1 Fig. 1 shows the zero error of a micrometer screw gauge.

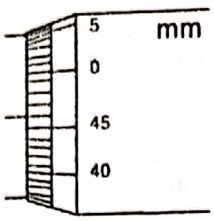


Fig. 1

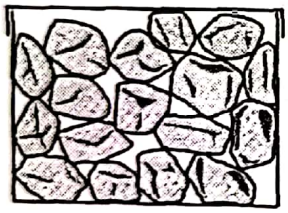
negative zero error
= −0.04 mm
Correction = − (−0.04)
= +0.04 mm

When this micrometer screw gauge is used to take a reading, it must be corrected by

A adding 0.04 mm
B subtracting 0.04 mm
C adding 0.46 mm
D subtracting 0.46 mm

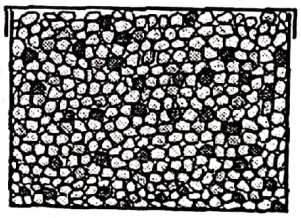
2 A box X full of large granite rocks is weighed. An identical box Y full of small granite chippings is then weighed.

X



large granite rocks

Y



small granite chippings

Granite rocks and chips have the same density
More air = less mass

Which box weighs more and why?

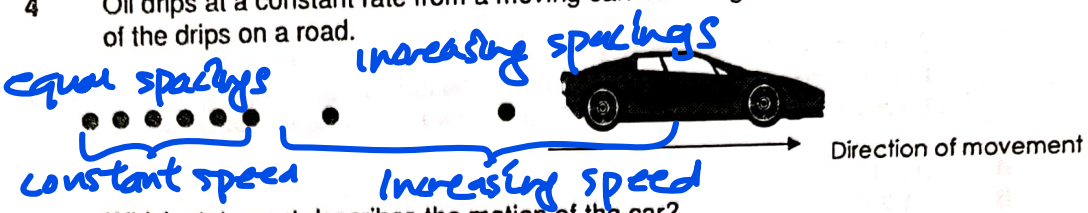
	Heavier Box	Reason
A	X	There is more air in box X
B	X	The density of a chipping is less than a rock
C	Y	There is less air in box Y
D	Y	The density of a chipping is greater than a rock

3 Which of the following is a scalar quantity?

A The braking force needed to stop a car.
B The effort required to lift up a load.
C The work done against friction.
D The upthrust on a floating object.

work done, energy are scalars

4 Oil drips at a constant rate from a moving car. The diagram shows the pattern of the drips on a road.



Which statement describes the motion of the car?

(A) It moved at a steady speed and then accelerated.
B It moved at a steady speed and then decelerated.
C It accelerated and then slowed down.
D It accelerated at a uniform rate.

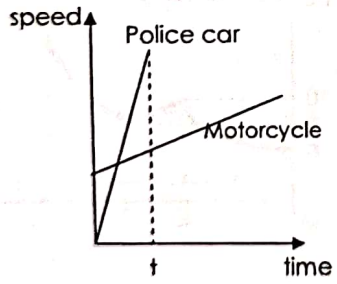
5 A man applied his brake upon seeing the red traffic light at a distance away. His car decelerates uniformly at 0.5 ms^{-2} for first 5 s and then reduces at a rate of 0.8 ms^{-2} for the next 5 s until it comes to a stop. Calculate the initial velocity at which the car is moving before the man sees the red light.

A 2.3 m/s
B 4.0 m/s
(C) 6.5 m/s
D 13.0 m/s

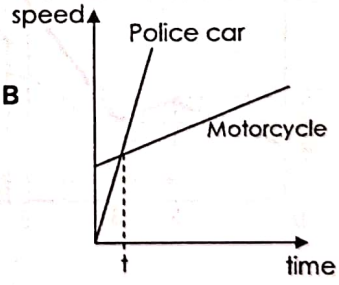
use $v = u + at$
For $a = -0.5\ ms^{-2}$: $v = u + (-0.5)(5) = u - 2.5$ — (1)
For $a = -0.8\ ms^{-2}$: $v_1 = v + at = (u - 2.5) + (-0.8)(5)$
$0 = u - 6.5$
$\therefore u = 6.5\ ms^{-1}$

6 A policeman spots a speeding motorcycle and starts accelerating his car from rest when the motorcycle passes by him. The policeman managed to catch up with the motorcycle after t minutes. Which graph shows the motions of the policeman's car and the motorcycle?

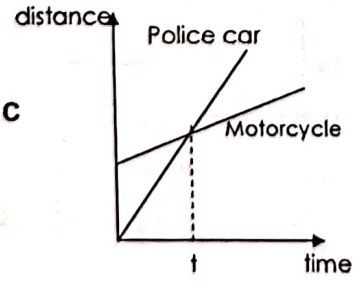
A



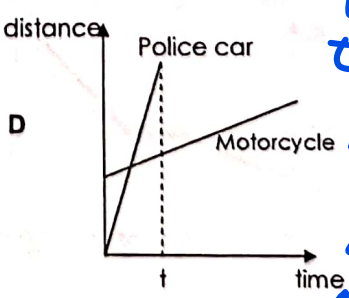
B



C



D

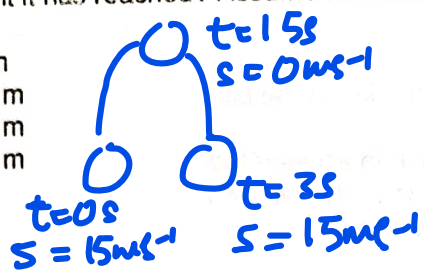


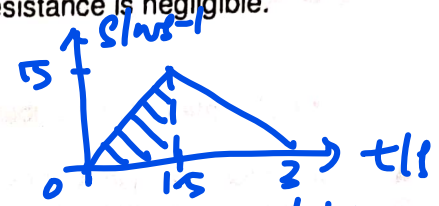
A, B & D all show different distance travelled by police car & motorcycle after t = ts

Assumption: police car accelerates from 0 ms⁻¹ to a constant speed. Motorcycle also moving at a constant speed

7 John threw a ball upwards at a height of x with an initial speed of 15 ms^{-1}. If it took 3 seconds for the ball to return to the original point, what is the maximum height it has reached? Assume that the air resistance is negligible.

