Name: _____ ( ) Class: 25 / _____

ANDERSON SERANGOON JUNIOR COLLEGE

2025 JC2 Preliminary Examination

PHYSICS Higher 2 9749/01

Paper 1 Multiple Choice **Wednesday 3 September 2025**

1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name and class on the Multiple Choice Answer Sheet.
Shade and write your NRIC/FIN.

There are **thirty** questions on this paper. Answer **all** questions. For each question there are four possible answers **A**, **B**, **C** and **D**.
Choose the **one** you consider correct and record your choice in **soft pencil** on the separate Multiple Choice Answer Sheet.

Read the instructions on the Multiple Choice Answer Sheet very carefully.

Each correct answer will score one mark. A mark will not be deducted for a wrong answer.
Any rough working should be done in this question paper.
The use of an approved scientific calculator is expected, where appropriate.

Data

speed of light in free space	$c = 3.00 \times 10^{8}$ m s^{-1}
permeability of free space	$\mu_0 = 4\pi \times 10^{-7}$ H m^{-1}
permittivity of free space	$\varepsilon_0 = 8.85 \times 10^{-12}$ F m^{-1}
	$(1/(36\pi)) \times 10^{-9}$ F m^{-1}
elementary charge	$e = 1.60 \times 10^{-19}$ C
the Planck constant	$h = 6.63 \times 10^{-34}$ J s
unified atomic mass constant	$u = 1.66 \times 10^{-27}$ kg
rest mass of electron	$m_e = 9.11 \times 10^{-31}$ kg
rest mass of proton	$m_p = 1.67 \times 10^{-27}$ kg
molar gas constant	$R = 8.31$ J K^{-1} mol^{-1}
the Avogadro constant	$N_A = 6.02 \times 10^{23}$ mol^{-1}
the Boltzmann constant	$k = 1.38 \times 10^{-23}$ J K^{-1}
gravitational constant	$G = 6.67 \times 10^{-11}$ N m^2 kg^{-2}
acceleration of free fall	$g = 9.81$ m s^{-2}

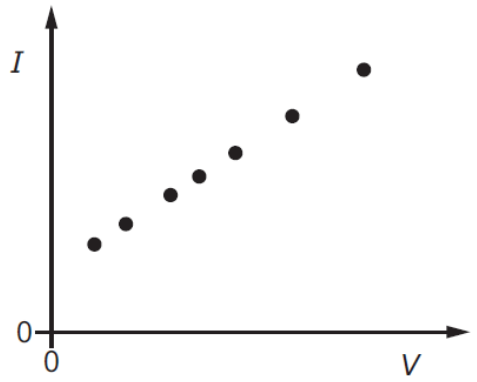
Formulae

uniformly accelerated motion	$s = ut + \frac{1}{2}at^2$ $v^2 = u^2 + 2as$
work done on/by a gas	$W = p\Delta V$
hydrostatic pressure	$p = \rho gh$
gravitational potential	$\phi = -\frac{Gm}{r}$
temperature	$T/\text{K} = T/^\circ\text{C} + 273.15$
pressure of an ideal gas	$p = \frac{1}{3}\frac{Nm}{V}\langle c^2 \rangle$
mean translational kinetic energy of an ideal gas molecule	$E = \frac{3}{2}kT$
displacement of particle in s.h.m.	$x = x_0 \sin \omega t$
velocity of particle in s.h.m.	$v = v_0 \cos \omega t$ $= \pm\omega\sqrt{x_o^{\,2} - x^2}$
electric current	$I = Anvq$
resistors in series	$R = R_1 + R_2 + \ldots$
resistors in parallel	$1/R = 1/R_1 + 1/R_2 + \ldots$
electric potential	$V = \frac{Q}{4\pi\varepsilon_o r}$
alternating current/voltage	$x = x_0 \sin \omega t$
magnetic flux density due to a long straight wire	$B = \frac{\mu_o I}{2\pi d}$
magnetic flux density due to a flat circular coil	$B = \frac{\mu_o NI}{2r}$
magnetic flux density due to a long solenoid	$B = \mu_o nI$
radioactive decay	$x = x_0 \exp(-\lambda t)$
decay constant	$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}}$

1 What is a reasonable estimate of the kinetic energy of a car travelling at a speed of 30 m s^{-1}?

A 10^2 J **B** 10^4 J **C** 10^6 J **D** 10^8 J

2 Readings are made of the current I for different voltages V across a fixed resistor. The results are plotted on a graph to show the variation of I with V.



