TEMASEK JUNIOR COLLEGE
2021 JC2 PRELIMINARY EXAMINATION
Higher 2

PHYSICS

9749/01

Paper 1 Multiple Choice

16 September 2021

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 Civics group on the Answer Sheet in the spaces provided.

There are **thirty** questions in 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.

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.

Do NOT open the booklets until you are told to do so.

This booklet consists of **16** printed pages.

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	$\phi = -Gm/r$
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.	$v = v_0 \cos \omega t = \pm\omega\sqrt{x_0^2 - x^2}$
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	$V = Q/(4\pi\varepsilon_0 r)$
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	$\lambda = \frac{\ln 2}{t_{\frac{1}{2}}}$

1 Which of the following expressions has the same SI base units as electric potential difference?

A $\frac{\text{length} \times \text{mass}}{\text{current} \times \text{time}}$

B $\frac{\text{length} \times \text{mass}}{\text{current} \times (\text{time})^3}$

C $\frac{(\text{length})^2 \times \text{mass}}{\text{current} \times \text{time}}$

D $\frac{(\text{length})^2 \times \text{mass}}{\text{current} \times (\text{time})^3}$

2 A straight river is flowing from west to east with a speed 0.50 m s^{-1}. A man can swim in still waters at a speed 0.80 m s^{-1}.

In which direction should the man swim to take the shortest path from the south bank to the north bank?

A 39° east of north

B 51° east of north

C 39° west of north

D 51° west of north

3 The density of a steel ball was determined by measuring its mass and diameter. The mass was measured within 1% and the diameter within 3%. The error in the calculated density of the steel ball is at most

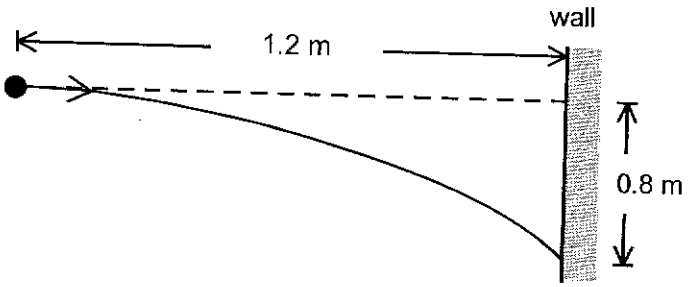
A 2%

B 4%

C 8%

D 10%

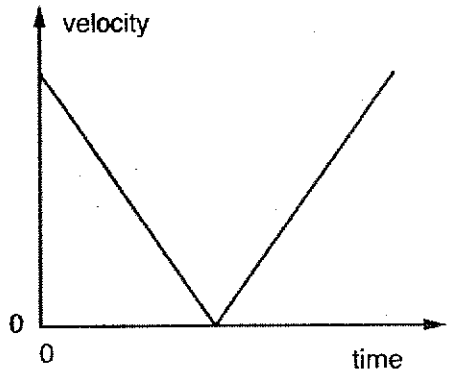
4 A small object is thrown horizontally towards a vertical wall 1.2 m away. It hits the wall 0.8 m below its initial horizontal level.



At what speed does the object hit the wall? (Neglect air resistance.)

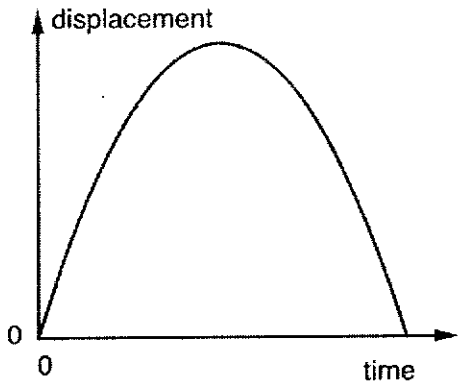
A 2 m s^{-1} **B** 3 m s^{-1} **C** 5 m s^{-1} **D** 7 m s^{-1}

5 The graph shows how the velocity of a moving body varies with time.

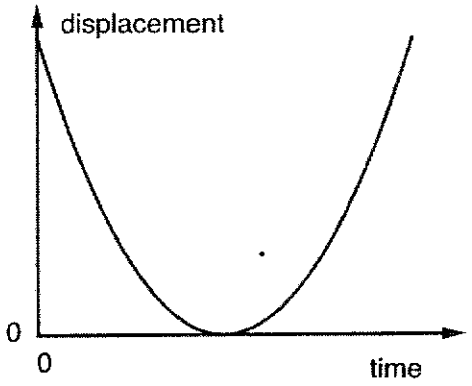


Which one of the displacement-time graphs below represents the same motion?