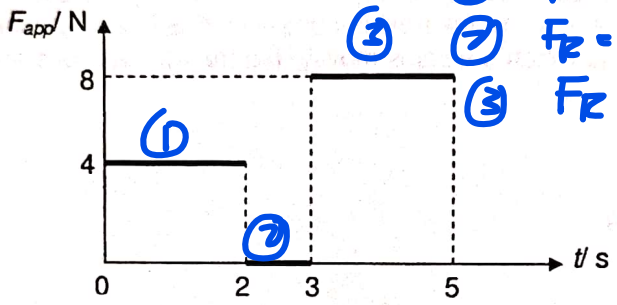
A 0.0 m
B 11.3 m
C 22.5 m
D 45.0 m





Area = $\frac{1}{2}bh$
Height = $\frac{1}{2} \times 15 \times 15 = 11.25$m

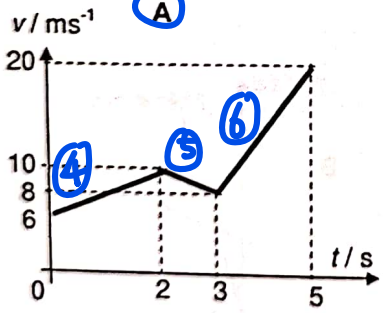
8 The graph below shows the force acting on a 1 kg block of wood which is originally moving at 6 ms^{-1} on a table.



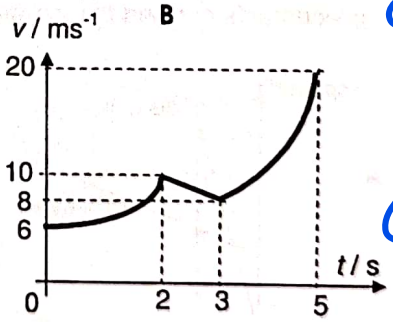
① $F_R = 4-2 = 2N$ (+ve) → +ve & const a
② $F_R = 0-2 = -2N$ (-ve) → -ve & const a
③ $F_R = 8-2 = 6N$ (+ve) → +ve & const a

If the table has a friction of 2 N, what is the velocity-time graph of the wood?

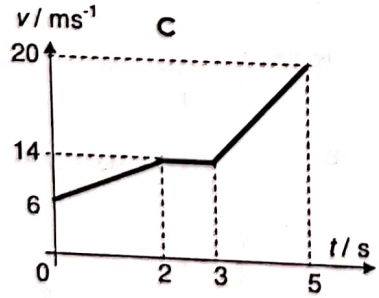
A



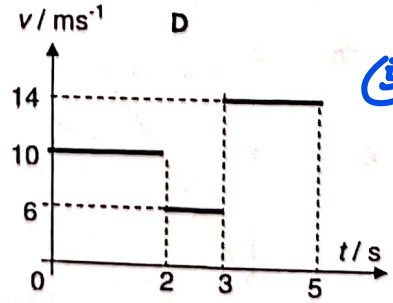
B



C



D



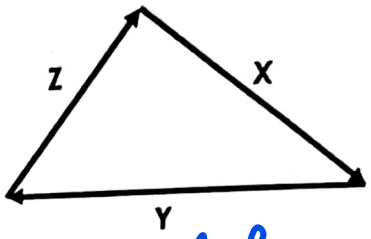
Check Graph A

$F = ma$
$a = \frac{2}{1} = 2ms^{-2}$
④ $a = \frac{10-6}{2-0} = 2ms^{-2}$ ✓

$F = ma$
$a = \frac{-2}{1} = -2ms^{-2}$
⑤ $a = \frac{8-10}{3-2} = -2ms^{-2}$ ✓

$F = ma$
$a = \frac{6}{1} = 6ms^{-2}$
⑥ $a = \frac{20-8}{5-3} = 6ms^{-2}$ ✓

9 The vector diagram shown below represents three forces X, Y and Z, acting on the same point of an object at rest.

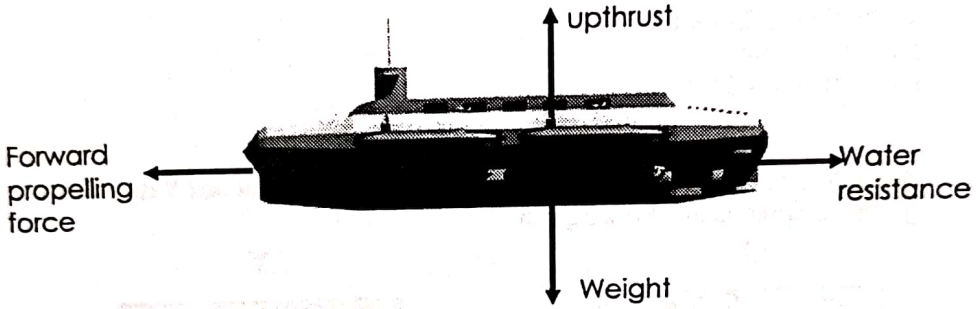


Which of the following concludes about the subsequent motion of the object?

(A) The object will not move.
B The object will rotate clockwise.
C The object will move upwards.
D The object will move in the direction of Z.

Direction of force vectors are continuous and vector triangle is closed
No resultant force

10 A submarine is moving at constant speed through the water at constant depth. It is being acted on by four forces as shown.