What is the best description of the errors in the readings?

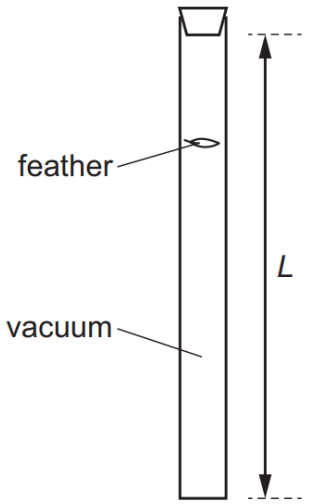
A random only

B systematic only

C both systematic and random

D neither systematic nor random

3 The diagram shows a laboratory experiment in which a feather falls from rest in a long evacuated vertical tube of length L.

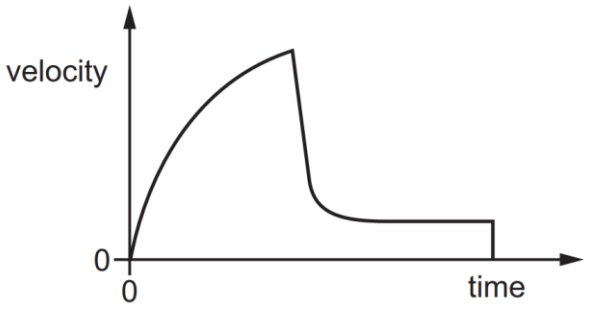


The feather takes time T to fall from the top to the bottom of the tube.

How far does the feather fall from the top of the tube in time $0.50T$?

A $0.13L$ **B** $0.25L$ **C** $0.38L$ **D** $0.50L$

4 The graph shows the variation of velocity with time for a stone that falls from a bridge into a lake and sinks to the bottom of the lake.



What can be deduced about the motion of the stone?

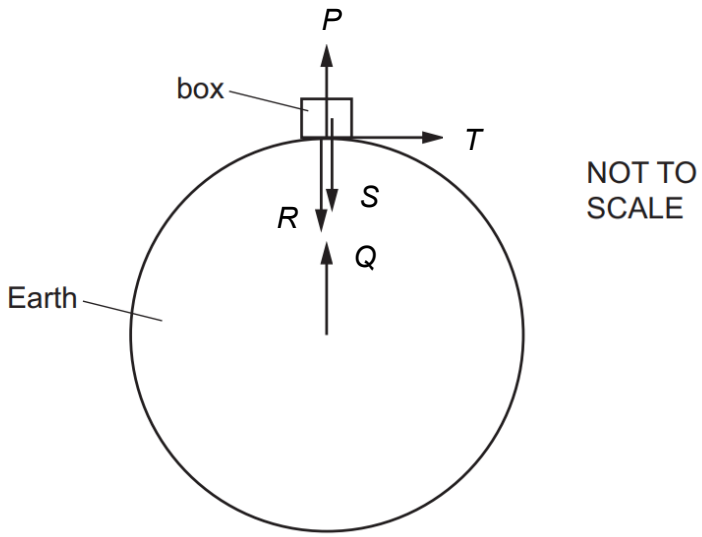
A Terminal velocity was reached in air.

B The distance travelled in water was greater than the distance travelled in air.

C The acceleration in air was decreasing with increasing time.

D The rate of change of velocity in air was constant.

5 A box rests on the Earth with forces *P*, *Q, R, S* and *T* acting on them as shown. Newton's third law describes how forces of the same type act in pairs.



Which of the following correctly identifies the pair of forces?

A *P* and *S*

B *P* and *Q*

C *P* and *R*

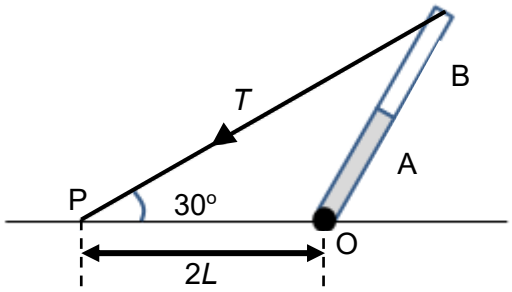
D *R* and *Q*

6 Water is pumped through a hosepipe at a rate of 90 kg per minute. It emerges from the hosepipe horizontally with a speed of 20 m s^{-1}.