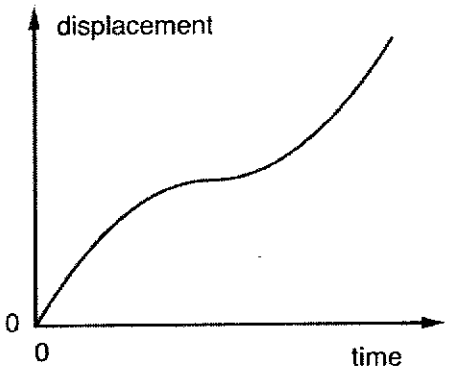
A



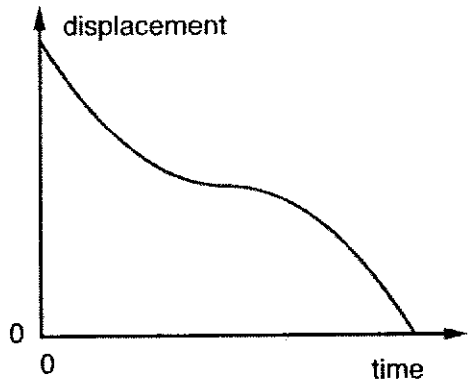
B



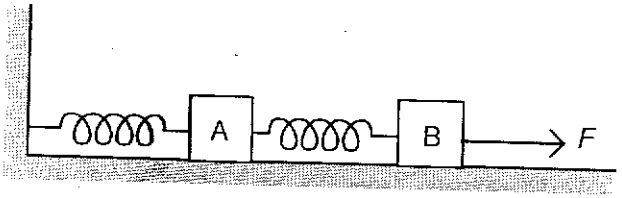
C



D



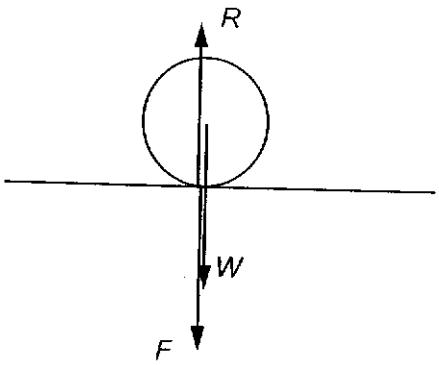
6 Two boxes A and B of equal mass m are connected by two identical light springs and are placed on a horizontal smooth surface. A horizontal force F is applied to box B so that the system is in equilibrium.



If the applied force F is suddenly removed, what are the magnitudes of the acceleration of each box at the instant when force F is removed?

	acceleration of box A	acceleration of box B
A	zero	$\frac{F}{m}$
B	zero	$\frac{F}{2m}$
C	$\frac{F}{2m}$	$\frac{F}{m}$
D	$\frac{F}{m}$	$\frac{F}{2m}$

7 A ball is at rest on the ground. The diagram shows three forces of equal magnitude.



The forces represented in the diagram are

W = weight of ball
F = force by ball on ground
R = normal contact force by ground on ball

Which row in the table shows Newton's first and third laws being applied correctly?

	Newton's first law	Newton's third law
A	$F = W$	$R = F$
B	$R = F$	$W = R$
C	$W = R$	$F = W$
D	$W = R$	$R = F$

[Turn over

8 A thin plastic bag is found to have a mass m when empty and pressed flat. When the bag is filled with air at atmospheric pressure and re-weighed on a weighing scale, the mass is again found to be m.

What is the correct reason?

A The gravitational field strength is constant at 9.81 N kg^{-1}.

B The density of air inside and outside the bag is the same.

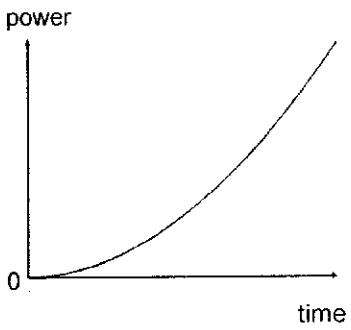
C The upthrust experienced by the flat and the inflated plastic bag is the same.

D The weight of the bag when flat and when inflated is the same.

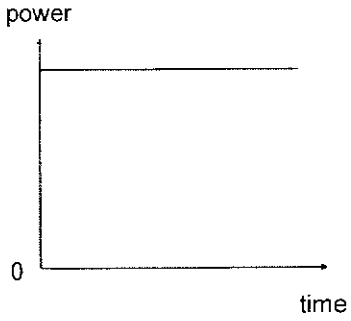
9 A constant force is applied on a box resting on a frictionless surface. (Assuming air resistance is negligible)

Which of the following graphs best represents the variation of power supplied with time?

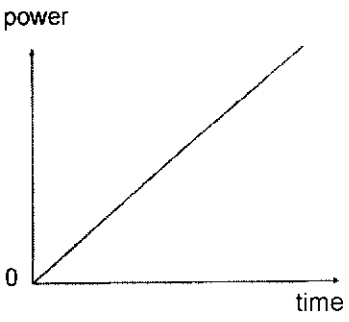
A



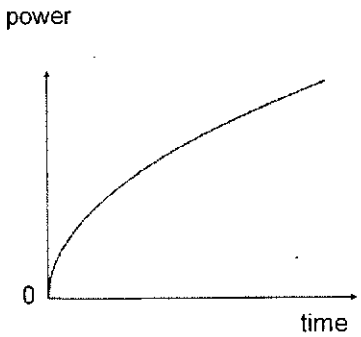
B



C



D



10 Two wooden cubes of masses 100 g and 25 g are placed at different positions from the centre of a turntable. When the turntable rotates at a constant rate, both cubes remain at the same positions on the turntable. The frictional force acting on each cube is proportional to its weight.

What is the ratio of the distance from the centre of the turntable of the 100 g cube to that of the 25 g cube?

A 0.25 B 1.0

C 2.0 D 4.0

11 A simple pendulum is released from rest at A.

What is the tension in the string when the pendulum is at position B where the string is vertical, given that the mass of the bob is m and the length of the pendulum is L?