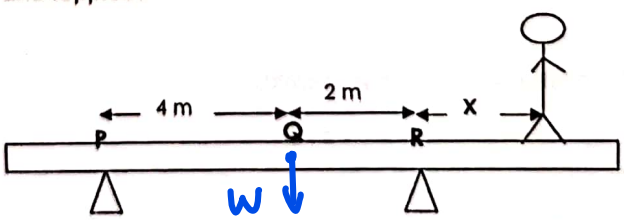


Which of the following statement(s) is/are correct?
1 The upthrust is balanced by the weight.
2 The resultant force of all four forces is zero.
3 Force of gravity does not act on the submarine.

A 1 only is correct.
B 2 only is correct.
(C) 1 and 2 only are correct.
D 1, 2 and 3 are correct.

C.G of plank is at its midpoint or at Q

11 A 80 kg man walks on a 40 kg uniform plank measuring 10 m long. **Q** is the midpoint of the plank. The plank is pivoted on two supports **P** and **R** as shown. How far a distance **x** can the man walk before the plank lifts off the pivot **P** and topples?



A 0.5 m
(B) 1.0 m
C 2.0 m
D 3.0 m

By the Principle of moments, taking moments about Q,

$\sum ACM = \sum CM$

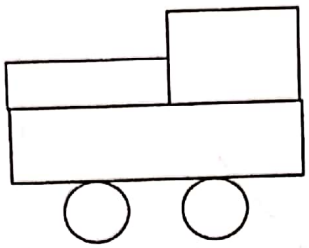
$F_1 d_1 = F_2 d_2$

$W_P \times 2 = W_M \times X$

$40 \times 10 \times 2 = 80 \times 10 \times X$

$X = 1\text{m}$

12 A crate filled with bricks has a total mass of 42 kg. It is being pushed by a force of 65 N along the level ground and moving at a constant speed of 12 ms^{-1}.



$P = \frac{W}{t}$

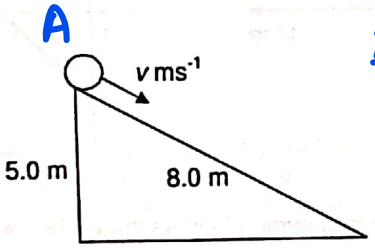
$= \frac{Fs}{t} = Fv = 65 \times 12$

$= 780 N$

Find the power required to push the trolley along the level ground.

A 485 W
B 780 W
C 5040 W
D 5820 W

13 A 0.5 kg ball rolls down a ramp from a height of 5.0 m, at an initial speed of v ms^{-1}, as shown. Upon reaching the bottom of the ramp, the speed of the ball is found to be 13.0 ms^{-1}.



$E_A = E_B$

$E_{KA} + E_{PA} = E_{KB} + W_f$

$\frac{1}{2}mv^2 + mgh = \frac{1}{2}mv_1^2 + Fs$

$\frac{1}{2} \times 0.5 \times v^2 + 0.5 \times 10 \times 5.0 = \frac{1}{2} \times 0.5 \times 13.0^2 + 2.0 \times 8.0$

If the friction along the ramp is 2.0 N, what is the initial speed of the ball, v?

$v = 11.53 ms^{-1}$

A 8.3 m/s
B 8.5 m/s
C 9.0 m/s
D 11.5 m/s

14 On a cloudy day, a sealed packet of potato chips taken to the top of a mountain became inflated. This could be because of

A the air outside the packet is now hotter than the air inside.
B the air outside the packet is now at a lower pressure.
C the ultraviolet radiation at the top of mountain has increased.
D the packet has a small hole that allowed air to move in.

15 The height h of the mercury in the barometer is recorded on Earth.

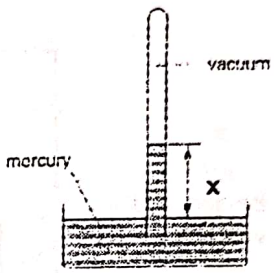
The barometer is set up on another planet where the atmospheric pressure is half that on Earth and the gravitational field strength is double that on Earth.
What will the recorded height **X** be on this planet?

A $\frac{h}{4}$

B $\frac{h}{2}$

C h

D $2h$



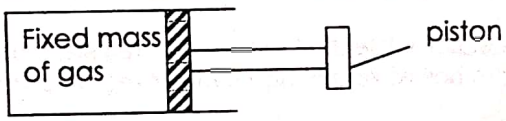
$P = \rho g h$

$h = \frac{P}{\rho g}$

$h_1 = \frac{\frac{1}{2}P}{\rho(2g)} = \frac{1}{4}\left(\frac{P}{\rho g}\right)$

$= \frac{1}{4}h$

16



The diagram above shows a cylinder with a piston containing a fixed mass of air. The temperature is kept constant and the piston is gradually pushed into the cylinder. Which of the following graphs does **not** show the variation of the volume (V) of the gas with its pressure (p)?