Which force is required from a person holding the hosepipe to prevent it moving backwards?

A 30 N **B** 270 N **C** 1800 N **D** 10800 N

7 A rod, made up of 2 uniform portions, A and B, is held in place by a cable under tension, *T*. The cable is at an angle of 30° to the horizontal.

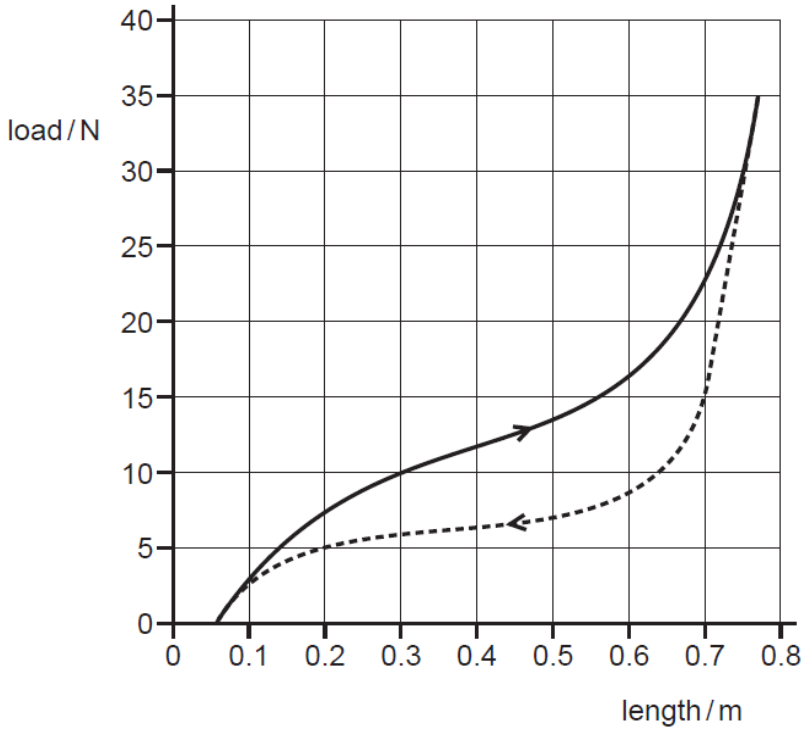


The portions A and B have masses of 20.0 kg and 30.0 kg respectively, and are of identical length, *L*.

What is the tension *T* in the cable?

A 150 N **B** 190 N **C** 230 N **D** 270 N

8 The solid line on the graph shows how the length of a rubber band varies when an increasing load is applied. The dotted line shows how the length subsequently varies as the load is gradually decreased.



Which statement is correct?

A The energy recovered when the load is removed is about 10 J.

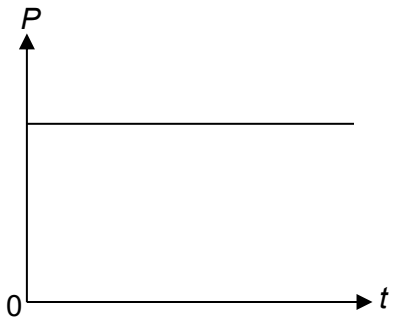
B The energy remaining in the rubber band after one cycle of loading and unloading is about 3 J.

C The total work done on the rubber band during one cycle of loading and unloading is about 14 J.

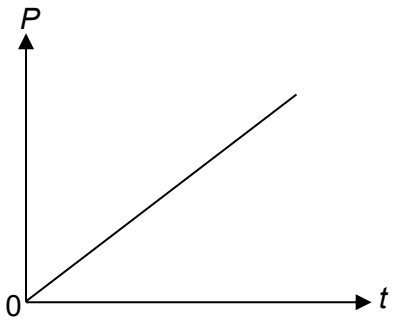
D The work done in stretching the rubber band is about 5 J.

9 A constant force is applied to a body which is initially stationary but free to move in the direction of the force. Assuming that the effects of friction are negligible, which of the following graphs best represents the variation of P, the power supplied, with time t?

