Class	Index Number	Name
21S		

ST. ANDREW'S JUNIOR COLLEGE
JC 2 2022
Preliminary Examination

PHYSICS, Higher 2 **9749/01**

Paper 1 Multiple Choice **16th September 2022**
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 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 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 **14** 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	$\phi = -\dfrac{Gm}{r}$
temperature	$T/\text{K} = T/{}^{o}\text{C} + 273.15$
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	$R = R_1 + R_2 + \ldots$
resistors in parallel	$1/R = 1/R_1 + 1/R_2 + \ldots$
electric potential	$V = \dfrac{Q}{4\pi\varepsilon_0 r}$
alternating current/voltage	$x = x_o \sin \omega t$
magnetic flux density due to a long straight wire	$B = \dfrac{\mu_0 I}{2\pi d}$
magnetic flux density due to a flat circular coil	$B = \dfrac{\mu_0 NI}{2r}$
magnetic flux density due to a long solenoid	$B = \mu_0 nI$
radioactive decay	$x = x_o \exp(-\lambda t)$
decay constant	$\lambda = \dfrac{\ln 2}{t_{1/2}}$

Answer all questions.

1 The table below shows estimates of some physical quantities.

Which quantity is **not** a reasonable estimate?

	quantity	estimate
A	electric current in a heater	12 A
B	mass of an adult person	70 kg
C	maximum speed of an Olympic sprinter	10 m s^{-1}
D	water pressure at the bottom of a swimming pool	10^7 Pa

2 The energy E stored in a certain electronic component is given by

$$E = \frac{Q^n}{2k}$$

where Q is the total charge in the component, n is an unknown integer and k is a physical quantity with SI base units $A^2\,s^4\,kg^{-1}\,m^{-2}$.

What is the value of n?

A -2 **B** -1 **C** 1 **D** 2

3 A micrometer is used to measure the diameters of two cylinders.

diameter of first cylinder = (12.78 $\pm$ 0.02) mm
diameter of second cylinder = (16.24 $\pm$ 0.03) mm

The difference in the diameters is calculated.

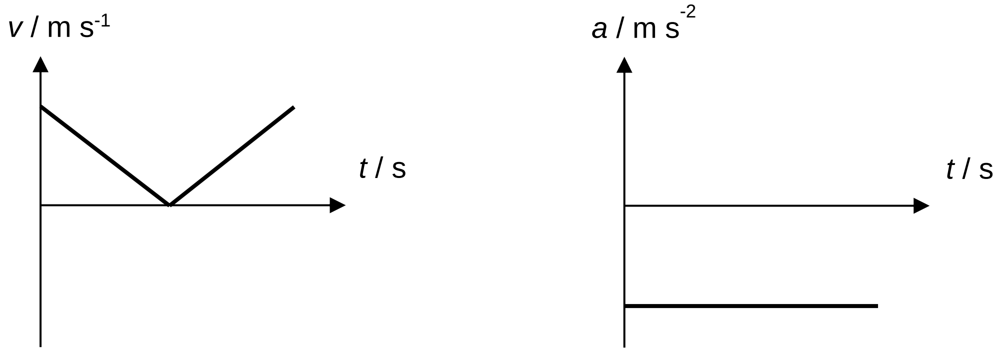
What is the percentage uncertainty in this difference?

A 0.29 **B** 0.58 **C** 0.87 **D** 1.4

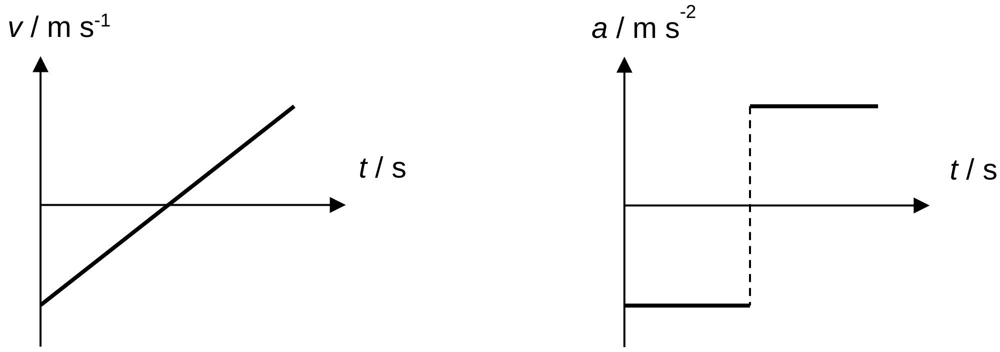
4 A driver decelerates uniformly to a stop as he approaches a junction, turns around immediately, and accelerates at the same rate that he decelerated earlier.

