Class	Index Number	Name
20S		

ST. ANDREW'S JUNIOR COLLEGE
JC 2 2021
Preliminary Examination

PHYSICS, Higher 2 **9749/01**

Paper 1 Multiple Choice **17th 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, index number and Civics Group 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.

For Examiner's Use	
Total	**/ 30**

This document consists of **15** printed pages including this page.

Data

speed of light in free space	$c = 3.00 \times 10^{8}$ m s^{-1}
permeability of free space	$\mu_o = 4\pi \times 10^{-7}$ H m^{-1}
permittivity of free space	$\varepsilon_o = 8.85 \times 10^{-12}$ 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	$p = \rho g h$
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.	$x = x_o \sin \omega t$
velocity of particle in s.h.m.	$v = v_0 \cos \omega t$
	$v = \pm\omega\sqrt{x_0^2 - x^2}$
electric current	$I = Anvq$
resistors in series	$R = R_1 + R_2 + ...$
resistors in parallel	$1/R = 1/R_1 + 1/R_2 + ...$
electric potential	$V = \frac{Q}{4\pi\varepsilon_0 r}$
alternating current/voltage	$x = x_o \sin \omega t$
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	$B = \frac{\mu_0 N I}{2r}$
magnetic flux density due to a long solenoid	$B = \mu_0 n I$
radioactive decay	$x = x_o \exp(-\lambda t)$

decay constant $\lambda = \frac{\ln 2}{t_{1/2}}$

Answer all questions.

1 Using an ohm-meter, a student measures the resistance of two resistors R_1 and R_2 separately with their associated uncertainties shown as follows:

$R_1 = 200 \pm 5\ \Omega$
$R_2 = 800 \pm 5\ \Omega$

The two resistors R_1 and R_2 are then connected in parallel. He calculated the effective resistance, R to be 160 Ω. What is the uncertainty of the effective resistance?

A 2.5 Ω **B** 3.4 Ω **C** 5 Ω **D** 10 Ω

2 A train, initially at rest at a station, has a uniform acceleration of 0.20 m s^{-2} until it reaches a speed of 20 m s^{-1}. It travels for some time at this constant speed and then has a uniform deceleration of 0.40 m s^{-2} until it comes to rest at the next station. The distance between the two stations is 3000 m.

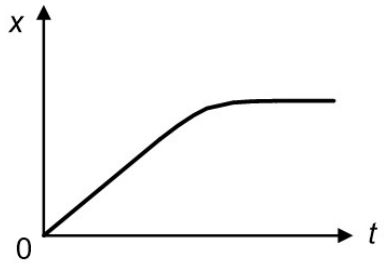
What is the time taken by the train to travel between the two stations?

A 75 s **B** 150 s **C** 230 s **D** 300 s

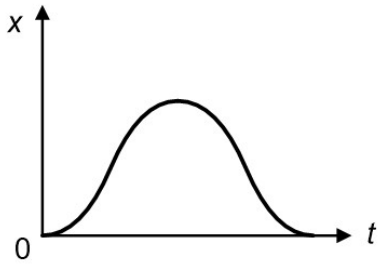
3 A ball bearing is released from rest 10 cm above a tall measuring cylinder which is filled with oil.

Which one of the following graphs best represents the variation with time t of displacement x of the ball bearing?

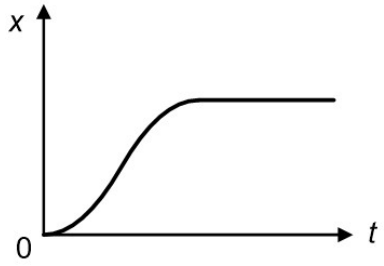
A



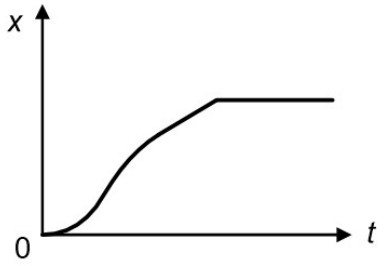
B



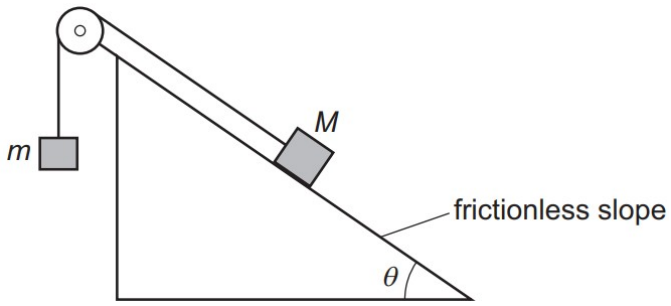
C



D



4 Two masses, *M* and *m*, are connected by an inextensible string which passes over a frictionless pulley. Mass *M* rests on a frictionless slope, as shown.



The slope is at an angle θ to the horizontal.

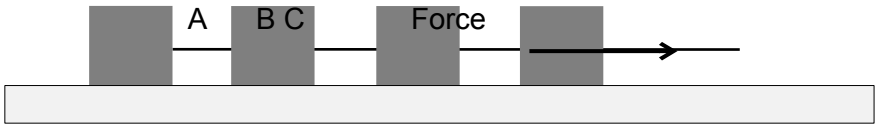
The two masses are initially held stationary and then released. Mass *M* accelerates down the slope.

Which expression must be correct?