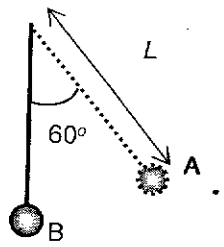


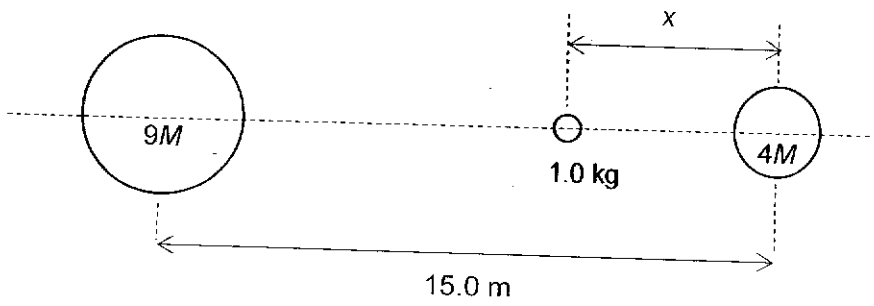
Diagram not to scale

A 0.87 mg B mg C 1.27 mg D 2 mg

12 A 1.0 kg mass is placed between two masses of mass $9M$ and $4M$ respectively. The distance between the two masses is 15.0 m.

If the net gravitational force due to the two masses on the 1.0 kg mass is zero, what is the distance x?

(Diagram is not to scale)

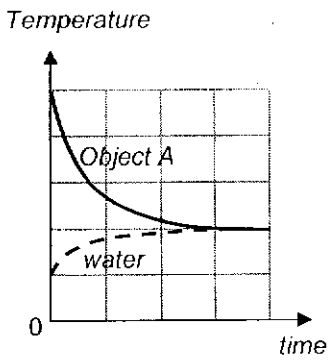


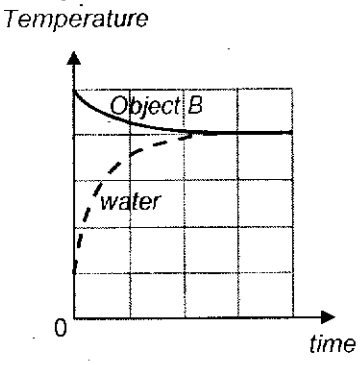
A 3.0 m B 4.0 m C 5.0 m D 6.0 m

[Turn over

13 Object A is dropped into water inside a thermally insulated container of negligible heat capacity. The object and water are then allowed to come to thermal equilibrium.

The experiment is repeated with a different object, B. The two objects have the same mass and initial temperature, and the mass and initial temperature of the water are the same in the two experiments. For each of the experiments, the following graphs show the variation with time of the temperatures of the object and the water.





If c_A and c_B are the specific heat capacities of object A and object B respectively, what is the relationship between c_A and c_B ?

A $c_A = \frac{1}{9} c_B$ **B** $c_A = \frac{1}{3} c_B$ **C** $c_A = 3 c_B$ **D** $c_A = 9 c_B$

14 The density of argon at a pressure of 1.00×10^5 Pa and at a temperature of 300 K is 1.60 kg m^{-3}.

What is the root mean square speed of argon atoms at this temperature?

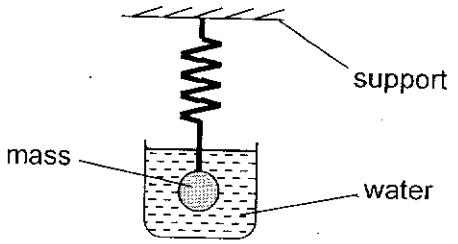
A 216 m s^{-1} **B** 250 m s^{-1} **C** 306 m s^{-1} **D** 433 m s^{-1}

15 A particle oscillates with simple harmonic motion along a straight line with amplitude A. When the displacement of the particle from its equilibrium position is $\frac{A}{2}$, its speed is u.

What is the speed of the particle when it passes the equilibrium position?

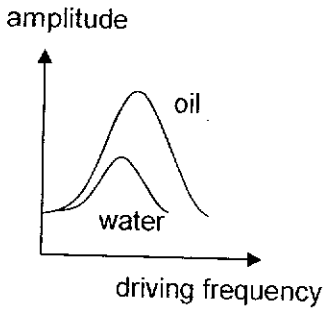
A $\frac{2}{\sqrt{3}} u$ **B** $\sqrt{2}\, u$ **C** $\sqrt{3}\, u$ **D** $4\, u$

16 A mass oscillates vertically in water as shown in the figure below.

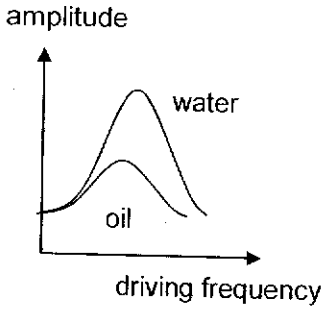


The support vibrates with a driving frequency, which can be varied. Another similar setup is used, with oil replacing water.
Which graph best represents the variation with driving frequency of the amplitude of oscillation of the mass?

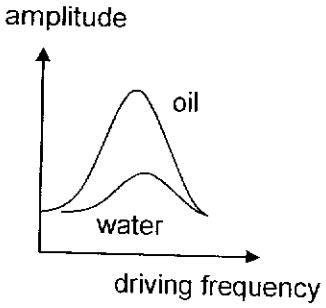
A



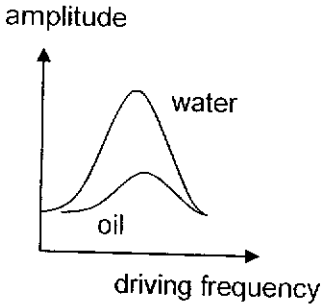
B



C



D



17 A satellite orbiting at a height of 500 km above the surface of the Earth, has two reflecting panels separated by a distance of 5.00 m. The panels reflect light of wavelength 500 nm towards an observer on the Earth's surface.