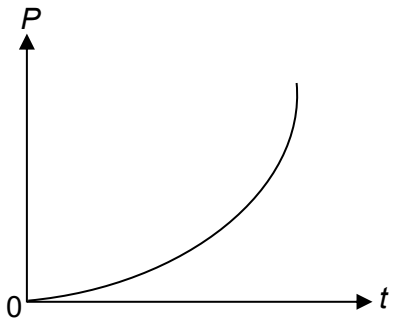
A



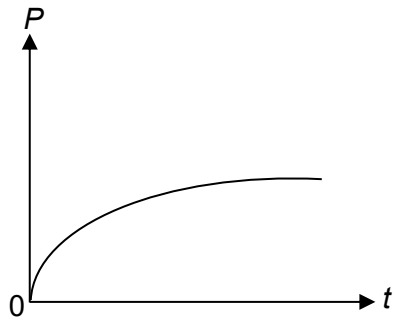
B



C



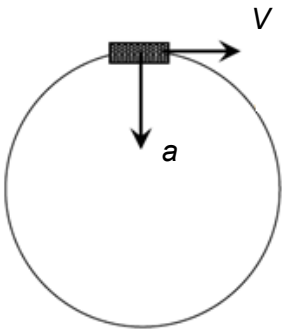
D



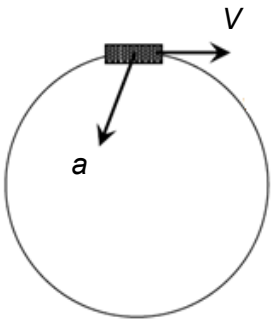
10 A drone is performing a vertical circular path stunt for its audience on the ground.

Which diagram shows the resultant acceleration a acting on the drone at the instant where its velocity is V and speeding up?

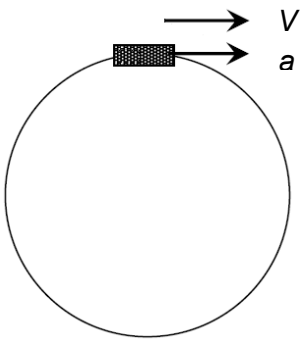
A



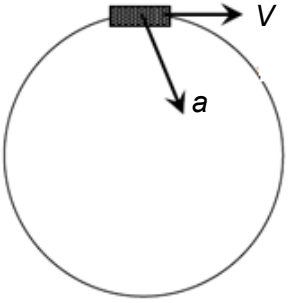
B



C



D



11 The gravitational field strength on the surface of planet P is one tenth of that on the surface of planet Q.

On the surface of P, a body has a mass of 1.0 kg and a weight of 1.0 N.

What are the mass and weight of the same body on the surface of planet Q?

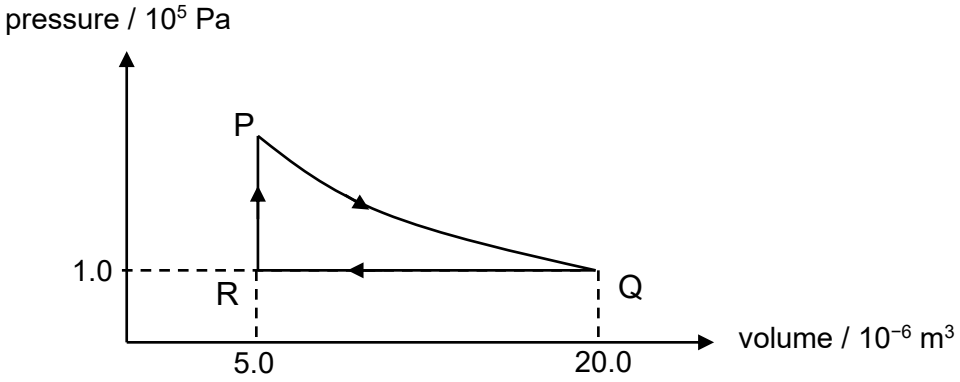
	mass on Q / kg	weight on Q / N
A	1.0	0.1
B	1.0	10
C	10	10
D	10	100

12 The density of an ideal gas is 1.2 kg m^{-3} at a pressure of 1.0×10^5 Pa.

What is the root-mean-square (r.m.s.) speed of the molecules of the gas?

A 350 m s^{-1} **B** 500 m s^{-1} **C** 3700 m s^{-1} **D** 2.50×10^5 m s^{-1}

13 A fixed mass of an ideal gas undergoes a cycle PQRP of changes, as shown below.



Work done by gas from P to Q is 4.2 J.

