H

NATIONAL JUNIOR COLLEGE

SENIOR HIGH 2 PRELIMINARY EXAMINATION

Higher 2

CANDIDATE NAME			
SUBJECT CLASS		REGISTRATION NUMBER	

PHYSICS **9749/01**

Paper 1 Multiple Choice

14 September 2022
1 hour

Additional Materials: Multiple Choice Answer Sheet

READ THE INSTRUCTION FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, subject class and registration number on the Answer Sheet in the spaces provided unless this has been done for you.

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 Answer Sheet.

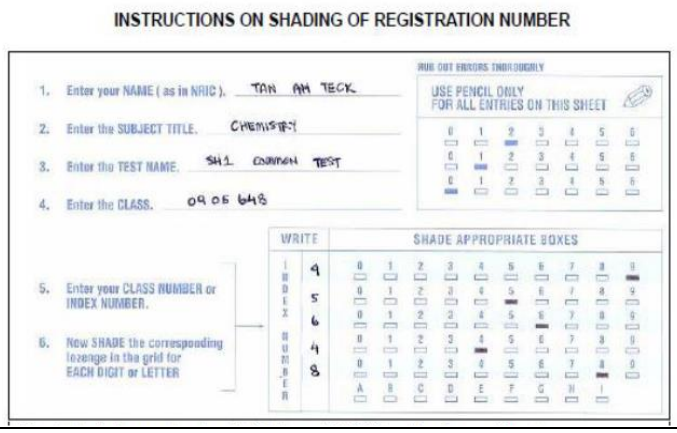
Read the instructions on the Answer Sheet very carefully.

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 booklet.
The use of an approved scientific calculator is expected, where appropriate.

The OAS index number is in a 5-digit format.

The 5-digit format is as follows: **2nd digit** and the **last four digits** of the Reg Number.

e.g. 2**00**5011 becomes **05011**



This document contains **15** printed pages and **1** blank pages.

[Turn over

Data

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

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	$\phi = -Gm/r$
temperature	$T/\mathrm{K} = T/^\circ\mathrm{C} + 273.15$
pressure of an ideal gas	$p = \frac{1}{3}\frac{Nm}{V} < c^2 >$
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.	$v = v_0 \cos\omega t$ $= \pm\omega\sqrt{x_0^2 - x^2}$
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	$V = \frac{Q}{4\pi\varepsilon_0 r}$
alternating current / voltage	$x = x_0 \sin\omega t$
magnetic flux density due to a long straight wire	$B = \frac{\mu_0 I}{2\pi d}$
magnetic flux density due to a flat circular coil	$B = \frac{\mu_0 NI}{2r}$
magnetic flux density due to a long solenoid	$B = \mu_0 nI$
radioactive decay	$x = x_0 \exp(-\lambda t)$
decay constant	$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}}$

[Turn over

1 Which of the following is the best estimate of the kinetic energy of an average National Junior College sprinter?

A 25 J **B** 1500 J **C** 3500 J **D** 11000 J

2 A student makes measurements from which he calculates the speed of sound as 327.66 m s^{-1}. He estimates that his result is accurate to $\pm$ 3%. Which of the following gives his results reduced to the appropriate number of significant figures?

A 300 m s^{-1}

B 320 m s^{-1}

C 328 m s^{-1}

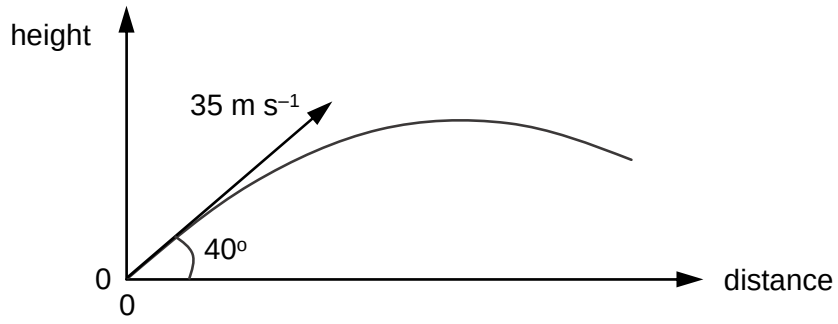
D 330 m s^{-1}

3 A car accelerates uniformly from rest for 16 s along a straight track.

What is the ratio $\frac{\text{distance travelled between 8 s and 16 s}}{\text{distance travelled between 0 s and 8 s}}$?