Boyle's law states that

$P \propto \frac{1}{V}$ — ① or

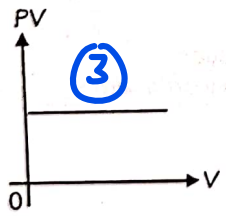
$P = k\left(\frac{1}{V}\right)$ — ②

$PV = k$

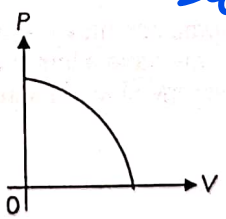
$P_1V_1 = P_2V_2$ — ③

$= \text{const}$

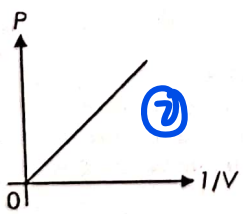
A



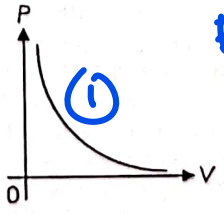
B ①



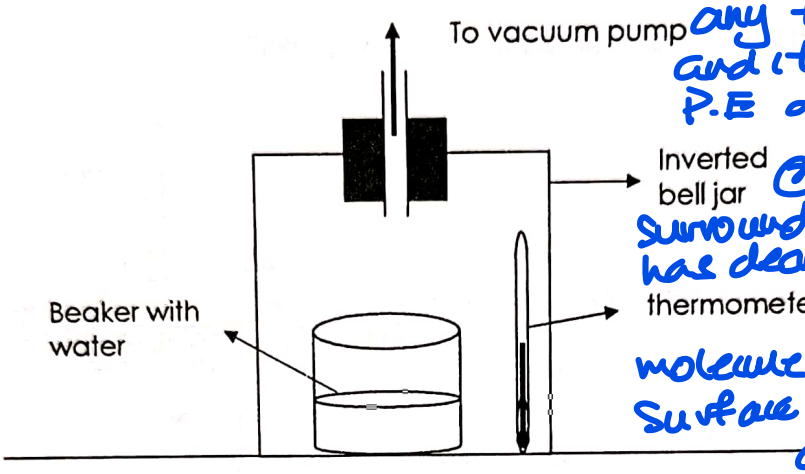
C



D



17 In the diagram below, some water in a beaker is placed in an inverted bell jar which is connected to a vacuum pump. Before the vacuum pump is set in operation, the thermometer reads room temperature.



As air is gradually pumped out of bell jar, what is observed?

A The water starts to boil while the thermometer registers 100 °C.
B The water starts to boil while the thermometer registers value lower than 100 °C.
C The water starts to boil while the thermometer registers room temperature
D The water starts to freeze while the thermometer registers 0°C.

① water did not gain any thermal energy and its internal K.E. and P.E did not increase

② however, its surrounding air pressure has decreased and it is now easier for the molecules at the water surface to escape into the air. when this happens, water starts to boil

③ water can start to boil at 30°C at a reduced air pressure of 0.6 Po ($0.6 \times 1 \times 10^5$ Pa)

18 When a metal is heated, which of the following will occur?

1 The atoms can move freely.
2 The atoms have a larger amplitude of vibration.
3 The average kinetic energy of the atoms is increased.

A 1 and 2
B 2 and 3
C 1 and 3
D 1, 2 and 3

19 A block of ice of 100 g at 0 °C, is placed in a beaker containing 100 g of water at room temperature of 30 °C. Assuming that there is no heat loss or gain from surrounding, which of the following statements describes the correct observation when the two substances are placed together?
[Specific Heat Capacity of water = 4.2 $kJkg^{-1}K^{-1}$,
Specific latent heat of ice = 336 $kJkg^{-1}$]

A All the ice melts in the water.
B Some of the ice melts.
C Some of the water freezes.
D No change is observed in the ice and water.

① Heat lost by water from 30°C to 0°C = mcΔθ
$= \frac{100}{1000} \times 4200 \times (30-0)$
$= 1260$ J

② Heat required for ice to melt at 0°C = ml
$= \frac{100}{1000} \times 336000 = 33600$ J

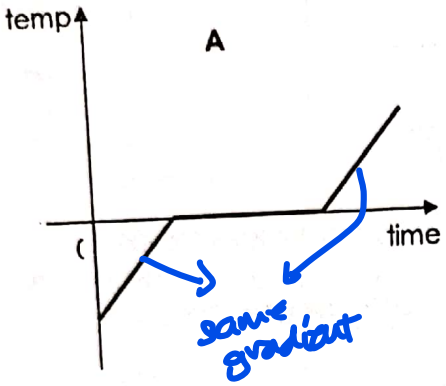
Since ② > ①, only some of the ice will melt

20 A block of ice at -10 º C was heated. Given that ice has a lower specific heat capacity as compared to water. Which of the following most correctly illustrate the heating curve?

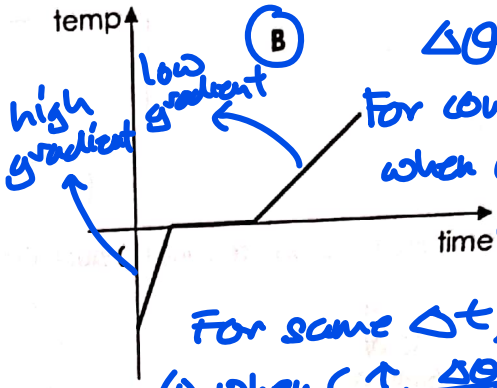
$Q = mc\Delta\theta$

$\Delta\theta = \frac{Q}{mc}$

A



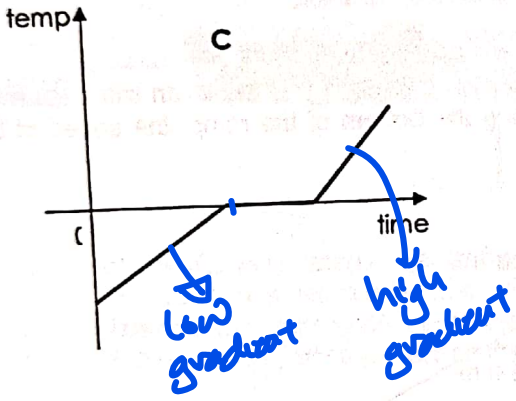
B



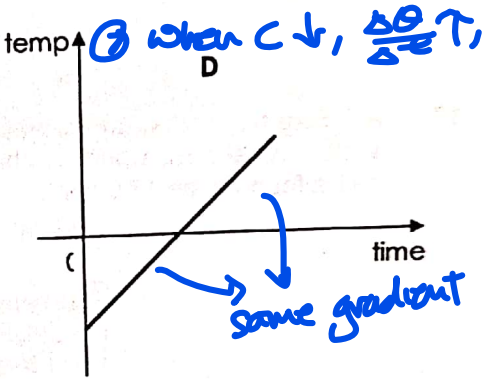
For const Q & m
when c↑, Δθ↓ (1)
c↓, Δθ↑ (2)