What is the overall heat gain in a cycle PQRP of changes?

A –5.7 J **B** –2.7 J **C** 2.7 J **D** 5.7 J

14 In order to check the speed of a camera shutter, the camera was used to photograph the bob of a simple pendulum moving in front of a horizontal scale. The extreme positions of the bob were at 600 mm and 700 mm marks. The photograph showed that while the shutter was opened, the bob moved from 650 mm to 675 mm mark.

If the period of the pendulum was 2.0 s, how long does the shutter remain open?

A 0.17 s

B 0.25 s

C 0.50 s

D 1.0 s

15 As the intensity of a single frequency sound wave travelling through the air is increased, how do the maximum speed of vibration of the air molecules and the speed of wave travel change?

	maximum speed of vibration of air molecules	speed of wave travel
A	increase	increase
B	increase	no change
C	no change	increase
D	no change	no change

16 Light of wavelength λ is emitted from two point sources R and S and falls onto a distant screen.

At point P on the screen, the light intensity is zero.

What could explain the zero intensity at P?

A Light from the two sources is emitted 180° out of phase and the path difference to P is λ .

B Light from the two sources is emitted 180° out of phase and the path difference to P is $\frac{1}{2}\lambda$.

C Light from the two sources is emitted 90° out of phase and the path difference to P is λ.

D Light from the two sources is emitted in phase and the path difference to P is λ.

17 A beam of red light of wavelength 720 nm is incident normally on a diffraction grating and produces a diffraction pattern on a screen placed parallel to the grating.

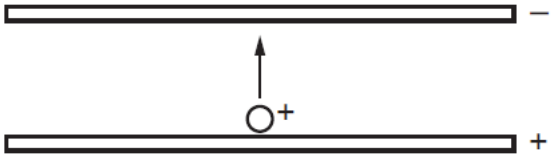
The beam of red light is replaced with a beam of electromagnetic radiation of wavelength *X*, which is incident normally on the same diffraction grating.

The third-order maximum for the electromagnetic radiation of wavelength *X* is at the same position on the screen as the second-order maximum for the red light.

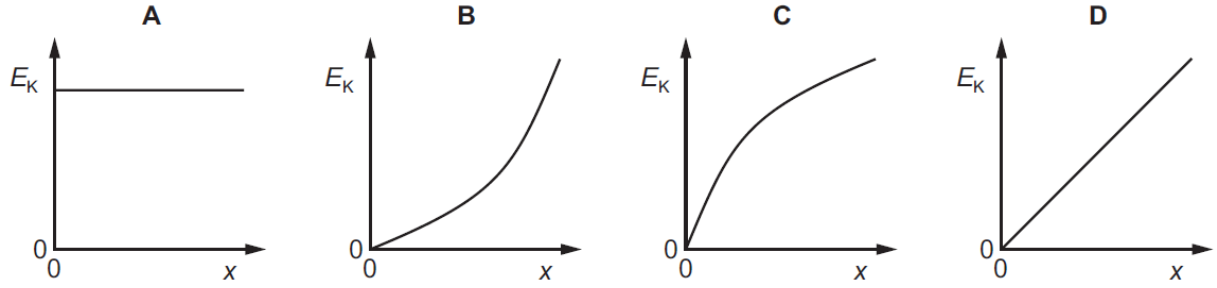
What is wavelength *X*?

A 480 nm **B** 540 nm **C** 960 nm **D** 1100 nm

18 Two oppositely-charged horizontal metal plates are placed in a vacuum. A positively-charged particle starts from rest and moves from one plate to the other plate, as shown.



Which graph shows how the kinetic energy E_K of the particle varies with the distance *x* moved from the positive plate?

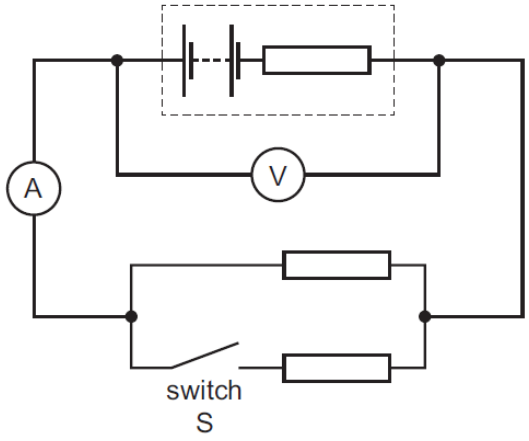


19 A resistor has resistance *R*. When the potential difference across the resistor is *V*, the current in the resistor is *I*. The power dissipated in the resistor is *P*. Work *W* is done when charge *Q* flows through the resistor.