A 1 **B** 2 **C** 3 **D** 4

4 An object is projected with velocity 35 m s^{-1} at an angle of 40° to the horizontal. Air resistance is negligible.



What is the speed of the object after 4.0 s?

A 26 m s^{-1} **B** 32 m s^{-1} **C** 67 m s^{-1} **D** 70 m s^{-1}

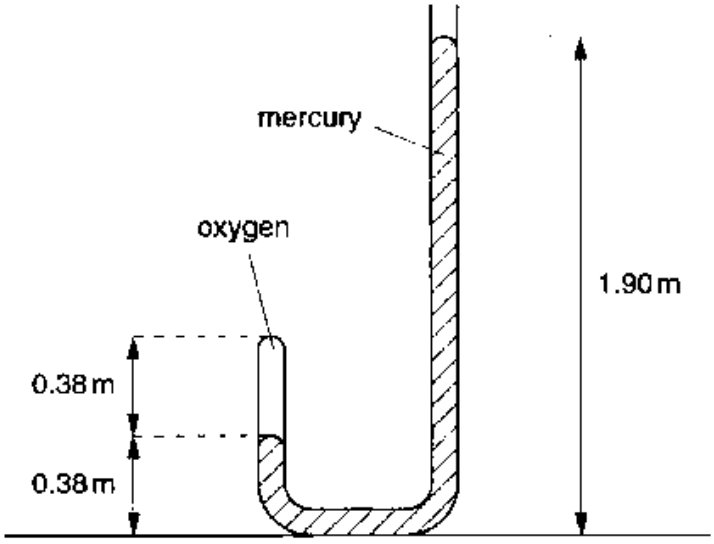
5 A trolley of mass 0.50 kg moves with a certain acceleration down a runway which is inclined to the horizontal at 15°. If the angle of inclination is increased to 20°, the acceleration of the trolley would be doubled. What is the frictional force, assumed to be the same in both cases, acting on the trolley?

A 0.12 N **B** 0.41 N **C** 0.86 N **D** 4.9 N

6 A 5.00 kg object moves at 15.0 m s^{-1} makes a head-on collision with a 10.0 kg object which was at rest. Both the objects coalesce and move off with a common velocity. How much kinetic energy is lost in the collision?

A 188 J **B** 375 J **C** 563 J **D** 702 J

7 Oxygen is compressed in the sealed end of a long J-tube by means of a column of mercury open to the atmosphere, as shown.

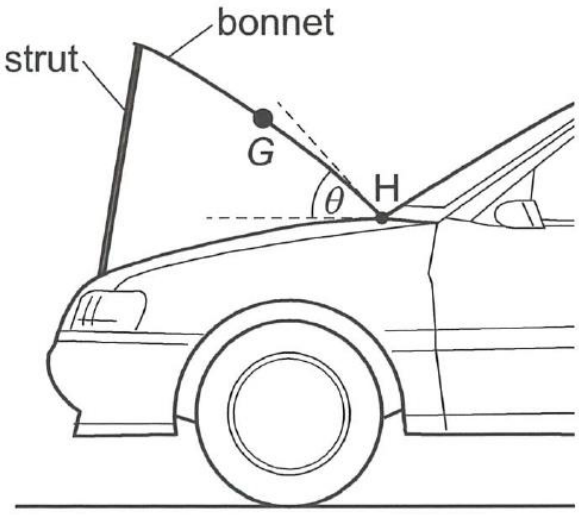


Mercury has density 13.6×10^3 kg m^{-3} and atmospheric pressure 1.01×10^5 Pa.

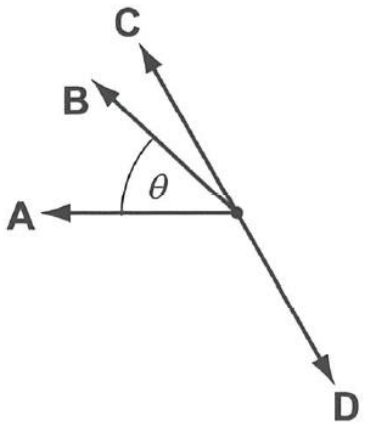
What is approximate value of $\frac{\text{pressure of oxygen}}{\text{pressure of atmosphere}}$?