A $\sin\theta < \frac{m}{M}$ **B** $\cos\theta < \frac{m}{M}$ **C** $\sin\theta > \frac{m}{M}$ **D** $\cos\theta > \frac{m}{M}$

5 The diagram below shows 4 identical wooden blocks connected by inelastic strings, A, B and C.

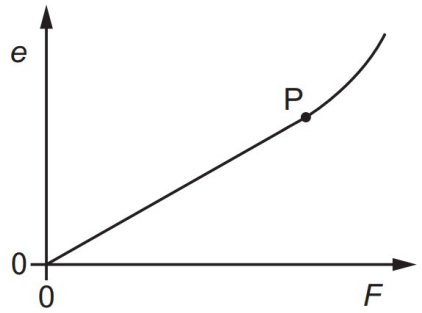
A constant force accelerates the blocks to the right on a horizontal frictionless table.



Which string has the greatest tension?

A String A
B String B
C String C
D All have the same tension

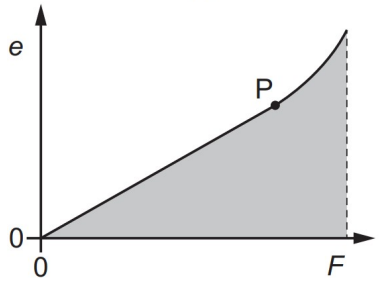
6 Forces are applied to the ends of a rod so that its length increases. The variation with force F of the extension e of the rod is shown.



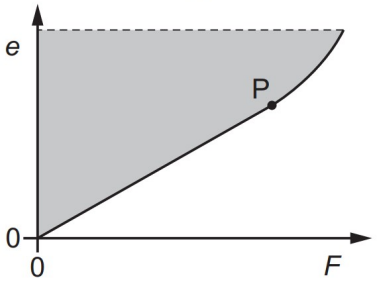
The point P is the elastic limit. Plastic deformation occurs when the rod is extended beyond point P, causing it to be permanently distorted.

Which shaded area represents the work done during the plastic deformation of the rod?

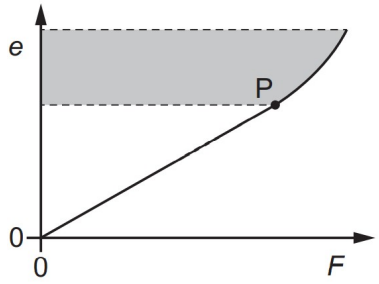
A



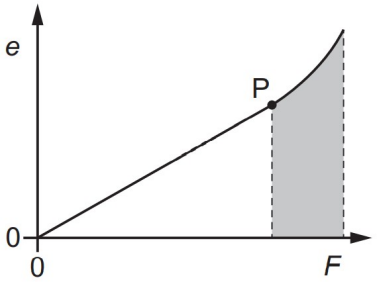
B



C



D



7 A man, carrying a large rock, sits in a boat on a lake. He drops the rock into the lake. Assume the total volume of the water in the lake is constant, the water level of the lake

A increases because the density of the rock is larger than water hence the upthrust acting on it would be larger for equilibrium to occur.

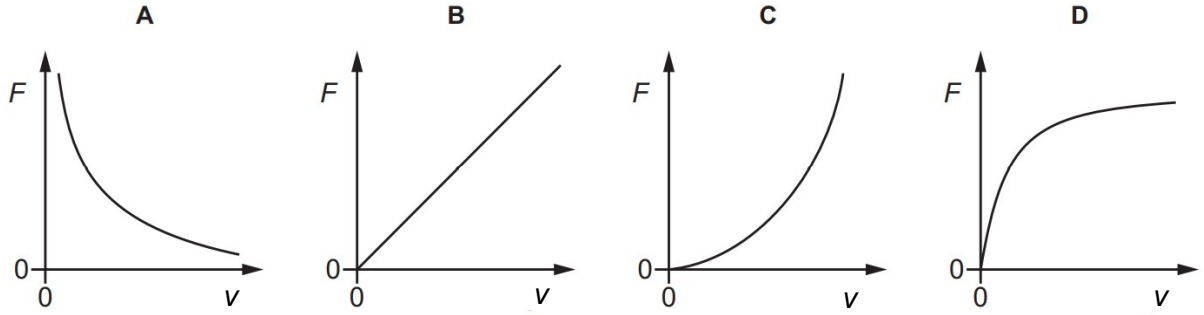
B decreases because the density of the rock is larger than water and hence displaces a smaller volume of water as compared to when it was on the boat.

C remains the same because the total mass of all the objects in the lake remains the same.

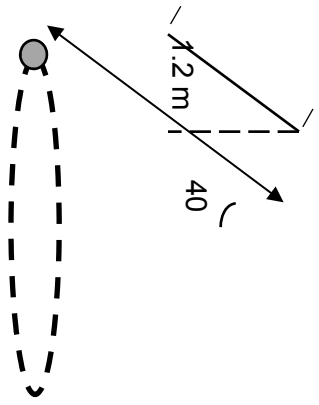
D remains the same because the rock will sink to the bottom of the lake and experience a normal contact force.

8 A body of mass m undergoes uniform circular motion with speed *v*.

Which graph represents the relationship between the force *F* acting on the body and *v*?



9 A simple pendulum of length 1.2 m is swung such that the mass goes round in a uniform circular motion in the horizontal plane. The string makes an angle of 40° with the vertical.



What is the speed of the mass in its circular path?

A 2.5 m s^{-1} **B** 2.8 m s^{-1} **C** 3.0 m s^{-1} **D** 3.3 m s^{-1}

10 The planet Jupiter has satellites called Io and Europa which have different orbital radii and different orbital time periods. The table shows the orbital radii for Io and Europa and the orbital time period of Io.

	orbital radius / km	orbital time period / days
Io	4.22×10^5	1.77
Europa	6.71×10^5	T_E

What is the orbital time period T_E of Europa?