Which of the following velocity-time and acceleration-time graphs best represents this motion?

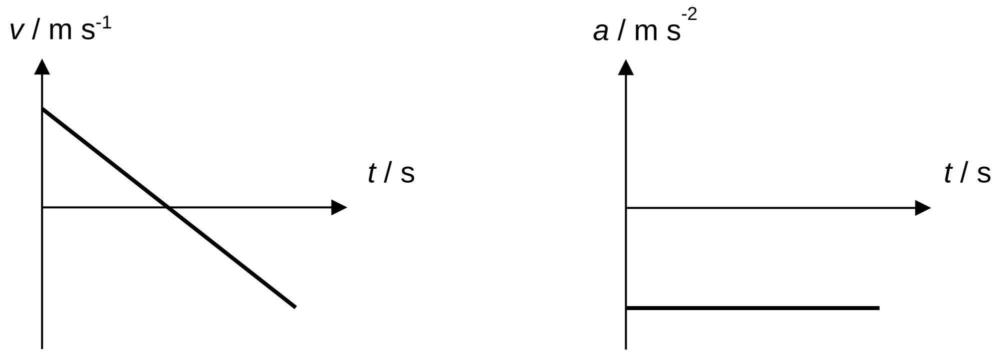
A



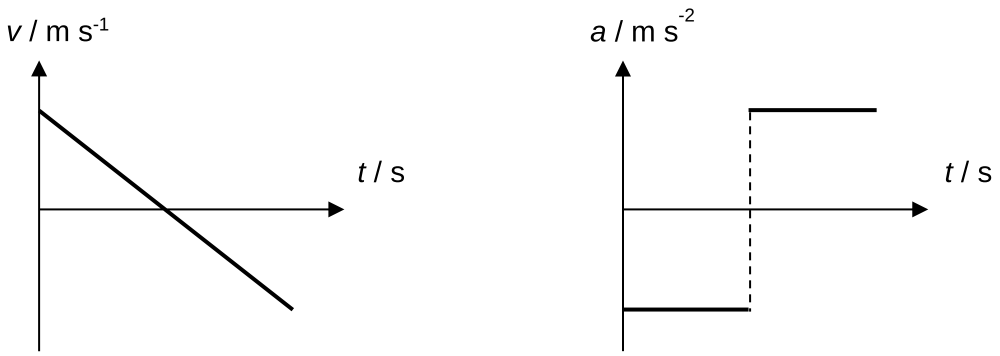
B



C



D

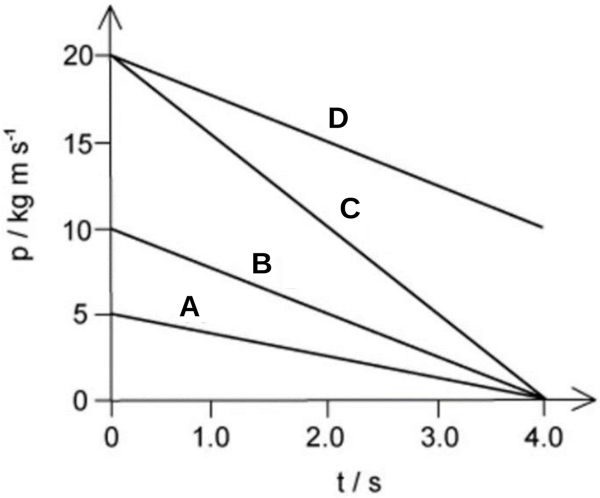


5 Mass M has the same kinetic energy as mass m. What is the ratio of their momenta $\frac{p_M}{p_m}$?

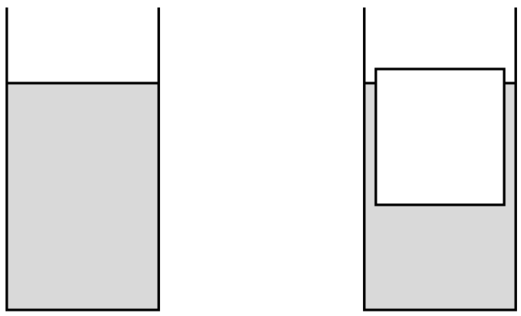
A $\frac{M+m}{M}$ **B** $\frac{M}{M+m}$ **C** $\sqrt{\frac{M}{m}}$ **D** $\sqrt{\frac{m}{M}}$