A 1.5 **B** 2.0 **C** 2.5 **D** 3.0

8 To inspect the engine of a car, the bonnet, hinged at H, is held open by a strut. The weight of the bonnet acts through its centre of gravity *G.*



Which arrow best represent the approximate direction of the force on the bonnet at the hinge H?



9 A body of mass *m* moves at constant speed *v* for a distance *s* against a constant *F*. What is the power required to sustain this motion?

A mv **B** $\frac{1}{2}mv^2$ **C** $\frac{1}{2}Fs$ **D** Fv

10 A mass of 2 kg rotates at a constant speed in a horizontal circle of radius 5 m and the time for one complete revolution is 3 s. The force acting on the mass is

A $\frac{20\pi^2}{3}$ N **B** $\frac{20\pi^2}{9}$ N **C** $\frac{40\pi^2}{9}$ N **D** $\frac{100\pi^2}{9}$ N

11 Two stationary particles of masses M_1 and M_2 are a distance d apart. A third particle of mass m, lying on the line joining the particles, experiences no resultant gravitational force.

What is the distance of this particle of this mass from M_1?

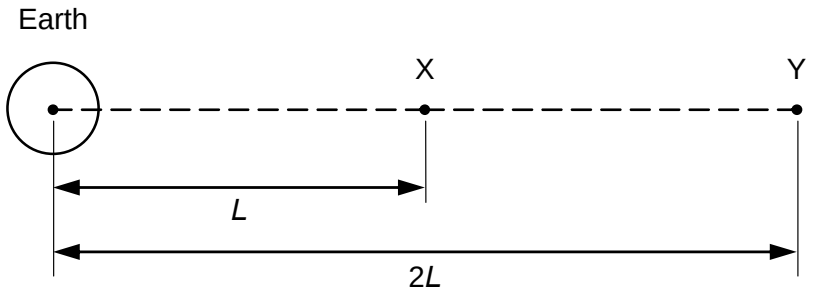
A $d\sqrt{\frac{M_1}{M_2}}$

B $d\left(\frac{M_1}{M_1+M_2}\right)$

C $d\left(\frac{\sqrt{M_1}}{\sqrt{M_1}+\sqrt{M_2}}\right)$

D $d\sqrt{\frac{M_1}{M_1+M_2}}$

12 The diagram shows two points X and Y at distance L and $2L$, respectively, from the centre of the Earth. The gravitational potential at X is -8 kJ kg^{-1}.



What is the gain in gravitational potential energy of a 2 kg mass when it is moved from X to Y?

A – 8 kJ **B** – 4 kJ **C** + 4 kJ **D** + 8 kJ

13 Which of the following statements is not correct?

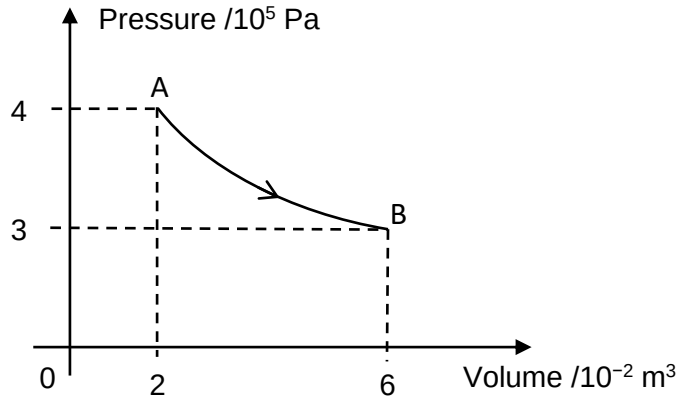
A The microscopic potential energy of an ideal gas is zero.

B Two bodies in thermal equilibrium have no heat flow between them.

C During the melting of ice, there is no increase in temperature.

D The average kinetic energy of a gas molecule is proportional to its thermodynamic temperature.

14 An ideal gas is enclosed in a cylinder by a gas-tight, frictionless piston. The gas then undergoes changes along the path as shown in the figure below (not to scale).



Which of the following statement is valid?

A There is no change in the internal energy of the gas.

B Work is done on the gas.