For same Δt,
(1) when c↑, $\frac{\Delta\theta}{\Delta t}$↓, gradient↓
(2) when c↓, $\frac{\Delta\theta}{\Delta t}$↑, gradient↑

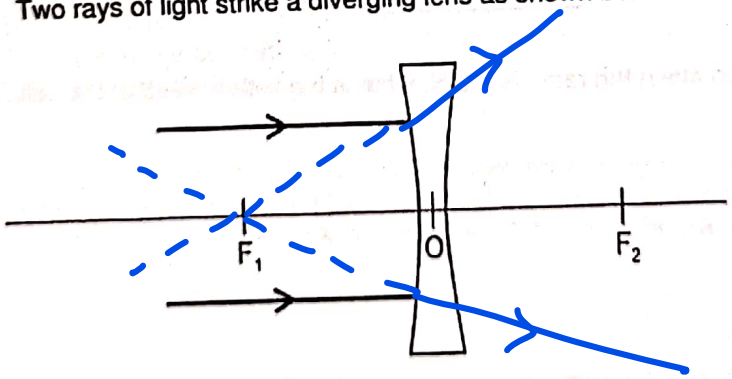
C



D



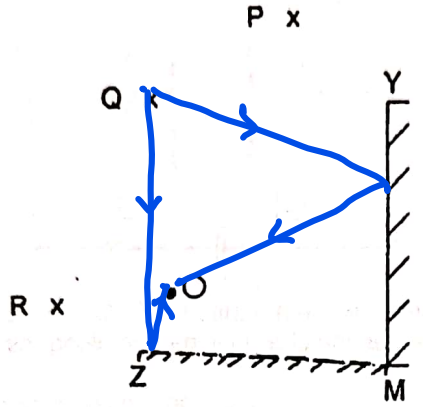
21 Two rays of light strike a diverging lens as shown below.



The distance from the centre of the lens, O to F1 or to F2 is the focal length of the lens. Which statement about the rays after they have passed through the lens is correct?

(A) They appear to come from F1.
B They appear to come from F2.
C They appear to come from O.
D They meet at F2.

22 There are three objects P, Q and R placed in front of a plane mirror as shown in the diagram. A boy is standing at O looking at the two mirrors MY and MZ.



Only point Q can form a point of incidence on mirror MY and MZ. Hence, light rays can be reflected off MY and MZ into the boy's eye

At first, the boy looked at mirror MY. Then he looked at mirror MZ. He is able to see _____ in both mirrors.

A object P
B object Q
C objects Q and R
D object P, Q and R

23 A ray of light passes from medium 1 to medium 2. The speed of light in medium 1 is v_1 and that in medium 2 is v_2. The refractive indices for medium 1 and 2 are n_1 and n_2 respectively. Which of the following conditions are possible?

	Speed	Refractive index
1	$v_1 > v_2$	$n_1 > n_2$
2	$v_1 = v_2$	$n_1 = n_2$
3	$v_1 < v_2$	$n_1 < n_2$
4	$v_1 < v_2$	$n_1 > n_2$

$n_1 v_1 = n_2 v_2$

$\frac{n_1}{n_2} = \frac{v_2}{v_1}$

when $v_2 < v_1$, $n_1 < n_2$

when $v_2 = v_1$, $n_1 = n_2$

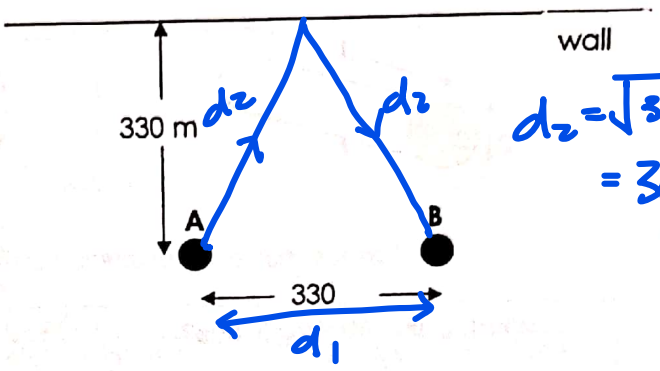
A 1, 2 and 3
B 2 and 3
C 2 and 4
D 2 only

A: $s = \frac{2d}{t} = \frac{2 \times 330}{2} = 330 \text{ ms}^{-1}$ (speed of sound)

B: $t = t_2 - t_1 = \frac{2d_2}{s} - \frac{d_1}{s} = \frac{2 \times 368.9512}{330} - \frac{330}{330} = 1.2361 \text{ s}$

24 Two persons A and B stand 330 m in front of a wall. The distance between A and B is also 330 m. Person A fires a gun. Both persons heard the firing twice. Given that person A heard the echo of the firing 2 s later, what is the time interval between the sound of the firing and its echo from the wall as heard by B?

A 1.0 s
B 1.2 s
C 2.0 s
D 2.2 s



$d_2 = \sqrt{330^2 + (\frac{330}{2})^2} = 368.9512 \text{ m}$

25 Which of the following describes the speed and wavelength of the water wave as it approaches the shore in the diagram below?

$v = f\lambda$

Assume f is constant

$\frac{v_1}{\lambda_1} = \frac{v_2}{\lambda_2}$

	Wave speed	Wavelength
A	Increases	Decreases
B	Decreases	Increases
C	Increases	Increases
D	Decreases	Decreases

As water waves move from deep to shallow, there will be more resistance and its speed will decrease

26 A storm cloud at a potential of 10^7 V with respect to Earth delivers a lightning strike of charge 65 C to the Earth's surface in one tenth of a second. How much energy is dissipated if the potential difference remains constant?