A 0.88 days **B** 2.4 days **C** 2.8 days **D** 3.5 days

11 The gravitational potentials on the surface of a planet P and on the surface of its moon Q are -120 MJ kg^{-1} and -20 MJ kg^{-1} respectively.

The minimum amount of energy required to project a 1 kg mass from the surface of Q to the surface of P is E.

Which of the following correctly describes the value of E?

A $E < 20$ MJ
B $E = 20$ MJ
C 20 MJ $< E <$ 100 MJ
D 100 MJ $< E <$ 120 MJ

12 A sealed tank of gas contains a mixture of nitrogen and oxygen. The tank is at room temperature.

What is the same for the particles of nitrogen and oxygen in the tank?

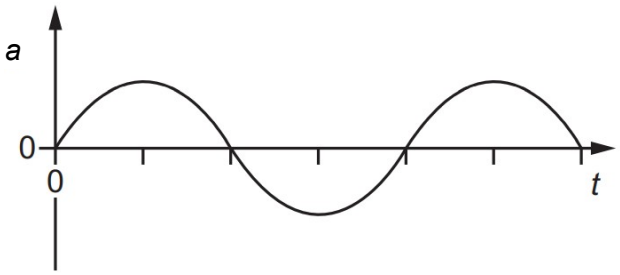
A internal energy
B mean square speed
C mean kinetic energy
D root mean square speed

13 The density of air is 1.20 kg m^{-3} at a temperature of 20 °C and standard atmospheric pressure.

What is the density of air at a temperature of 27 °C and standard atmospheric pressure?

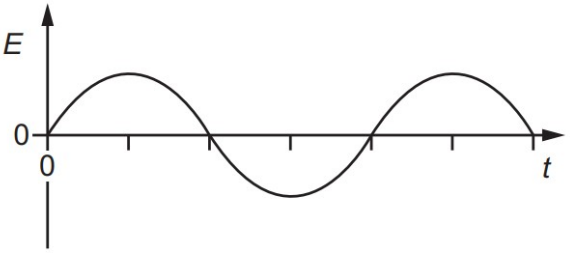
A 0.89 kg m^{-3} **B** 1.17 kg m^{-3} **C** 1.23 kg m^{-3} **D** 1.62 kg m^{-3}

14 An undamped oscillator is executing simple harmonic motion. A graph of the acceleration a against time t for this oscillator is shown.

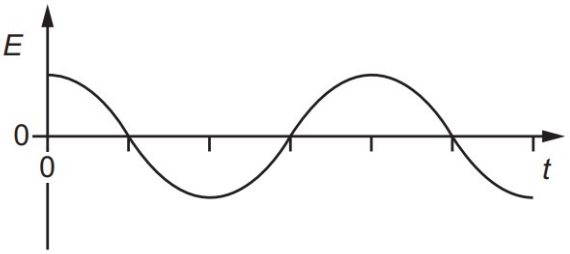


Which graph shows the variation of the kinetic energy E of the oscillator with time t?