C The average kinetic energy of the gas molecules is the same at both states A and B.

D Heat is gained by the gas.

15 Which statements about internal energy is correct?

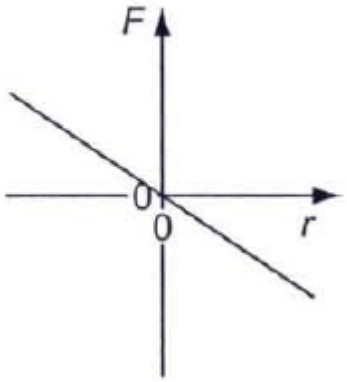
A The internal energy of a system depends only on its temperature.

B The internal energy of a system can be increased without heating.

C When the internal energy of a system is increased, its temperature always rises.

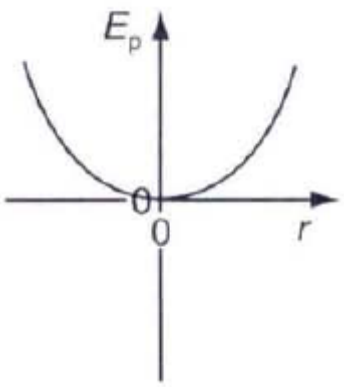
D When two systems have the same internal energy, they must be at the same temperature.

16 A particle is moving such that the force F on it changes with the distance r from a fixed point as shown.

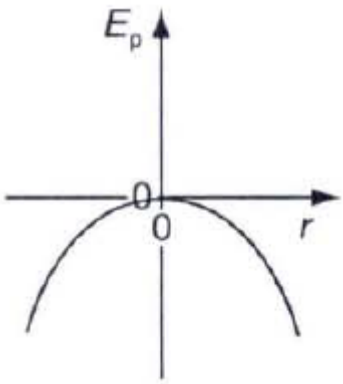


Which graph best shows the relationship between the potential energy E_p of the particle and the distance r?

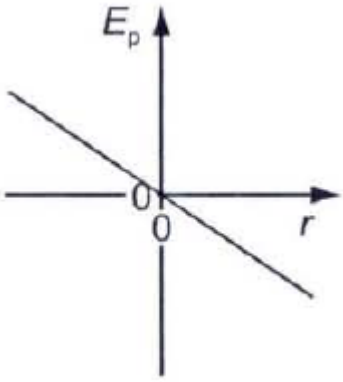
A



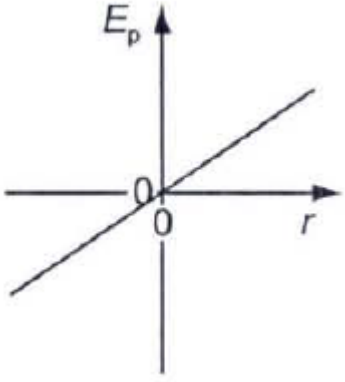
B



C



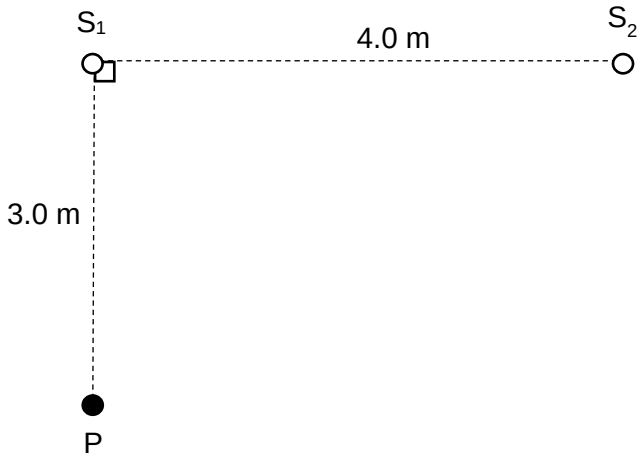
D



17 A sound wave of frequency 400 Hz is travelling in air at a speed of 320 m s^{-1}. What is the difference in phase between two points on the wave 0.2 m apart in the direction of travel?

A $\frac{\pi}{4}$ rad **B** $\frac{\pi}{2}$ rad **C** $\frac{2\pi}{5}$ rad **D** $\frac{8\pi}{5}$ rad

18 Water waves of wavelength 2.0 m are produced by two generators, S_1 and S_2, placed 4 m apart. Each generator, when operated by itself, produces waves which have an amplitude of *A* at point P as shown in the diagram.