A 6.5×10^{-5} J
B 6.5×10^{7} J
C 6.5×10^{8} J
D 6.5×10^{9} J

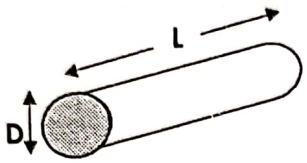
$V = \frac{W}{Q}$

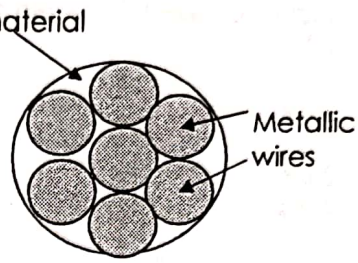
$W = VQ$

$= 10^7 \times 65$

$= 6.5 \times 10^8 \text{ J}$

27 A metallic wire of resistivity ρ has a length L and a diameter D. Seven strands of this wire is bundled together to create an electrical cable as shown in the diagram below.





Cross section of the electrical cable

$R = \frac{\rho l}{A}$

$R_L = \frac{\rho l}{(7A)}$

$= \frac{1}{7}\left(\frac{\rho l}{A}\right)$

$R_L = \frac{1}{7}R$

Which of the following is true?

A The electrical cable has resistance about 7 times that of the original wire.
B The electrical cable has resistance about 1/7 times that of the original wire.
C The resistance of the cable is equivalent to a single wire of diameter 7*D*.
D The resistance of the cable is equivalent to a single wire with diameter 3*D*.

28 Two charged polystyrene spheres are suspended by insulating thread as shown in Fig a. What happens when an earthed metal plate is inserted between the two spheres as shown in fig b?

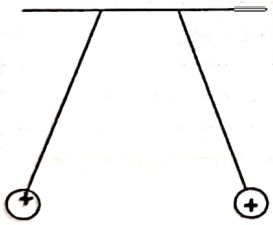


Fig a

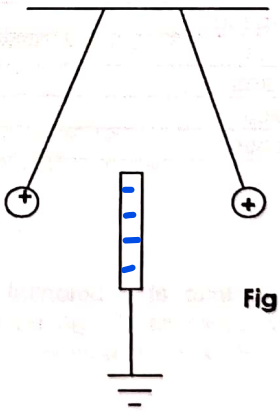
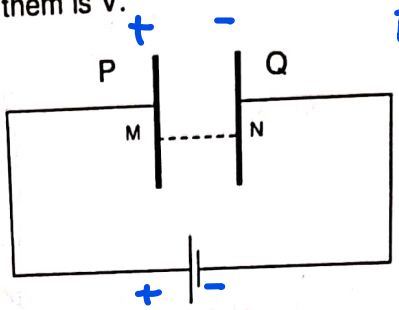


Fig b

Since the spheres are insulators and not conductors, only the side touching the metal plate are neutralised. The other side remains positively charged and the sphere are attracted to the negatively charged metal plates

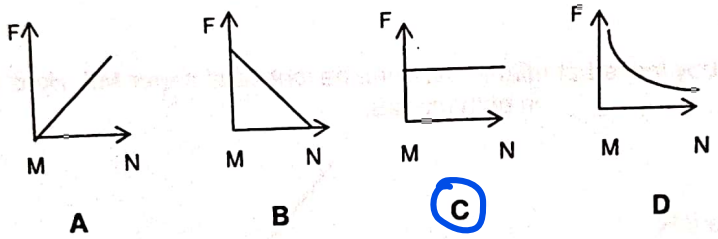
A The spheres remain in the same positions.
B The spheres touch the plate and remain in contact with it.
C The spheres touch the plate and repel from it.
D The spheres swing back and forth on the respective sides of the plate.

29 Two conducting plates P and Q are placed parallel to each other at a fixed distance apart. They are connected to a d.c. supply so that the potential difference between them is V.

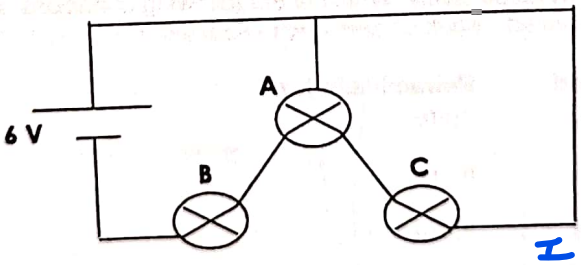


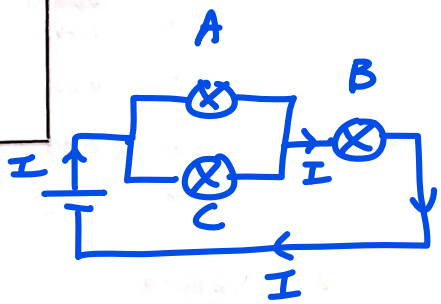
Force exerted on the point charge depends on the distance between the plates. Since the distance is constant, the force remains constant

Which graph shows how the magnitude of the electric force F experienced by a point charge, varies as the charge is moved along the line MN ?



30 Three identical lamps A, B and C are connected as shown in the following circuit.





Which of the following is true?

A Lamp A is brighter than lamp C.
B Lamp A and lamp B are equally bright.
C The potential difference across lamp A is half of the emf.
D All the current will pass through lamp B.