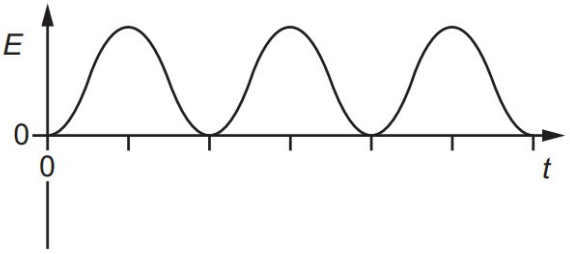
A



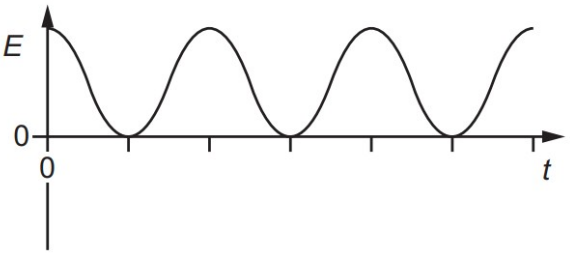
B



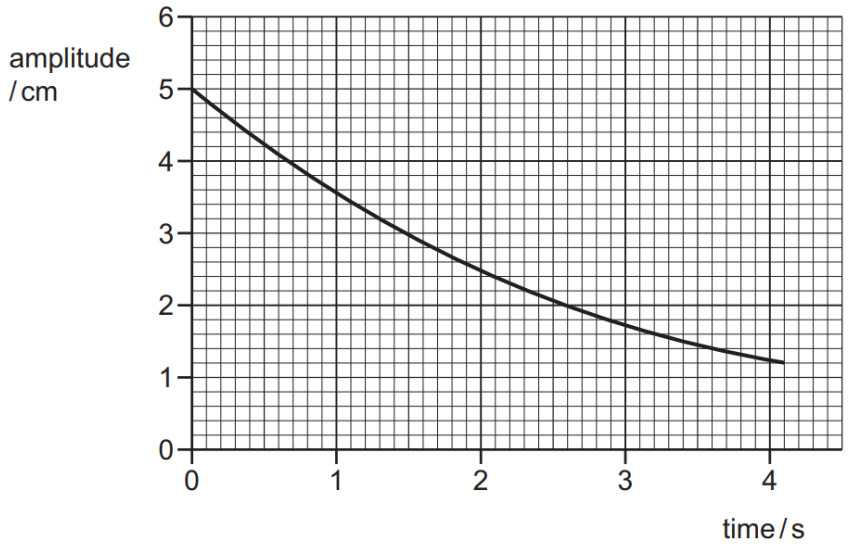
C



D



15 The graph shows how the amplitude of a simple pendulum decays with time from an initial amplitude of 5.0 cm.



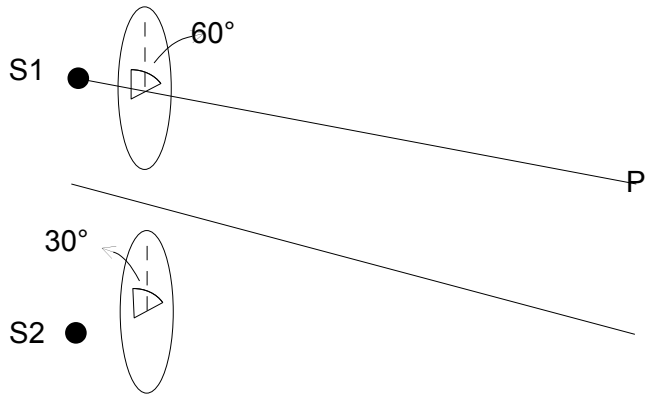
What is the fraction of the initial energy that has been lost in the first 4.0 s?

A $\frac{1}{16}$ **B** $\frac{1}{4}$ **C** $\frac{3}{4}$ **D** $\frac{15}{16}$

16 S_1 and S_2 produce waves in phase of amplitude A and intensity I that are polarized vertically. S_1P is equal to S_2P.

Waves from S_1 is made to pass through a polariser rotated 60° clockwise.
Waves from S_2 is made to pass through a polariser rotated 30° anticlockwise.

The 2 waves meet at point P.

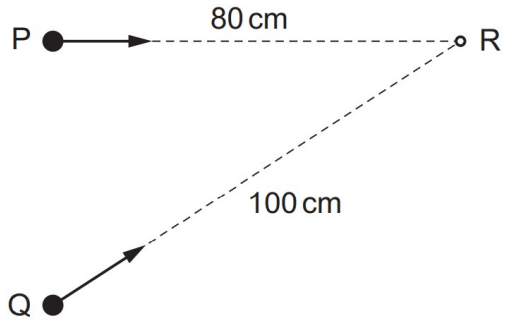


What is the amplitude and intensity of the resultant wave at P?

	resultant amplitude	resultant intensity
A	0	0
B	A	I
C	1.37 A	1.87 I

D	2.0 *A*	4.0 *I*

17 Two identical waves are produced by sources at points P and Q. The waves travel along different paths to reach point R, as shown.

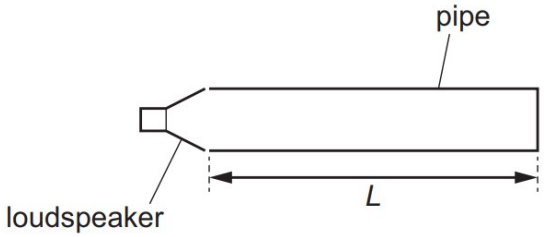


Both waves have a wavelength of 6.0 cm. The waves are in phase at point R.

What is the phase difference between the waves as they leave points P and Q?

A 0° **B** 60° **C** 90° **D** 120°

18 A pipe of length L is open at one end and closed at the other end. A loudspeaker is at the open end and emits a sound wave into the pipe.



When a stationary wave is formed, there is an antinode at the open end of the pipe.

Which wavelength of sound could be used to produce a stationary wave?

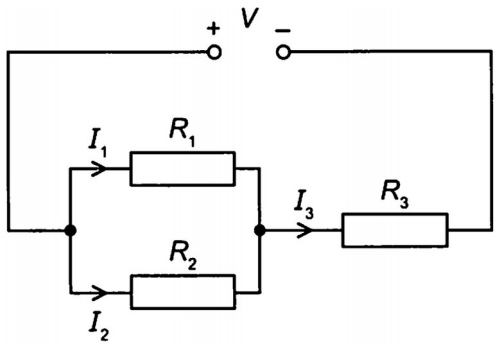
A $\frac{2L}{3}$ **B** L **C** $\frac{4L}{3}$ **D** $2L$

19 To be able to resolve a grain of green colour sand of radius 50 μm, the maximum distance that your eye can be positioned is 19 cm away from the grain.

What is the maximum distance for your eye to be able resolve a blue colour grain of sand?

A The new distance is smaller than 19 cm.
B The distance remains the same.
C The new distance is larger than 19 cm.
D The blue grain of sand cannot be resolved.

20 A power supply giving an output potential difference V is connected as shown to resistors R_1, R_2 and R_3. The currents in the circuit are I_1, I_2, and I_3.



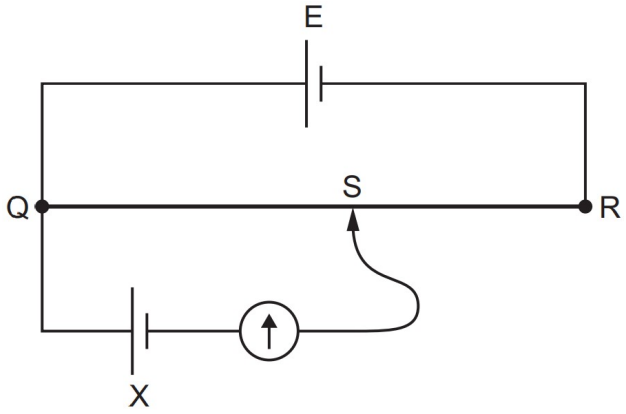
A student wishes to calculate the value of R_2.