When the generators are operating in antiphase, the amplitude of the oscillation at P is

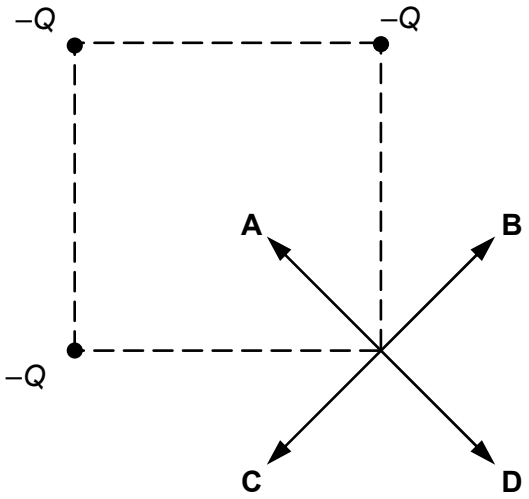
A 0 **B** ½ *A* **C** *A* **D** 2 *A*

19 A student blows gently across the top of a piece of glass tubing, the lower end of which is closed by his finger so that the tube gives its fundamental note of frequency *f*. While blowing, he removes his finger from the lower end. The note he then hears will have a frequency of approximately

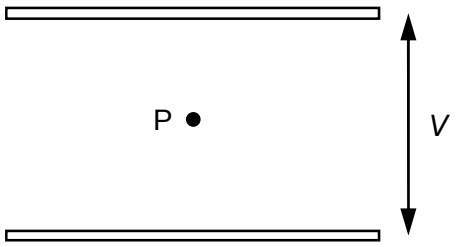
A $\frac{f}{4}$ **B** $\frac{f}{2}$ **C** $2f$ **D** $4f$

20 The diagram shows point charges, each of magnitude *Q* placed at three corners of a square.

What is the direction of the resultant electric field at the fourth corner?



21 A small positively-charged particle P is balanced halfway between two horizontal plates when a potential difference *V* is applied between the plates.



When *V* is increased, P rises towards the upper plate.

Which statement is correct?

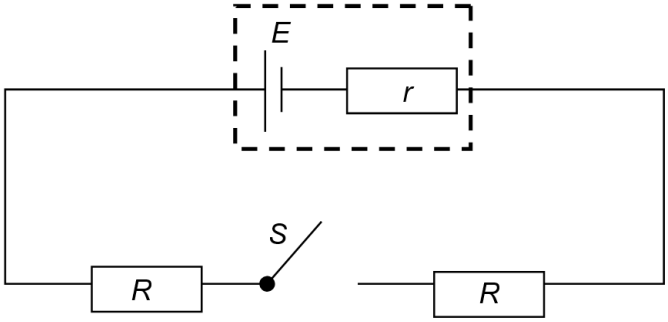
A Decreasing *V* decreases both the gravitational and electric potential energy of the particle.

B Decreasing *V* decreases the gravitational potential energy and increases the electric potential energy of the particle.

C Increasing *V* increases both the gravitational and electric potential energy of the particle.

D The change of electric potential energy of the particle must equal the change of gravitational potential energy of the particle.

22 A battery, with an e.m.f *E* and internal resistance *r*, is connected to a switch *S* and two identical resistors in series. Each resistor has resistance *R*.



Which one of the following statements is correct when the switch *S* is closed?

When an ideal voltmeter is connected

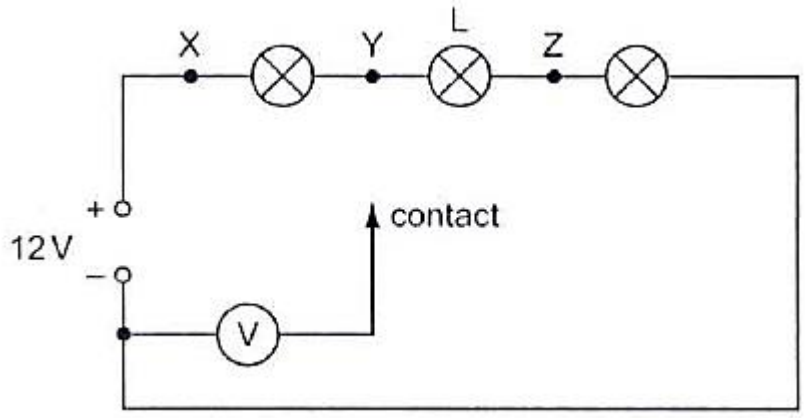
A across one resistor, the voltmeter's reading is 0.5 *E*.