$R_{AC} = \left(\frac{1}{R}+\frac{1}{R}\right)^{-1}$
$= \frac{R}{2}\ \Omega$

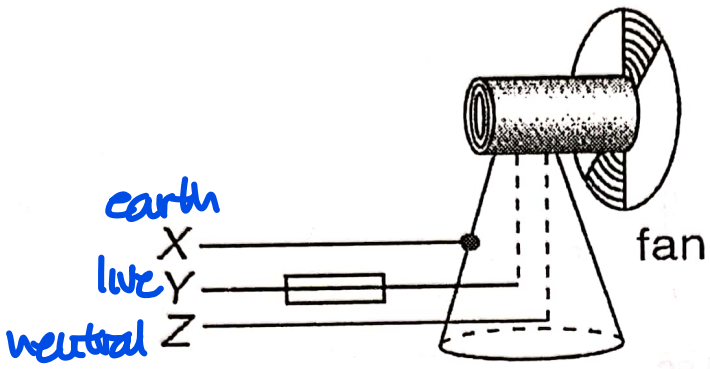
$V_{AC} = I\left(\frac{R}{2}\right) = \frac{1}{2}IR\ V$

$V_B = IR\ V$

$E = V_{AC} + V_B = \frac{3}{2}IR\ V$

Hence $V_{AC} = \frac{1}{3}E$

31 The diagram below shows the external wiring of an electric fan. Which of the following statements is/are correct?

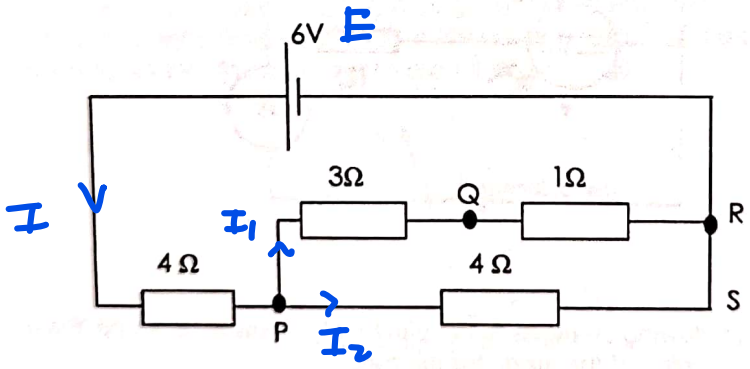


1 Wire *X* is always at zero potential
2 The switch of the fan should be connected to wire *Y*.
3 Wire *Z* is blue in colour.

neutral → blue

A 1 only
B 1 and 2 only
C 2 and 3 only
(D) 1,2 and 3

32 Four resistors are connected as shown.



The potential difference between P and Q is

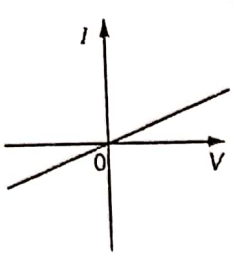
(A) 1.5 V
B 2.0 V
C 2.5 V
D 3.0 V

$I = I_1 + I_2$
where $I_1 = I_2$
$\therefore I_1 = \frac{I}{2}$

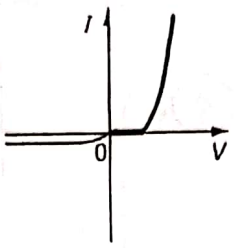
$I = \frac{V}{R}$
$= \frac{E}{R_T}$
$= \frac{6}{4 + (\frac{1}{4} + \frac{1}{4})^{-1}}$
$= 1\,A$ and $I_1 = \frac{1}{2}$
$= 0.5\,A$

$V_{PQ} = IR$
$= I_1 R_{PQ}$
$= 0.5 \times 3$
$= 1.5\,V$

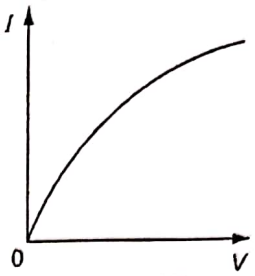
33 The three graphs X, Y and Z show the *I/V* characteristics for three different components.



graph X



graph Y

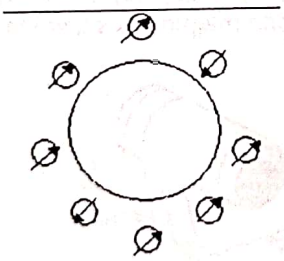


graph Z

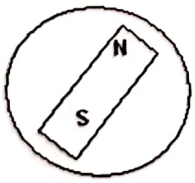
To which components do these characteristics correspond?

	Graph X	Graph Y	Graph Z
A	Filament lamp	Metallic conductor	Semiconductor diode
B	Metallic conductor	Semiconductor diode	Filament lamp
C	Semiconductor diode	Metallic conductor	Filament lamp
D	Metallic conductor	Filament lamp	Semiconductor diode

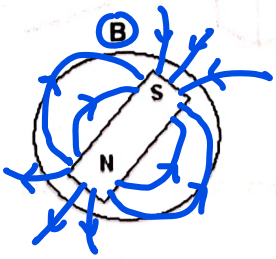
34 The diagram shows a box which has a bar magnet hidden inside it. Compasses are placed around the outside of the box and their needles point as shown. Which diagram shows the position of the magnet inside the box?



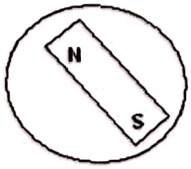
A



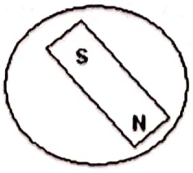
B



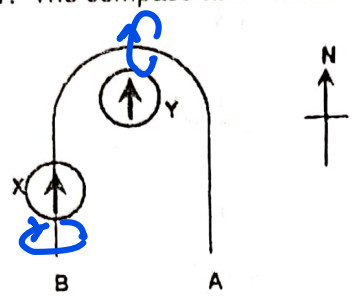
C



D



35 The diagram below shows a wire AB that is bent into a U-shaped and placed along the earth's north-south direction. Two plotting compasses are placed at positions X and Y. The compass at X is below the wire.

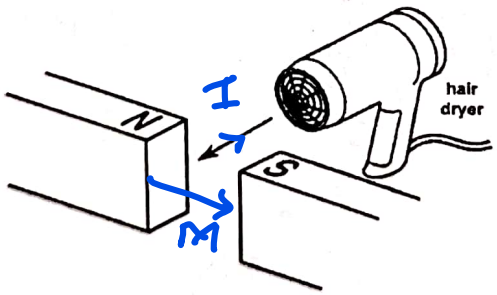


Use right-hand grip rule to determine direction of magnetic field lines

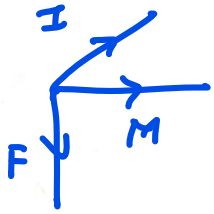
What will happen when a current flows from A to B in the wire?