Which group of values would be enough to enable the student to find R_2?

A I_1, I_2, I_3 and R_3
B I_1, I_2, I_3 and V
C I_2, R_1, R_3, and V
D I_3, R_1, R_3, and V

21 A potentiometer circuit is used to determine the unknown electromotive force (e.m.f.) of a cell X.

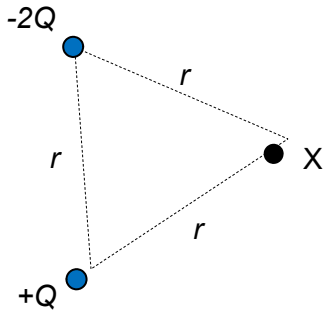
In the circuit shown, E is a cell with an e.m.f. that is known accurately. QR is the potentiometer wire, which has a movable contact S. Contact S is connected to a galvanometer and to cell X.



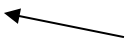
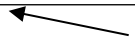
What is not a necessary requirement to determine the e.m.f. of X from the circuit?

A The e.m.f. of cell X must be lower than the e.m.f. of cell E.
B The internal resistance of cell X must be known.
C The lengths QS and QR must be determined accurately.
D The resistance of the wire QR must be proportional to its length.

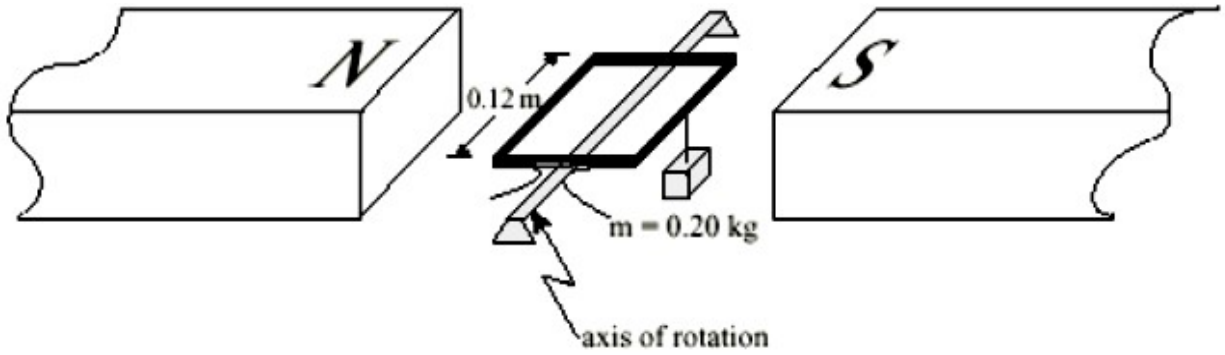
22 Two point charges of charged *-2Q* and *+Q* are arranged at two corners of an equilateral triangle of side *r* in vacuum.



What can be deduced about the electric potential *V*, and the magnitude and direction of electric field strength *E* at point X?

	V	magnitude of *E*	direction of *E*
A	$\frac{-Q}{4\pi\varepsilon_0 r}$	$\frac{Q}{4\pi\varepsilon_0 r^2} < \lvert E\rvert < \frac{3Q}{4\pi\varepsilon_0 r^2}$	
B	$\frac{-2Q}{4\pi\varepsilon_0 r}$	$\lvert E\rvert < -\frac{3Q}{4\pi\varepsilon_0 r^2}$	
C	$\frac{-Q}{4\pi\varepsilon_0 r}$	$\lvert E\rvert < \frac{Q}{4\pi\varepsilon_0 r^2}$	
D	$\frac{-Q}{4\pi\varepsilon_0 r}$	$\lvert E\rvert = \frac{Q}{4\pi\varepsilon_0 r^2}$	

23 A 35 loop square coil 0.12 m on a side is positioned in a 0.050 T magnetic field. A 0.20 kg mass is suspended from one side of the coil as shown in the diagram below.

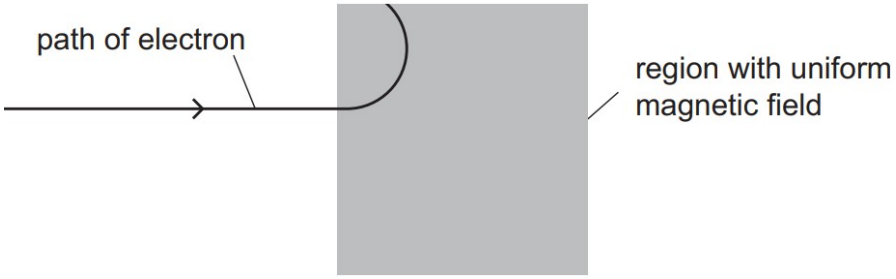


How much current must pass through the coil in order for the coil to remain horizontal?

A 2.3 A **B** 4.7 A **C** 9.3 A **D** 330 A

24 An electron, travelling in a straight line at 1.46×10^7 m s^{-1}, enters a region where there is a uniform magnetic field.

The diagram shows the path followed by the electron before it enters the magnetic field and within the field.



In the magnetic field, the electron follows a semi-circular path of diameter 0.0700 m.

In which direction is the magnetic field and what is the size of the magnetic flux density?