6 A resultant force of 5 N acts on a body for a time of 4.0 s.

Which graph could show the variation with time t of the momentum p of the body?



7 A cup contains 100 g of water. The pressure at the bottom of the cup is P.



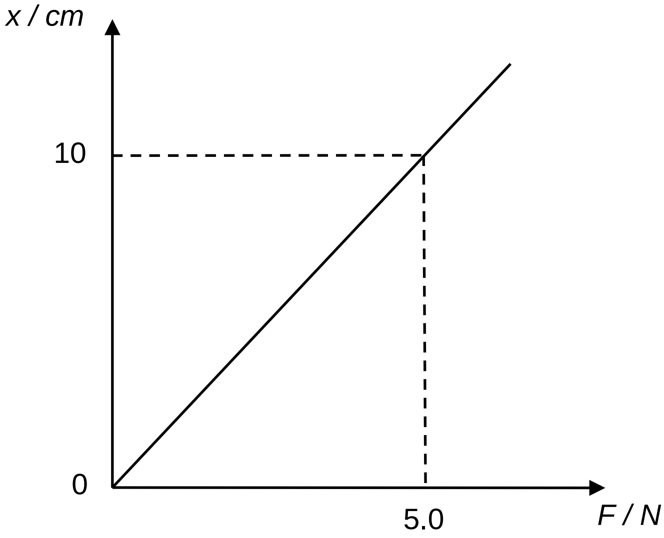
before after

50 g of water is removed from the cup, frozen into ice, and added back to the cup, as shown above. 10% of the volume of the ice is above the surface of the water.

What is the new pressure at the bottom of the cup?

A 0.95P **B** P **C** 1.05P **D** 1.10P

8 The variation of the extension x of a light spring with the force F applied is shown below.



Slotted masses with a total weight of 3.0 N were initially hung on the spring.

What is the decrease in the elastic potential energy stored in the spring when a slotted mass weighing 0.5 N is removed from the system?

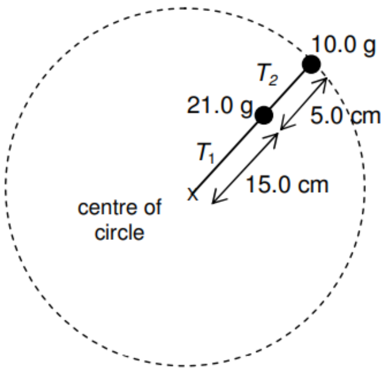
A 0.013 J **B** 0.015 J **C** 0.028 J **D** 0.056 J

9 A lorry of mass 2000 kg has an engine which can deliver a maximum power of 50 kW.

What is the minimum time in which the lorry can be accelerated from rest to a speed of 100 km h^{-1} on level ground?

A 11.3 s **B** 15.4 s **C** 30.9 s **D** 200 s

10 Two blocks of mass 10.0 g and 21.0 g are tied together and performing a uniform horizontal circular motion on a smooth table, at an angular speed of 6.28 rad s^{-1}, as shown below.



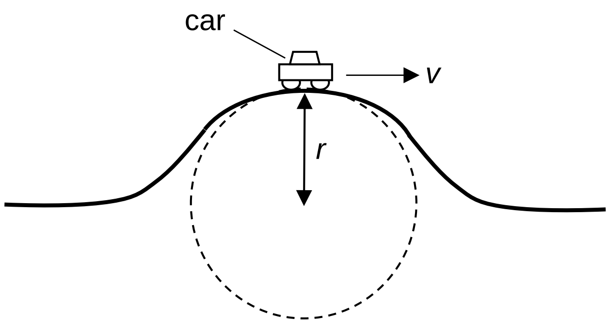
Tension T_1 is the tension in the string connecting the 21.0 g mass to the centre and T_2, the tension in the string connecting the 10.0 g mass to the 21.0 g mass.