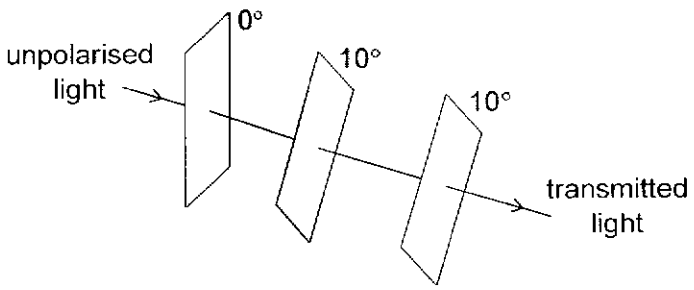
The observer views the panels with a telescope that has an aperture diameter of 10.0 cm. Assume that the panels act as point sources of light for the observer.

Which of the following is correct?

	Will the two images seen by the observer be resolved?	Angular separation of two sources as measured from aperture / rad
A	Yes	2.50×10^{-6}
B	Yes	1.00×10^{-5}
C	No	2.50×10^{-6}
D	No	5.00×10^{-6}

18 A narrow, parallel beam of unpolarised light of Intensity I_o is directed towards three ideal polarising filters.

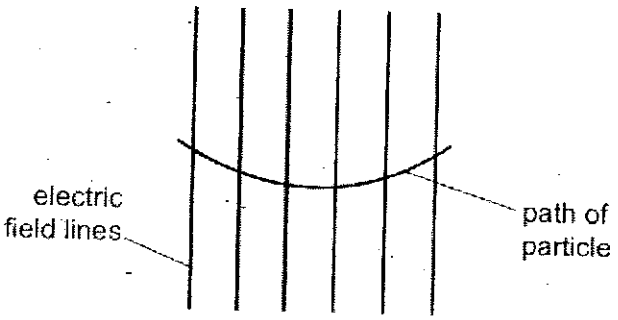
The beam meets the first filter with its axis of polarisation vertical. The axis of polarisation of the second filter is at an angle of 10° to the first filter. The third filter has its axis of polarisation parallel to the second filter as shown.



The third filter is now turned and at 34° to the second filter. What is the intensity of the transmitted light?

A $0.25I_o$ **B** $0.33I_o$ **C** $0.5I_o$ **D** I_o

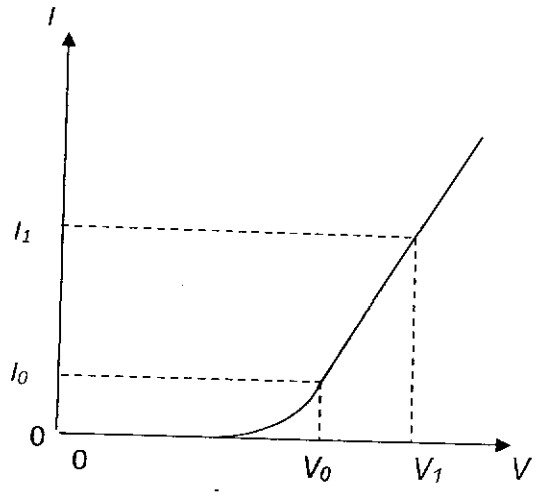
19 The diagram shows the path of a charged particle through a uniform electric field, having vertical field lines.



What could give a path of this shape?

A A positive charge travelling left to right in a field directed downwards.
B A positive charge travelling right to left in a field directed downwards.
C A negative charge travelling right to left in a field directed upwards.
D A negative charge travelling left to right in a field directed downwards.

20 The graph shows the current-voltage (*I*-*V*) characteristic of an electrical component.

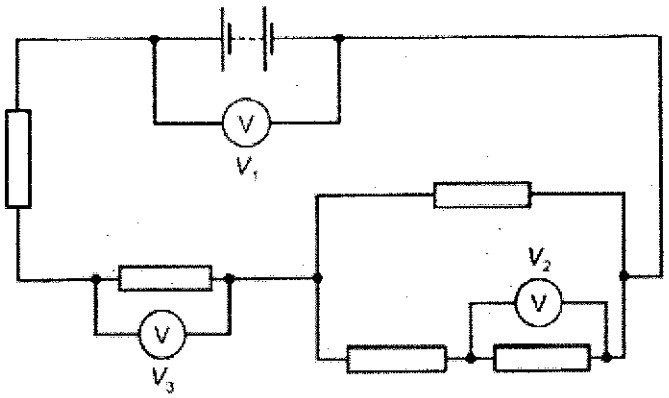


What is the resistance of the component at potential difference V_1 and how does the resistance change, if at all, when the potential difference increases from V_0 to V_1?

	resistance at V_1	**resistance change from V_0 to V_1**
A	$\frac{V_1 - V_0}{I_1 - I_0}$	no change
B	$\frac{V_1 - V_0}{I_1 - I_0}$	decreases
C	$\frac{V_1}{I_1}$	no change
D	$\frac{V_1}{I_1}$	decreases

[Turn over

21 In the circuit shown, all the resistors are identical.



The reading V_1 is 8.0 V and the reading V_2 is 1.0 V.