What is **not** a valid relationship between these variables?

A $I = \frac{PQ}{W}$ **B** $Q = \frac{W}{IR}$ **C** $R = \frac{V^2}{P}$ **D** $R = \frac{W}{PQ}$

20 A battery, with internal resistance, is connected to a parallel arrangement of two resistors and a switch S, as shown.

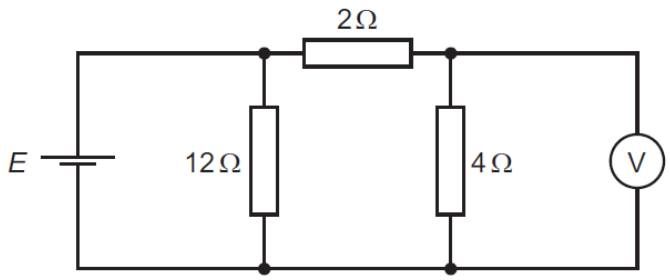


Initially switch S is open.

What happens to the voltmeter and ammeter readings when switch S is closed?

	voltmeter reading	ammeter reading
A	decreases	increases
B	decreases	decreases
C	increases	increases
D	increases	decreases

21 A cell of electromotive force (e.m.f.) E and negligible internal resistance is connected into a circuit, as shown.

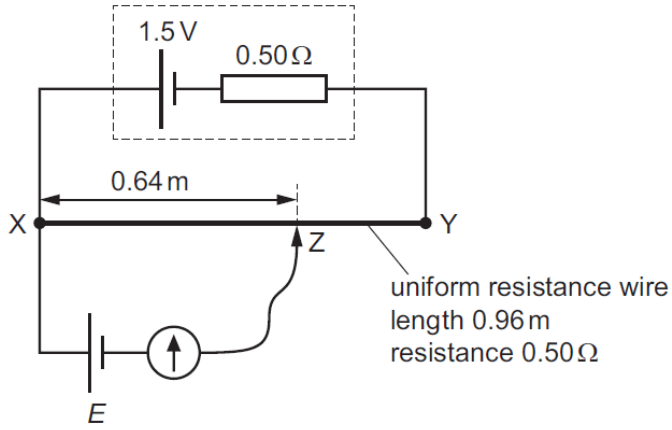


The voltmeter has a very high resistance and reads a potential difference V_{out}.

What is the ratio $\frac{V_{out}}{E}$?

A $\frac{1}{6}$ **B** $\frac{1}{3}$ **C** $\frac{1}{2}$ **D** $\frac{2}{3}$

22 A potentiometer circuit is used to determine the electromotive force (e.m.f.) *E* of a cell. The circuit includes a second cell of e.m.f. 1.5 V and internal resistance 0.50 Ω that is connected to a uniform resistance wire XY, as shown.



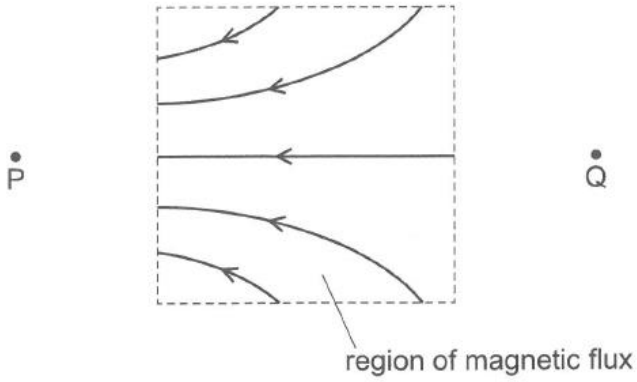
The resistance wire XY has a length of 0.96 m and a resistance of 0.50 Ω.

The movable connection Z is moved along wire XY. The galvanometer reading is zero when length XZ is 0.64 m.

What is the value of e.m.f. *E* ?

