment of inertia of $2.5 \times 10^{-4} \text{ kg m}^2$ and rotates with an angular velocity of 140 rad/s . What is the angular momentum of the spinning top?

- (A) $0.035 \text{ kg} \cdot \text{m}^2/\text{s}$
- (B) $0.025 \text{ kg} \cdot \text{m}^2/\text{s}$
- (C) $0.015 \text{ kg} \cdot \text{m}^2/\text{s}$
- (D) $0.045 \text{ kg} \cdot \text{m}^2/\text{s}$

A gymnast rotates around a bar with a moment of inertia of 15 kg m^2 and an angular velocity of 6.0 rad/s . When the gymnast dismounts, he tucks his body and reduces his moment of inertia to 3.9 kg m^2 . Assume no external torques act on the gymnast.

What is his angular velocity while in the air?

- (A) 23 rad/s
- (B) 19 rad/s
- (C) 26 rad/s
- (D) 17 rad/s

A closed and isolated ice skater spins with her arms held in.
Her angular momentum is $1.3 \text{ kg m}^2/\text{s}$ and her angular velocity is 3.2 rad/s .
What is her moment of inertia with her arms held in?

- Ⓐ 0.41 kg m^2 Ⓑ 4.0 kg m^2 Ⓒ 0.51 kg m^2 Ⓓ 1.0 kg m^2



A diver turns in the air with a straight body and a moment of inertia of 15.5 kg m^2 .
She then changes to a curved body position with an angular velocity of 12.6 rad/s and a moment of inertia of 3.40 kg m^2 .
What is the diver's angular velocity when her body is straight?

- Ⓐ 0.439 rad/s Ⓑ 12.6 rad/s Ⓒ 2.76 rad/s Ⓓ 42.8 rad/s

An ice skater pulls her arms inward while rotating.

What happens to her moment of inertia and angular velocity?

	Moment of Inertia	Angular Velocity
A	Increases	Increases
B	Increases	Decreases
C	Decreases	Increases
D	Decreases	Decreases



An ice skater is spinning and then extends her arms outward while no external torque acts on her. **What happens to her moment of inertia and angular velocity?**

	Moment of Inertia	Angular Velocity
A	Increases	Increases
B	Increases	Decreases
C	Decreases	Increases
D	Decreases	Decreases



The figure shows an ice skater spinning with his arms **outstretched** in case A and **pulled in above his head** in case B.

Assuming that the skater's **angular momentum remains constant**, which of the following statements is correct regarding the **moment of inertia** and **angular velocity**?

- Ⓐ The angular velocity in case A is less than the angular velocity in case B.
Ⓑ The angular velocity in case A is greater than the angular velocity in case B.
Ⓒ The moment of inertia in case A is equal to the moment of inertia in case B.
Ⓓ The moment of inertia in case A is less than the moment of inertia in case B.



Which of the following statements is **not true** about a rotating object?

- Ⓐ The object's angular velocity remains the same even if the shape of the object changes.
Ⓑ The moment of inertia depends on the object's mass.
Ⓒ The moment of inertia depends on how the object's mass is distributed about the axis of rotation.
Ⓓ The angular velocity of an object can change even when no external torque acts on it.

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