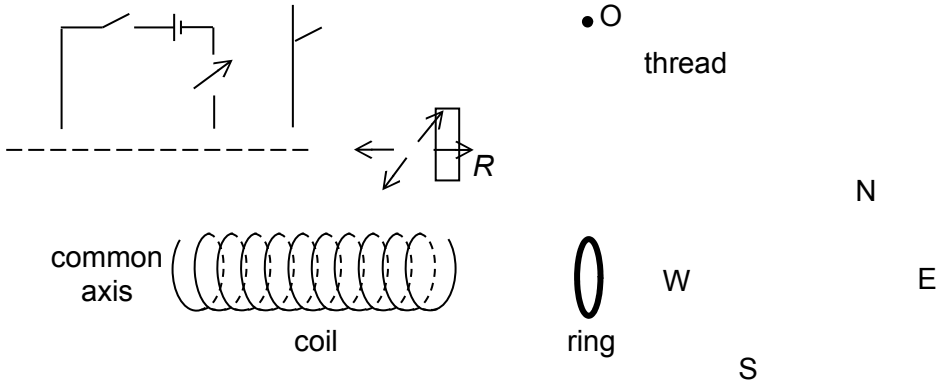
	direction of magnetic field	size of magnetic flux density/T
A	into page	1.19×10^{-3}
B	into page	2.38×10^{-3}
C	out of page	1.19×10^{-3}
D	out of page	2.38×10^{-3}

25 A metal disc of radius r is spinning with an angular velocity ω about an axis through its centre and perpendicular to its plane. The disc is in a uniform magnetic field B which is perpendicular to the plane of the disc.

What is the electromotive force induced between the centre of the disc and its edge?

A $\pi r^2 \omega B$ **B** $\pi r \omega^2 B$ **C** $\frac{\omega r^2 B}{2}$ **D** $\omega r^2 B$

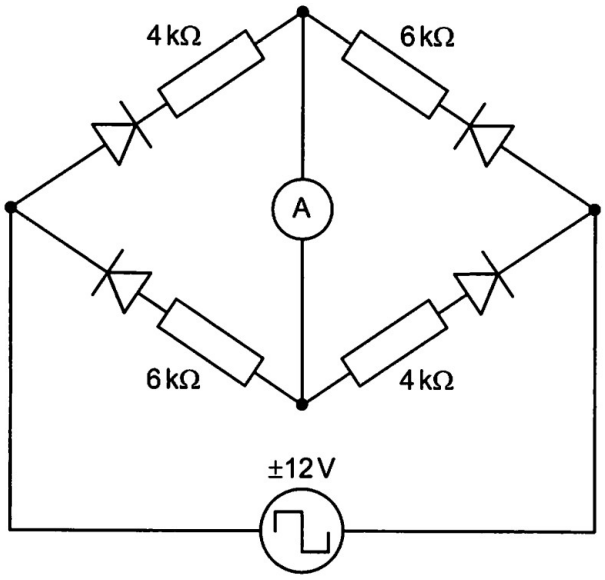
26 An aluminium ring hangs vertically from a thread with its axis pointing east-west and is free to swing about point O, as shown in the diagram below. A coil is fixed near to the ring and coaxial with it. With the switch closed, the rheostat *R* is adjusted to increase the current in the circuit to a maximum.



What will the motion of the aluminium ring be during this time?

A swings in the direction of E and remains there.
B swings in the direction of W and remains there.
C swings in the direction of E then drops back.
D swings in the direction of W then drops back.

27 The diagram shows a diode-resistor network. The network is connected to a 12 V source that changes it polarity at regular intervals. The direction of the current leaving the source is either left to right or right to left.



The ammeter records the mean current in the central link between the upper and lower parts of the network. The diodes have either zero or infinite resistance.

What is the mean reading on the ammeter?

A 1.00 mA **B** 1.25 mA **C** 1.50 mA **D** 2.50 mA

28 The energy levels in a hydrogen atom are shown.

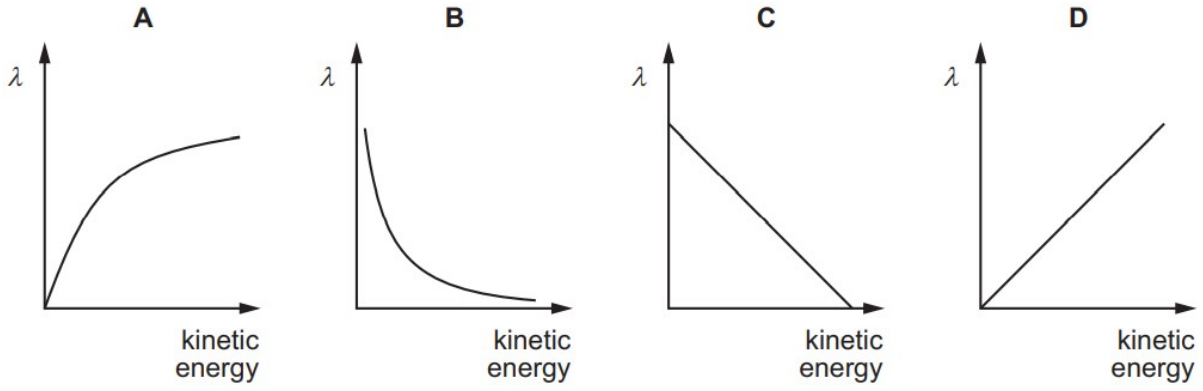
energy level *n*	energy / eV
1	−13.6
2	−3.4
3	−1.5
4	−0.9
5	−0.5

A red spectral line known as the hydrogen alpha line has been of great value to astronomers. Its wavelength is 656.28 nm.

Which level change gives rise to the hydrogen alpha line?

A 2 to 1 **B** 3 to 1 **C** 3 to 2 **D** 5 to 2

29 For velocities much less than the speed of light, which graph shows how the de Broglie wavelength of an electron and its kinetic energy are related?