A 0.50 V **B** 0.75 V **C** 1.0 V **D** 1.1 V

23 The magnetic flux pattern formed in a region of space is shown.



What could cause the magnetic flux pattern?

A a current-carrying, flat, circular coil with a diameter along the line PQ

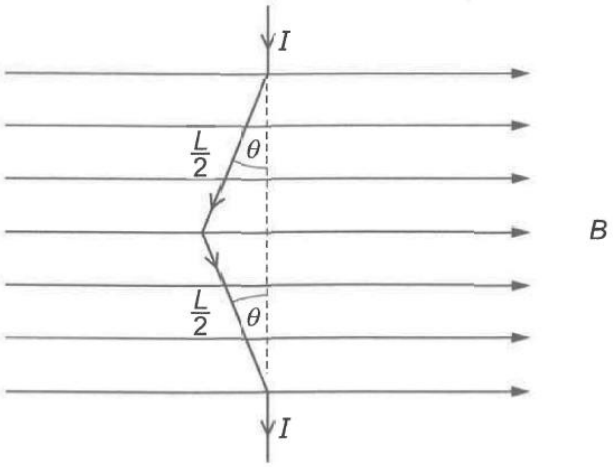
B a current-carrying solenoid with one end at P

C a long, straight, current-carrying wire along the line PQ

D a south pole of a bar magnet at Q

24 The diagram shows a bent wire in a uniform magnetic field of flux density *B*.

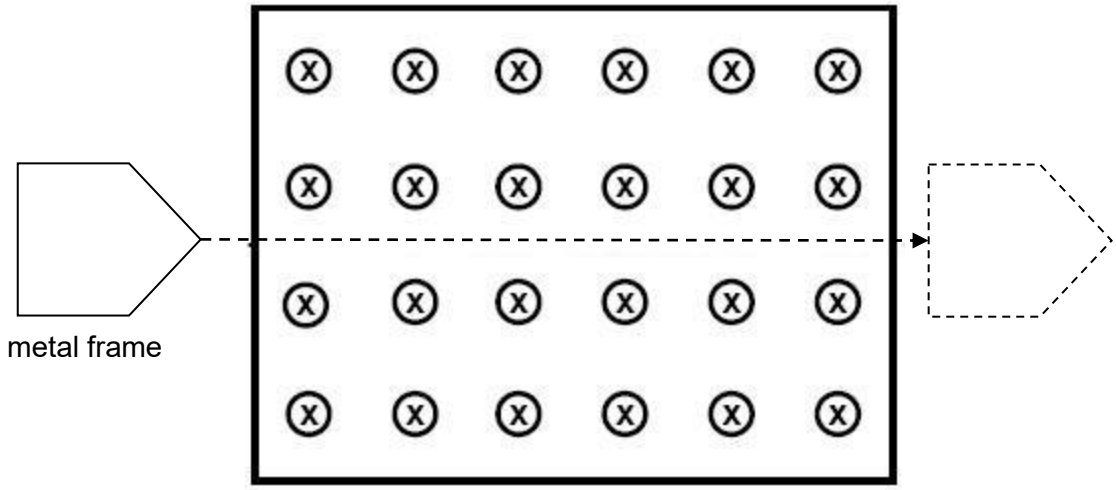
The length of wire in the field is *L* and each half of the wire is inclined at an angle θ normal to the field direction. There is a current I in the wire.



Which row gives the magnitude and the direction of the force acting on the wire?

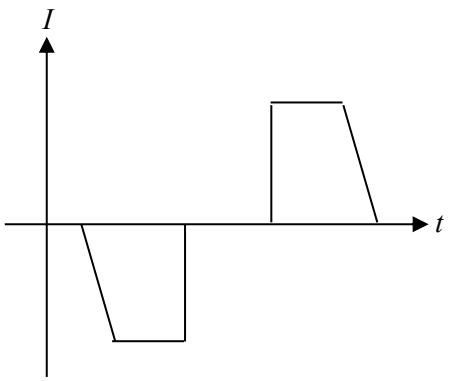
	magnitude	direction
A	*BIL* cos θ	out of the page
B	*BIL* cos θ	into the page
C	*BIL* sin θ	out of the page
D	*BIL* sin θ	into the page

25 The figure below shows a metal frame entering a region of uniform magnetic field. The plane of the metal frame is always normal to the magnetic field, and the metal frame moves at a constant speed.