What is the reading V_3?

A 1.5 V **B** 3.0 V **C** 4.5 V **D** 6.0 V

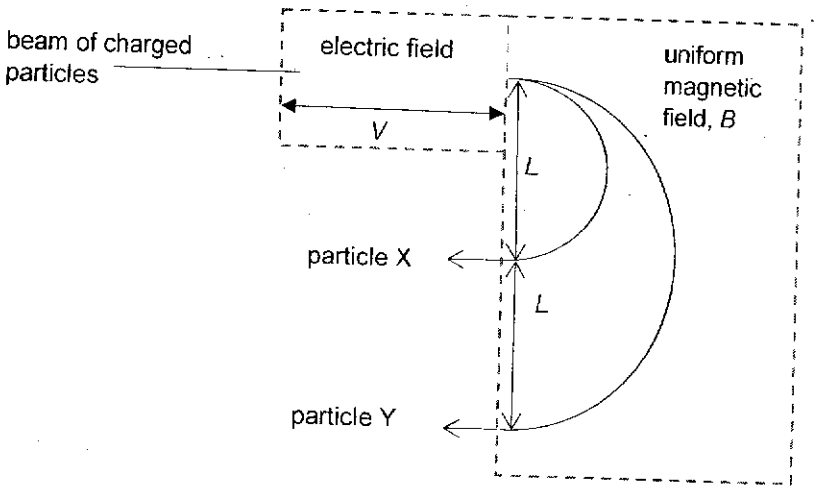
22 Two wires each of length L are used to connect an a.c. power supply to a lamp. The a.c power supply has a peak voltage of 12 V and negligible internal resistance.

The r.m.s potential difference across the lamp is 7.00 V. The r.m.s current in the wires is 2.50 A. Each wire is made of a metal of resistivity 1.70×10^{-8} Ω m and has a cross-sectional area of 6.00×10^{-7} m^2.

What is the length L of each wire?

A 10.5 m **B** 21.0 m **C** 35.3 m **D** 58.8 m

23 A beam consists of two different particles X and Y. Initially of negligible energy, they are both accelerated through the same potential difference V before entering a region with uniform magnetic field of strength B. Particles X and Y exit from the magnetic field at distance L and $2L$ from the entry point respectively.



α_X and α_Y are the mass to charge ratio of particles X and Y respectively. Which of the following is correct?

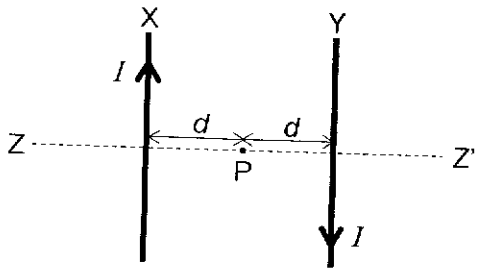
A $2\,\alpha_X = \alpha_Y$

B $\alpha_X = 2\,\alpha_Y$

C $4\,\alpha_X = \alpha_Y$

D $\alpha_X = 4\,\alpha_Y$

24 Two infinitely long straight conductors X and Y are placed parallel to each other. Each conductor carries a current I. Point P is equidistant from either conductor.
X is fixed while Y is rotated about the axis ZZ' until it is perpendicular to X and its current is out of the plane of the paper.



Which of the following statements describing what happens during the rotation is incorrect?

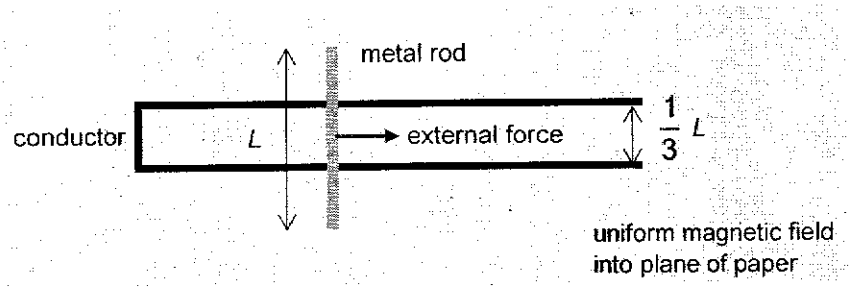
A X experiences a force to the left that decreases to zero.

B The forces on X and Y are always equal in magnitude and opposite in direction.

C The resultant magnetic flux density at P decreases to a value that is $\sqrt{2}$ times the flux density due to each wire at P.

D The resultant magnetic flux density at P decreases to a value that is equal to the flux density due to either wire at P.

25 A metal rod of length L and resistance per unit length r is placed on the parallel section of a smooth conductor of negligible resistance. A uniform magnetic field B is directed perpendicularly into the paper.



The two parallel sections are separated by $\frac{1}{3}L$. An external force causes the metal rod to slide at constant speed v.

Which expression gives the magnitude of the external force?

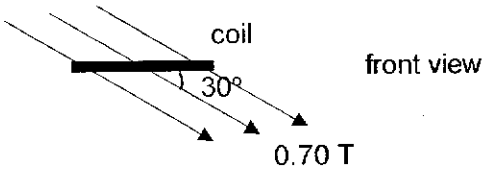
A $\frac{3B^2Lv}{r}$

B $\frac{B^2Lv}{r}$

C $\frac{B^2Lv}{3r}$

D $\frac{B^2Lv}{9r}$

26 A square coil of area 16.0 cm^2 and resistance $2.0 \times 10^{-3}\ \Omega$ is mounted with its plane horizontal. The coil is situated in a magnetic field of strength 0.70 T directed downwards at 30° to the plane of the coil.