30 In 2010, the Japanese launched the world's first interplanetary solar sail spacecraft, called IKAROS. This works because photons reflected from the sail of area *A* exerts a forward force on the sail.

A beam of light of intensity I and frequency f is reflected at right angles to a solar sail.

What is the force exerted on the sail?

A $\frac{IA}{hf}$ **B** $\frac{2hf}{c}$ **C** $\frac{I}{c}$ **D** $\frac{2IA}{c}$

End of paper

JC2 H2 Physics 2021 Preliminary Exam

Paper 1 Solutions

Qn	1	2	3	4	5	6	7	8	9	10
Ans	B	C	D	C	C	C	B	C	A	D
% correct	39.7%	77.5%	41.0%	63.5%	50.5%	71.0%	11.4%	81.4%	44.6%	62.2%

Qn	11	12	13	14	15	16	17	18		
Ans	A	C	B	D	D	B	D	C		
% correct	15.0%	56.0%	56.0%	70.7%	44.6%	25.4%	34.5%	66.4%	40.4%	58.6%

Qn	21	22	23	24	25	26	27	28	29	30
Ans	B	A	B	D	C	C	B	C	B	D
% correct	70.0%	53.4%	22.1%	63.8%	52.1%	46.3%	56.0%	78.8%	72.6%	39.7%

1 Ans: B

$\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}$ or R = ¿ $\frac{R_1 R_2}{R_1+R_2}$

From 1st principle,

min R_1 = 195 Ω, max R_1 = 205 Ω
min R_2 = 795 Ω, max R_2 = 805 Ω

min R = $\frac{(195)(795)}{195+795}$ = 156.6 Ω

max R = $\frac{(205)(805)}{205+805}$ = 163.4 Ω

ΔR = (max R – min R)/2 = (163.4 – 156.6)/2 = 3.4 Ω

2 Ans: C

time to accelerate to 20 m s^{-2} = 20 / 0.2 = 100 s
time to decelerate to rest = 20 / 0.4 = 50 s

distance travelled = ½ (20)(100) + 20(t) + ½ (20)(50)
3000 = ½ (20)(100) + 20(t) + ½ (20)(50)
t = 75

total time taken = 100 + 75 + 50 = 225 s

3 Ans: D

Since the ball bearing is released from rest, its initial speed is zero. Hence at t = 0 s, it is a stationary point on the graph.

The ball bearing accelerates downwards under the pull of gravity until it enters the oil. During this part of the motion, the gradient of the graph increases.

In the oil, the ball bearing will experience a resistive force upwards that is greater than its weight. This will cause the ball bearing to decelerate. During this part of the motion, the gradient of the graph decreases.

When the resistive force decreases (speed is decreasing) until it is equal in magnitude to its weight, the ball bearing will travel downwards with constant speed until it hits the bottom of the cylinder and comes to a sudden stop. During this part of the motion, the gradient of the graph is constant and will become zero abruptly.

4 Ans: C

To accelerate down the slope, $Mg \sin \theta > mg$.

5 Ans: C

Acceleration is the same for each block.
For the left most first block, $T_A = ma$
2nd block, $T_B - T_A = ma$, $T_B = 2ma$
3rd block, $T_C - T_B = ma$, $T_C = 3ma$
Hence, T_C is the greatest.

6 Ans: C

Notice that extension is y-axis, force is x-axis.
Hence work done is area wrt to extension (y-axis).
Work done to deform consist of only area under the portion beyond elastic limit.

7 Ans: B

When the rock is dropped into the lake, it sinks as the upthrust on it is smaller than its weight. This means the weight of the water displaced is smaller than the weight of the water displaced when the rock is on the boat.

8 Ans: C

$F = mv^2/r$.
Hence, graph should be quadratic.

9 Ans: A

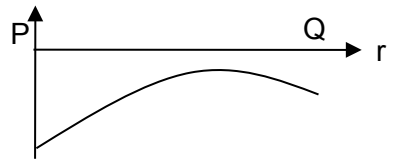
$T \cos 40° = mg$ ---------- (1)
$T \sin 40° = mv^2 / r$ ---------- (2)

(2) / (1), $\tan 40° = v^2 / rg$
$v^2 = rg \tan 40° = (1.2 \sin 40°)(9.81)(\tan 40°)$
$v = 2.5 \text{ m s}^{-1}$

10 Ans: D

$T^2 \propto r^3$
$(T_E / 1.77)^2 = (6.71 / 4.22)^3$
$T_E = 3.549$ days

11 Ans: A



The highest potential between P and Q is greater than -20 MJ kg^{-1} and less than 0.

12 Ans: C

At same temperature, average KE will be the same.
Internal energy can be different because total mass of the gases may not be equal.

13 Ans: B

Using $pV = NkT$, $p / kT = N / V$
$pm / kT = Nm / V = \rho$, where m = mass of each molecule

Hence, $pm / k(273.15 + 20) = 1.20$
$pm / k(273.15 + 27) = \rho$

Solving, $\rho = 1.17$ kg m^{-3}

14 Ans: D

KE vs t is twice the frequency of x vs t graph.
KE starts from maximum, since x starts from equilibrium.

15 Ans: D

Total energy is proportional to amplitude square.
Reading off the graph, the final amplitude is 1.25 cm, and initial amplitude is 5.0 cm.
Therefore, ratio of final TE / initial TE = $(1.25 / 5)^2 = 1 / 16$
Hence, fraction of energy lost = 1 – 1/16 = 15/16

16 Ans: B

Amplitude of wave from S_1 after passing polariser = $A \cos 60°$
Amplitude of wave from S_2 after passing polariser = $A \cos 30°$
Amplitude of resultant wave at P (vector sum) = sqrt $[(A \cos 60°)^2 + (A \cos 30°)^2] = A$
Hence, intensity is also I.