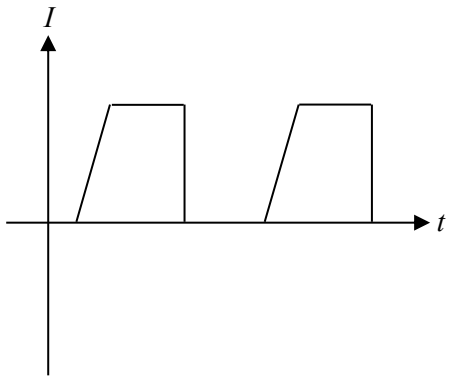


Which graph best shows the variation with time t of the current I induced in the frame?

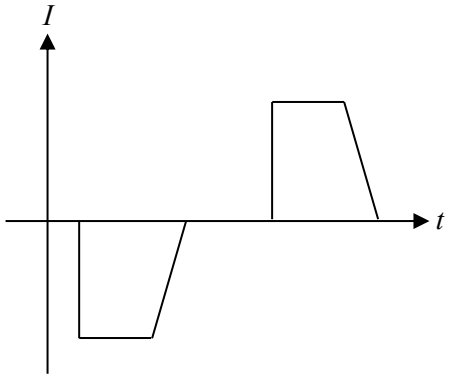
A



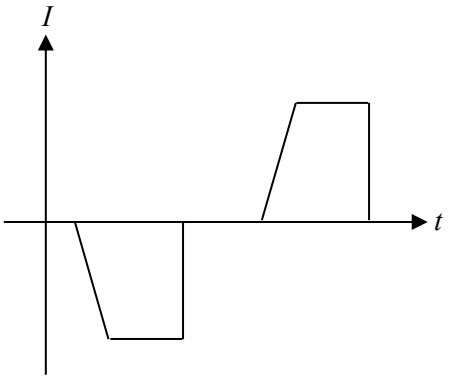
B



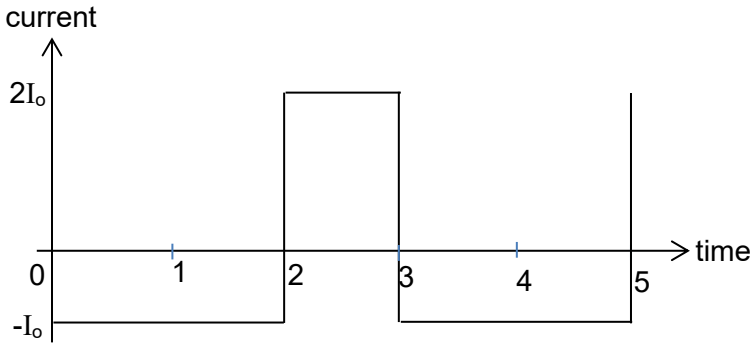
C



D



26 The graph shows the variation with time of a periodic current. What is the root-mean-square value of the current?



A $\sqrt{2}\,I_o$ **B** $\frac{I_o}{\sqrt{2}}$ **C** $\frac{I_o}{2}$ **D** $2\,I_o$

27 What is the reasonable estimate, to one significant figure, of the energy of a photon of violet light?

A 4 eV **B** 6 eV **C** 3×10^{-19} J **D** 5×10^{-19} J

28 The uncertainty in position of a particle in space is 2.00×10^{-20} m and the uncertainty in its momentum is 4.00×10^{-14} N s.

What is the minimum percentage change in uncertainty of momentum when the uncertainty in position is halved?

A - 100 % **B** - 66 % **C** 66 % **D** 100 %

29 Today, the activity of a sample of caesium-137 is 4.0×10^5 Bq. The half-life of caesium-137 is 33 years.

What is the best estimate of the number of caesium-137 nuclei that will decay in the next two days?

A 5.0×10^8 **B** 1.2×10^9 **C** 6.9×10^{10} **D** 9.5×10^{12}

30 A nucleus X decays into a nucleus Y by emitting an alpha particle followed by two beta particles.

Which statement about this nuclear decay is correct?

A Beta particle decay occurs when an orbital electron is emitted.

B Nucleus Y has the same nucleon number as nucleus X.

C Nucleus Y is an isotope of nucleus X.

D The total mass of the products is equal to the mass of the initial nucleus X.