When the magnetic field is switched off, it decreases to zero at a uniform rate in 0.80 s.

What is the charge induced in the loop during the change in the magnetic field?

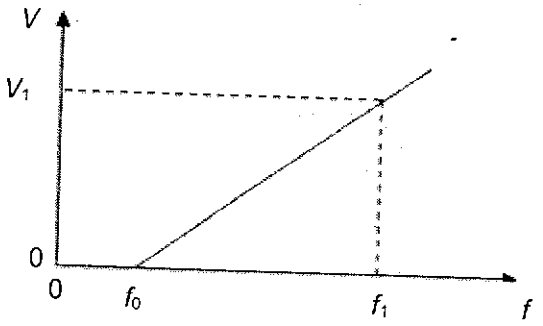
A 0.28 C

B 0.48 C

C 0.56 C

D 0.96 C

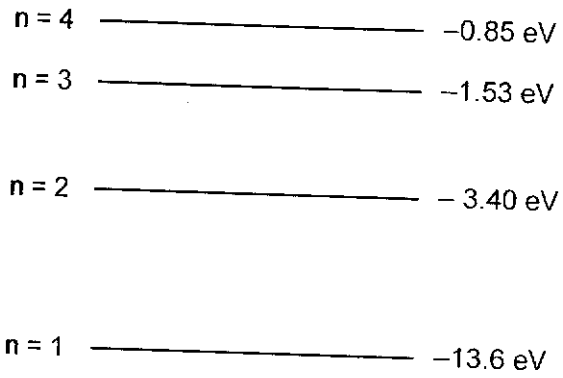
27 In a photoelectric experiment, the potential difference V that must be maintained between the illuminated surface and the collector so as to just prevent any electrons from reaching the collector is determined for different frequencies f of the incident light. The graph below is obtained.



What is the maximum kinetic energy of the electron emitted at frequency f_1?

A hf_1 **B** $h(f_1 - f_0)$ **C** $eV_1 - hf_0$ **D** $\frac{V_1}{f_1 - f_2}$

28 The figure shows the four lowest energy levels of a hydrogen atom. It is known that the wavelength of visible light ranges from 400 nm to 700 nm.

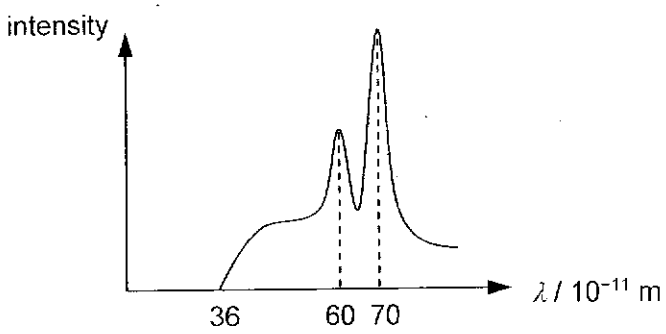


If electrons having kinetic energy of 12.5 eV are used to bombard a large number of hydrogen atoms at room temperature, how many spectral lines in the visible region can be obtained subsequently?

A 0 **B** 1 **C** 2 **D** 3

[Turn over

29 X-ray tubes generate X-rays by accelerating electrons across a vacuum and bombarding them into a metal target. The X-ray spectrum of a metal target is shown in the figure below.



Which of the following statements is incorrect?

A The smallest wavelength detected, 36×10^{-11} m, is dependent on the maximum kinetic energy of the electrons.

B The wavelength detected at 50×10^{-11} m is due to photon emitted as a result of energy loss when an electron passes near the atom and its path is deflected.

C The locations of the peaks can be used to identify the element that the target material is made of.

D The positions of the peaks allow us to calculate the energy of the electrons used to bombard the target.

30 Two samples of radioactive nuclides X and Y are prepared. Y has twice the initial activity and twice the half-life of X.

What is the ratio of the activity of X to Y after 6 half-lives of X?

A $\frac{1}{2}$ **B** $\frac{1}{4}$ **C** $\frac{1}{8}$ **D** $\frac{1}{16}$

2021 H2 Prelim Paper 1 Solutions:

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D	D	A	D	A	B	B	B	D	D
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B	A	C	D	C	A	B	B	D	D

1 **D** Units of electric potential difference = Units of (work done / charge) = Units of (force x displacement / (current x time))

SI base units of p.d. are N m / (A s) = kg m^2 s^{-2} A^{-1} s^{-1} = kg m^2 A^{-1} s^{-3}

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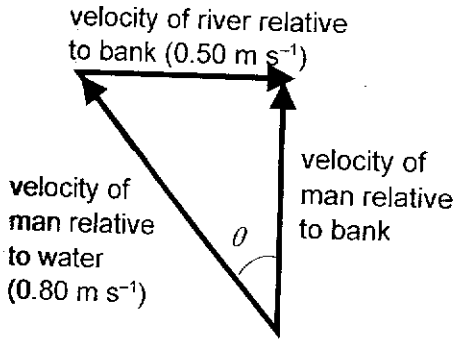