17 Ans: D

Path difference = 20 cm

The easier way is to imagine the reverse where R is the source.
In this case then, we are calculate phase difference between 2 points of the same wave that is 20 cm apart.

Hence, using ϕ $= (\Delta x / \lambda)(360°)$
$= (20/6)(360°)$
$= 1200°$
$= 1200° - 360° – 360° – 360°$
$= 120°$

18 Ans: C

Stationary wave can be formed if we have an antinode at open end and node at closed end.
Hence, L must be in multiple of odd multiples of ¼ wavelengths, i.e. L = ¼ λ or ¾ λ etc
Hence, the only correct option is C.

19 **Ans: C**
Blue light from the sand has smaller wavelength.
By $\theta \approx \lambda / b$, and by small angle approximation,
Range proportional to b / λ , so smaller wavelength, larger range

20 **Ans: D**

To find R_2, we use this equation $V = I_3\left(\left(\frac{R_1+R_2}{R_1R_2}\right)^{-1}+R_3\right)$

21 **Ans: B**
At balance length, current across X is zero, hence terminal p.d. is equal to e.m.f. of X.
Internal resistance therefore does not affect the measurement of e.m.f. of X.

22 **Ans: A**

Potential at X: V = $\frac{-2Q}{4\pi\varepsilon_o r} + \frac{Q}{4\pi\varepsilon_o r} = -\frac{Q}{4\pi\varepsilon_o r}$

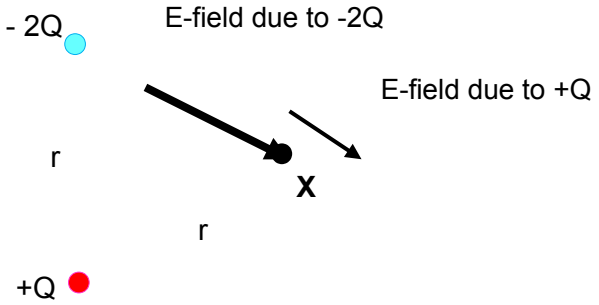
Magnitude of E-field at X: E due to -2Q charge = $\frac{2Q}{4\pi\varepsilon_o r^2}$

E due to +Q charge = $\frac{Q}{4\pi\varepsilon_o r^2}$
If these 2 vectors were in a straight line and “head to tail” ,

then the largest possible magnitude of the total E-field = $\frac{2Q}{4\pi\varepsilon_o r^2} + \frac{Q}{4\pi\varepsilon_o r^2} = \frac{3Q}{4\pi\varepsilon_o r^2}$

If these 2 vectors were in a straight line and “head to head” ,

then the minimum possible magnitude of the total E-field = $\frac{2Q}{4\pi\varepsilon_o r^2} - \frac{Q}{4\pi\varepsilon_o r^2} = \frac{Q}{4\pi\varepsilon_o r^2}$
Direction of E: At point X,



The resultant of these 2 E-fields would point upwards and to the left

23 **Ans: B**
Taking moments about axis of rotation,
Anti-clockwise moment due to magnetic force = clockwise moment due to mass
35 × BIL × 0.06 × 2 = 0.20 (9.81) × 0.06
35 × (0.050 × I × 0.12) × 0.06 × 2 = 0.20 (9.81) × 0.06
I = 4.67 A

24 Ans: D

Using FLHR (current finger points in opposite direction of electron's motion), B is out of page.

Magnetic force provides for centripetal force

$F_B = mv^2/r$

$Bqv = mv^2/r$

$B = mv/qr = (9.11\times10^{-31})(1.46\times10^{7}) / (1.6\times10^{-19})(0.0350) = 2.38\times10^{-3}$

25 Ans: C

For Faraday's disc, emf induced = $B\pi r^2 f$, and $\omega = 2\pi f$

Hence, emf = $\frac{\omega r^2 B}{2}$

26 Ans: C

By Lenz's law, there is a repulsion when current is increasing.

After reaching maximum current, B induced no longer changes, and hence no further induced emf and hence induced current in ring. Therefore, ring drops back.

27 Ans: B

When the current from the a.c. sources travels from left to right through the external circuit (during first half cycle), I = EMF / total R = 12 / (4000 + 4000) = 1.5 mA.

When the current from the a.c. sources travels in the other direction (second half cycle), I = EMF / total R = 12 / (6000 + 6000) = 1.0 mA.

Hence, average current through ammeter = (1.5+1.0)/2 = 1.25 mA

28 Ans: C

Energy of photon emitted = hc/λ

$= (6.63 \times 10^{-34})(3 \times 10^{8}) / (656.28 \times 10^{-9})$

$= (3.03072 \times 10^{-19}\ J) / (1.6 \times 10^{-19})$

$= 1.9\ eV$

Energy between 3 to 2 = 1.9 eV. Hence, answer is C.

29 Ans: B

$KE = ½\ mv^2$

$m(KE) = ½\ m^2v^2 = ½\ p^2$

$p = \sqrt{2m(KE)}$

From de Broglie's equation, $\lambda = h / p = h / \sqrt{2m(KE)}$

Hence, we can see that as KE increases, λ decreases, and it will not be linear.

30 Ans: D

$p = h/\lambda = hf/c$

$F = N\Delta p / t = 2Nhf / tc$, where N = number of photons

Since intensity = $(N/t)(hf)(1/A)$ => $Nhf/t = IA$

Hence, $F = 2IA/c$