B across two resistors, the voltmeter's reading is *E*.

C across the battery, the voltmeter's reading is *E*.

D across the battery, the voltmeter's reading is less than *E*.

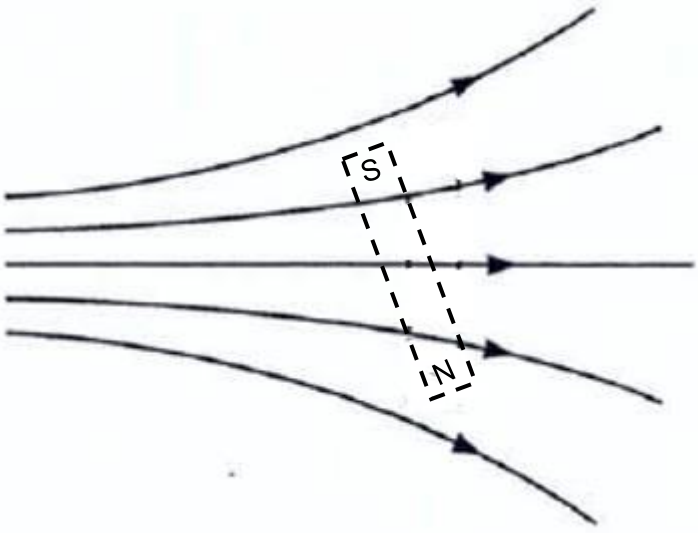
23 The diagram shows three lamps in series with a 12 V supply.



To test the circuit, the contact is connected in turn to points X, Y and Z. The lamps **do not light** because lamp L has a broken filament.
Which of the following is correct?

	reading at X	reading at Y	reading at Z
A	12 V	8 V	4 V
B	8 V	8 V	0 V
C	12 V	12 V	0 V
D	8 V	12 V	4 V

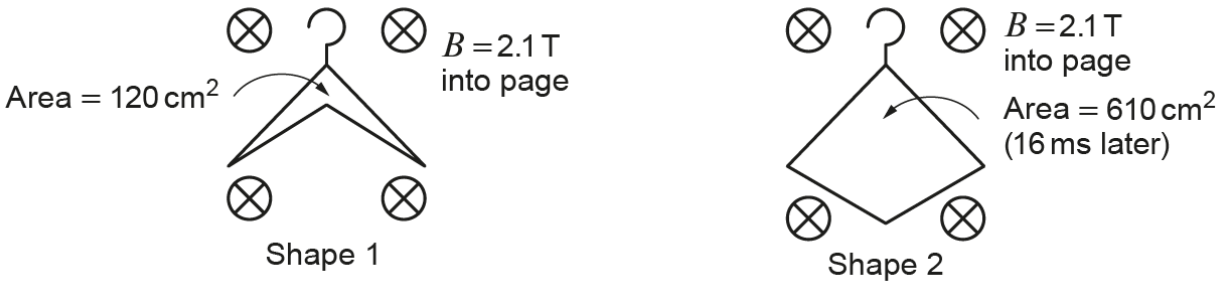
24 A bar magnet is to be placed in a non-uniform magnetic field as shown.



Which line of the table describes the subsequent motion of the magnet?

	rotation	movement
A	anticlockwise	to the left
B	anticlockwise	to the right
C	clockwise	to the left
D	clockwise	to the right