$\sin\theta = 0.50/0.80$

$\theta = 39°$

3 **D**

$$\rho = \frac{M}{V} = \frac{M}{\frac{4}{3}\pi\left(\frac{d}{2}\right)^3}$$

$$\frac{\Delta\rho}{\rho} = \frac{\Delta M}{M} + 3\left(\frac{\Delta d}{d}\right)$$

$$\frac{\Delta\rho}{\rho}\times 100\% = \frac{\Delta M}{M}\times 100\% + 3\left(\frac{\Delta d}{d}\right)\times 100\%$$

$= 1+3(3) = 10\%$

4 **C** $s_y = ½gt^2$

$0.8 = ½ (9.81)t^2$

$t = 0.40$ s

$v_x = 1.2/0.40 = 3.0$ m s^{-1}

$v_y = gt = 9.81(0.40) = 3.9$ m s^{-1}

$v^2 = 3.0^2 + 3.9^2$

$v = 4.9 \approx 5$ m s^{-1}

OR $½ mv^2 = ½ mu^2 + mgh$

$v^2 = 3.0^2 + 2(9.81)(0.8)$

$v = 5$ m s^{-1}

5 **C** Velocity is positive throughout, except for when it is zero at midpoint. Hence, gradient of displacement graph must be increasing throughout, except at midpoint when gradient is zero.

6 **A** At equilibrium the two forces acting on A are equal and opposite. Same applies for B.

When *F* is removed, B experiences a net force equal to *F* towards the left. A has not yet experienced any net force as the initial tension on both sides have not changed.

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8 **B** The weight of the air inside the bag is balanced by the upthrust which depends on the density of air outside the bag.

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Since F is constant, a is constant

P= Fat $\propto$ t

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$$\frac{f_1}{f_2} = \frac{m_1 r_1 \omega^2}{m_2 r_2 \omega^2}$$

$$\frac{k(0.100g)}{k(0.025g)} = \frac{(0.100)r_1}{(0.025)r_2}$$

$$\frac{r_1}{r_2} = 1.0$$

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Gain in ke = loss in gpe
½ m v^2 = mg (L- Lcos 60°)
v^2 = Lg

At the bottom:
T – mg = mv^2 /L = m(Lg)/L = mg
T = 2 mg

12 **D** Since net gravitational force is zero,

$$\frac{GM_1 m}{r_1^2} = \frac{GM_2 m}{r_2^2}$$

$$\frac{9M}{(15-x)^2} = \frac{4M}{x^2}$$

$$\frac{3}{15-x} = \frac{2}{x}$$

$$3x = 30 - 2x$$

$$x = 6.0\,\text{m}$$

13 A For water, $(\Delta\theta_{water})_{expt\ B} = 3\ (\Delta\theta_{water})_{expt\ A}$

Gain in heat, $Q_{water} \propto \Delta\theta_{water} \Rightarrow (Q_{water})_{expt\ B} = 3\ (Q_{water})_{expt\ A}$

$\therefore$Loss in heat for objects to water, $Q_B = 3\ Q_A$

For objects, $c \propto \frac{Q}{\Delta\theta}$

$$\frac{c_A}{c_B} = \frac{Q_A}{Q_B}\frac{\Delta\theta_B}{\Delta\theta_A} = \frac{1}{3}x\frac{1}{3} = \frac{1}{9}$$

14 D $P = 1/3\ \rho\ \langle c^2 \rangle$
$1.00 \times 10^5 = 1/3\ (1.60)\ \langle c^2 \rangle$
$\langle c^2 \rangle = 1.86 \times 10^5\ m^2\ s^{-2}$
$C_{rms} = 433\ m\ s^{-1}$

15 A At displacement = $\frac{A}{2}$, $u^2 = \omega^2\left[A^2 - \left(\frac{A^2}{4}\right)\right]$

At displacement = 0, $v^2 = \omega^2 A^2$

Therefore $v = \frac{2}{\sqrt{3}}\ u$

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17 B $s = r\theta$

$$\theta = \frac{s}{r} = \frac{5.00}{500x10^3} = 1.00x10^{-5} rad$$

Min angle of resolution $\theta_m = \frac{\lambda}{b} = \frac{500x10^{-9}}{10.0x10^{-2}} = 5.00x10^{-6}\ rad$

Images seen are resolved since angular separation between two sources is larger than the min angle of resolution.

18 B Using Malus' law,

$I_2 = I_1 \cos^2 10° = \frac{1}{2} I_0 \cos^2 10°$

$I = I_2 \cos^2 34°$

where θ is the angle between the axes of polarisation of the second and third filters

$I = I_2 \cos^2 34° = \frac{1}{2} I_0 \cos^2 10° \cos^2 34°$

$= \frac{1}{2} I_0 \cos^2 10° \cos^2 34° = 0.33 I_0$

19 D The path of the particle indicates that it experiences an upward force. A negatively charged particle (e.g. an electron) in an electric field directed downwards experiences an upward force. Here, the path of the particle is independent of the direction of travel (eg, left to right), and not to be confused with magnetic forces.