	Compass at X	Compass at Y
A	Deflects to the right	Remains in the position shown
B	Deflects to the right	Deflects to the left
C	Deflects to the left	Remains in the position shown
D	Remains in the position shown	Remains in the position shown

36 Hot air from a hair-dryer contains many negatively charged ions. The hot air is directed between the poles of a strong magnet as shown in the figure.



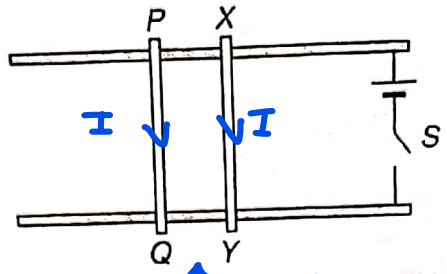
Use Fleming's left-hand rule



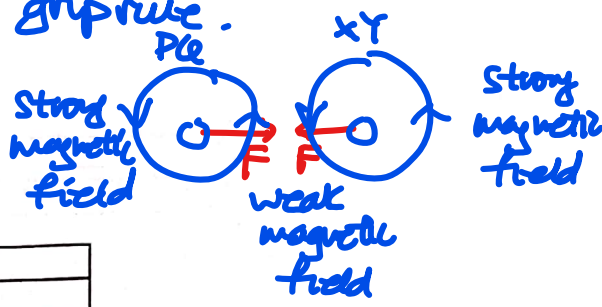
What happens to the negatively charged ions?

A They are deflected towards the North Pole N.
B They are deflected towards the South Pole S.
C They are deflected upwards.
D They are deflected downwards.

37 Two light conducting rods *XY* and *PQ* are supported on fixed smooth conducting rails as shown in the diagram below. What will happen to the rods when the switch *S* is closed?

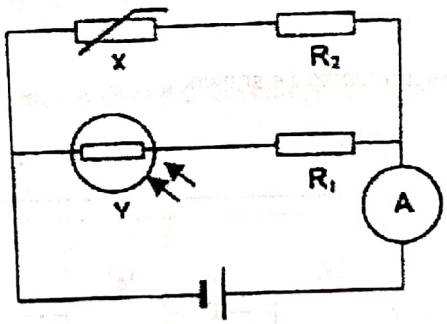


when viewed from ↑ and using right-hand grip rule.



	XY	PQ
A	Moves to right	Moves to left
B	Moves to left	Moves to right
C	Moves to right	Moves to right
D	Moves to left	Moves to left

38 In the circuit shown, R_1 and R_2 are identical resistors.

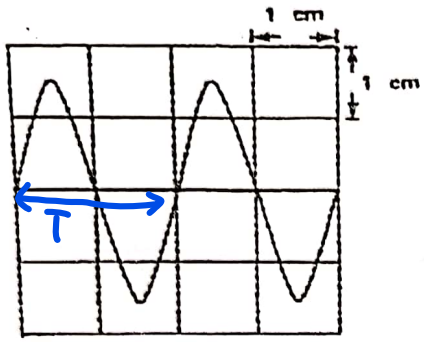


Which of the following changes to the electrical components X and Y will increase the reading of the ammeter the most.

A Immerse X in a beaker of ice water and decrease the light intensity on Y.
B Immerse X in a beaker of ice water and increase the light intensity on Y.
C Immerse X in a beaker of hot water and decrease the light intensity on Y.
D Immerse X in a beaker of hot water and increase the light intensity on Y.

To increase reading on ammeter the most, R_T must decrease
To decrease R_T, R_X and R_Y must decrease
When X is in hot water, R_X will decrease
When Y is in bright light, R_Y will decrease

39 An a.c. signal of frequency 50 Hz and peak-to-peak voltage 15 V is input to the oscilloscope. The waveform is displayed as showed. What is the time-base scale and voltage sensitivity on the oscilloscope?



① $T = \frac{1}{f}$

$= \frac{1}{50} = 0.02s$

Since $T \rightarrow 2cm$

$2cm \rightarrow 0.02s$

$1cm \rightarrow 0.01s$

$\rightarrow 10.0ms$ [Time-base]

② $V_{pp} = 1.5cm$

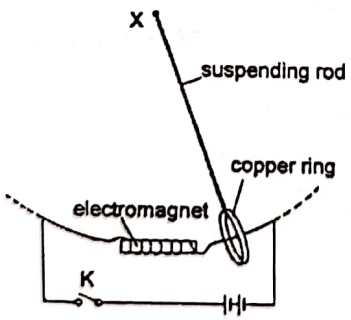
$3cm \rightarrow 15V$

$1cm \rightarrow 5V$ [Voltage sensitivity]

The time-base scale and the voltage sensitivity of the oscilloscope are:

	Time-base scale ms/cm	Voltage sensitivity V/cm
A	5.0	5.0
B	10.0	5.0
C	5.0	10.0
D	10.0	10.0

40 A copper ring is suspended by a long, light rod pivoted at X so that it may swing as a pendulum, as shown in the diagram below. An electromagnet is mounted so that the ring passes over it as it swings.



The swinging copper ring causes a rate of change of magnetic flux and an induced current flows in it. According to Lenz's Law, the the induced current will flow in a direction that will produce a magnetic effect that opposes the change that produces it. Hence, the oscillation will be damped.

The ring is set into oscillation with switch K open. What happens to the motion after switch K has been closed?

A The ring will be brought to rest with the rod inclined to vertical.
B The amplitude will increase because the ring is accelerated towards the magnet.
C The periodic time will decrease.
D The oscillation will be damped.

→ fades away with time