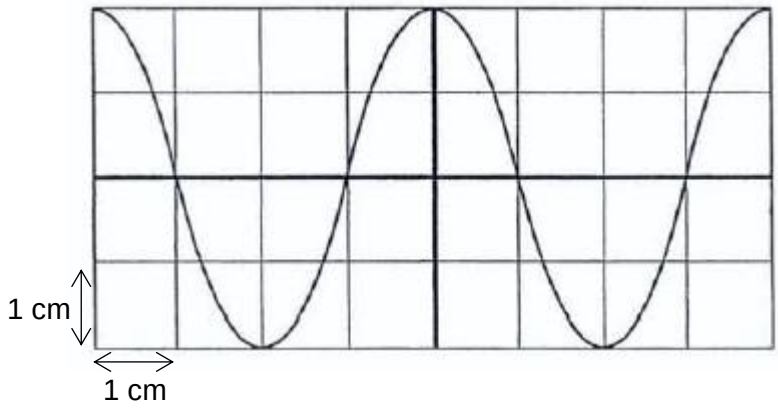
25 An experiment is carried out in a very strong uniform magnet in order to confirm the Faraday's Law under extreme conditions. A coat hanger made of aluminum wire is bent from Shape 1 to Shape 2 in a time of 16 ms as shown below.



What is the magnitude of the average e.m.f. induced in the hanger?

A 0 V **B** 6.4×10^{-3} V **C** 6.4 V **D** 64 V

26 A cathode-ray oscilloscope (c.r.o.) screen with a grid of 1 cm squares displays an alternating voltage waveform. The Y-plates sensitivity of c.r.o is 0.50 V cm^{-1} and the time-base setting is 5.0 ms cm^{-1}.



The voltage V of this waveform is related to time t by the expression

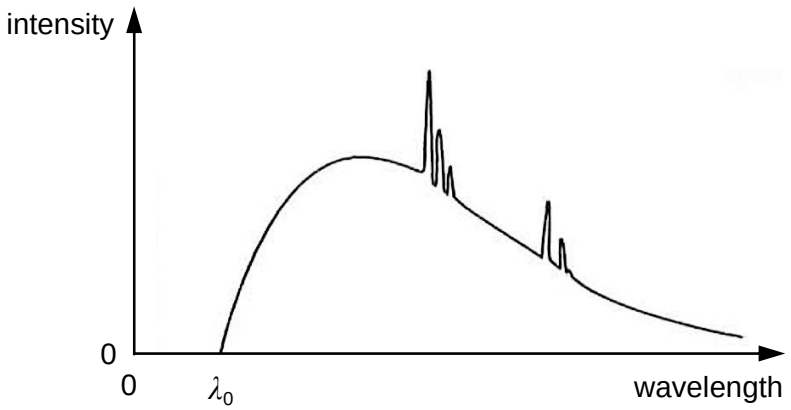
A $V = 1.0 \cos 50\,t$

B $V = 2.0 \cos 50\,t$

C $V = 1.0 \cos 310\,t$

D $V = 2.0 \cos 310\,t$

27 An electron is accelerated from rest through a potential difference (p.d.) of 8.0 kV in a vacuum and incident on a tungsten target to produce X-ray spectrum below.



λ_0 is the minimum wavelength of the spectrum.

The potential difference is reduced to 6.0 kV.

What is the ratio $\frac{\text{minimum wavelength when p.d. is 6.0 kV}}{\text{minimum wavelength when p.d. is 8.0 kV}}$?

A 0.5 **B** 0.75 **C** 1.3 **D** 1.5

28 An electron of mass 9.11×10^{-31} kg travelling at 3.00×10^{7} m s^{-1} passes through a narrow slit of width 1.00×10^{-10} m.

What is the uncertainty in the momentum of the electron after passing through the slit?

A 6.63×10^{-24} kg m s^{-1}

B 2.73×10^{-23} kg m s^{-1}

C 7.28×10^{6} kg m s^{-1}

D 1.00×10^{9} kg m s^{-1}

29 In the Rutherford scattering experiment most α-particles passed through the foil undeflected. Which one of the following is a correct conclusion from this result?

A The atom is overall electrically neutral.

B The nucleus is positively charged.

C The diameter of the nucleus is much less than the diameter of the atom.

D Mass of electrons is negligible compared to the mass of nucleus.

30 A student placed different types of radioactive sources which can emit alpha, beta and gamma radiation into an aluminium container of 10 mm thick. He uses a Geiger-Muller tube to read the radiation outside the container. The Geiger-Muller counter register counts from

A gamma radiation only.

B alpha particles and beta particles only.

C beta particles and gamma radiation only.

D alpha particles, beta particles and gamma radiation.

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