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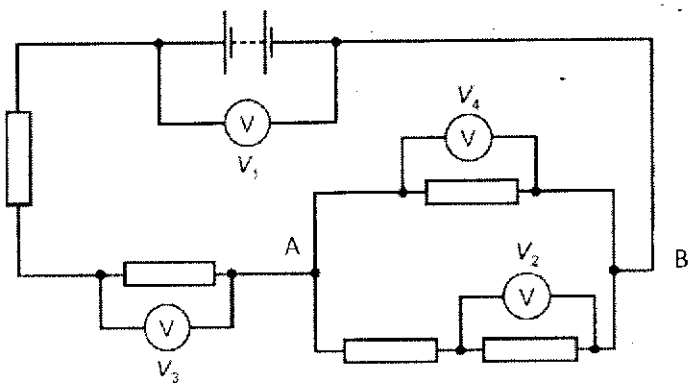

$V_4 = 1.0 + 1.0 = 2.0$ V

$R_{AB} = \frac{2R \times R}{2R+R} = \frac{2}{3}R$

$V_3 = \frac{R}{R + R + \frac{2}{3}R} \times 8.0 = 3.0\ V$

22 A RMS voltage of supply = $12.0/\sqrt{2} = 8.49$ V

p.d. across connecting wires = $8.49 - 7.00 = 1.49$ V

Total resistance of 2 wires $R_T = 1.49/2.50 = 0.594\ \Omega$,

Resistance of 1 wire = $0.297\ \Omega$

$R = \rho L/A \rightarrow L = RA/\rho = 10.5$ m

23 C In electric field

$$\frac{1}{2}mv^2 = qV$$

$$v = \sqrt{\frac{2qV}{m}}$$

In magnetic field,
electromagnetic force provides centripetal force

$$Bqv = \frac{mv^2}{r}$$

$$Bq = \frac{mv}{r} = \frac{m}{r}\sqrt{\frac{2qV}{m}}$$

$$\frac{m}{q} = \frac{B^2r^2}{2V}$$

$$\therefore \frac{m}{q} \propto r^2$$

$$\frac{\alpha_X}{\alpha_Y} = (\frac{L}{2L})^2 = \frac{1}{4}$$

24 **D** Final resultant magnetic flux density =

$$\sqrt{\left(\frac{\mu_o I}{2\pi d}\right)^2 + \left(\frac{\mu_o I}{2\pi d}\right)^2} = \sqrt{2}\left(\frac{\mu_o I}{2\pi d}\right)$$

25 **C**

$$\varepsilon = -B\left(L/3\right)v$$

$$i = \frac{\varepsilon}{r\left(L/3\right)} = \frac{B\left(L/3\right)v}{r\left(L/3\right)} = \frac{Bv}{r}$$

At constant speed, $F_{ext} = F_B$

$$F_{ext} = Bi\left(\frac{L}{3}\right) = B\left(\frac{Bv}{r}\right)\left(\frac{L}{3}\right) = \frac{B^2Lv}{3r}$$

26 **A**

$$\varepsilon_{ind} = \frac{\Delta BA}{t} = \frac{\left(B\sin 30^\circ\right)A}{t}$$

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$$Q = it = \frac{\varepsilon_{ind}}{R}t = \frac{\left(B\sin 30^\circ\right)A}{R}$$

$$= \frac{\left(0.70 \times \sin 30^\circ\right)\left(16.0 \times 10^{-4}\right)}{\left(2.0 \times 10^{-3}\right)}$$

$$= 0.28\ C$$

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$KE_{max} = hf_1 - hf_o$

28 **B** The highest energy level the hydrogen atom can reach is **n** = 3 if max KE is 12.5 eV.

The following transitions and the corresponding wavelengths are:

$\lambda = hc/E = [(6.63 \times 10^{-34})(3.00 \times 10^8)/(1.60 \times 10^{-19})]/\Delta E$ in eV

n = 3 to n = 2: $\lambda = 1.24 \times 10^{-6}/(3.40 - 1.53) = 6.65 \times 10^{-7}$ **m** (red)

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n = 2 to n = 1: $\lambda = 1.24 \times 10^{-6}/(13.6 - 3.40) = 1.22 \times 10^{-7}$ **m**

29 **D** The positions of the peaks are characteristic of the energy levels in the target metal.

30 D

$$A_{o,Y} = 2A_{o,X}$$

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$$A_X = A_{o,X} e^{-\frac{\ln 2}{T_{1/2,X}} t}$$

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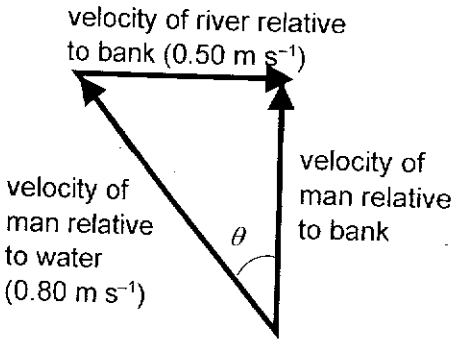

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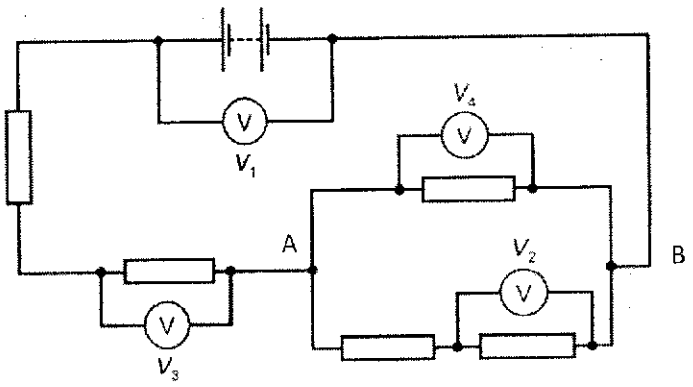

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