What is the ratio T_1 to T_2?

A 1.0 **B** 1.6 **C** 2.1 **D** 2.6

11 A car of mass *m* moving at a constant speed *v* passes over a humpback bridge of radius of curvature *r*.

Given that the car remains in contact with the road, what is the normal reaction force *R* experienced by the car when it is at the top of the bridge?



A $R = mg + \frac{mv^2}{r}$

B $R = mg - \frac{mv^2}{r}$

C $R = \frac{mv^2}{r} - mg$

D $R = \frac{mv^2}{r}$

12 The acceleration of free fall on the surface of the Earth is 6 times its value on the surface of the Moon. The mean density of the Earth is $\frac{5}{3}$ times the mean density of the Moon.

If r_E is the radius of the Earth and r_M the radius of the Moon, what is the value of $\frac{r_E}{r_M}$?

A 2.4 **B** 3.6 **C** 4.8 **D** 6.0

13 A car tyre, initially at 25^0 C, has been inflated to a pressure of 200 kPa as indicated by the pressure gauge. This means that the pressure in the tyre is 200 kPa above atmospheric pressure of 100 kPa. After driving on hot roads, the temperature of the air in the tyre is 50^0 C.

What is the percentage increase in the pressure gauge reading?

A 8.4 % **B** 12.5 % **C** 100 % **D** 150 %

14 A liquid is maintained at its boiling point by means of an electric heater.
The constant rate at which the liquid boils away is measured for two different powers of the heater as shown.

Power of heater	Rate of loss of mass of liquid
P_1	m_1
P_2	m_2

For each power of the heater, P_1 or P_2, the rate of heat loss h to the environment is the same.

Which expression is correct for the specific latent heat of vaporization of the liquid?

A $\frac{P_1}{m_1}$ **B** $\frac{1}{2}\left(\frac{P_1}{m_1}+\frac{P_2}{m_2}\right)$ **C** $\frac{P_1 - P_2}{m_1 - m_2}$ **D** $\frac{P_1 + P_2}{m_1 + m_2}$

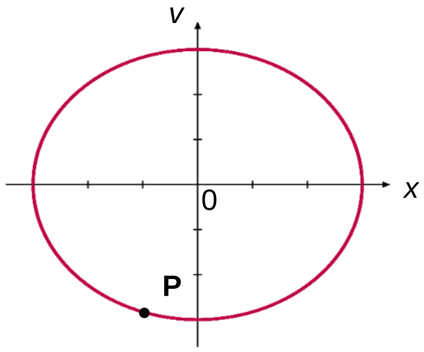
15 A system absorbs 80 J through heating while doing 100 J of external work.

What is the change in the internal energy of the system?

A -100 J **B** -20 J **C** +80 J **D** +180 J

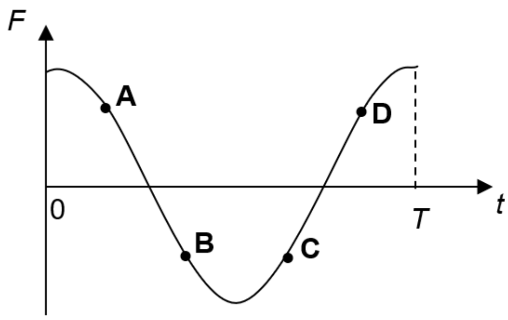
16 An object undergoes simple harmonic motion.

The variation with displacement x of the velocity v of the object is as shown. **P** is a position during the oscillation.



The variation with time t of the net force F acting on the object is as shown below. T is the period of the oscillation.

Which point on the graph corresponds to the state of motion at position **P**?



17 An object placed on a horizontal platform is oscillating vertically in simple harmonic motion with a frequency of 1.5 Hz.

What is the maximum amplitude of oscillation that will allow the object to remain in contact with the platform throughout the motion?

A 0.11 m **B** 1.0 m **C** 6.5 m **D** 9.0 m

18 A sound wave is emitted from a point source. At a distance r from the source, the amplitude of the wave is 8X.

What is the amplitude at a distance 2r from the source?

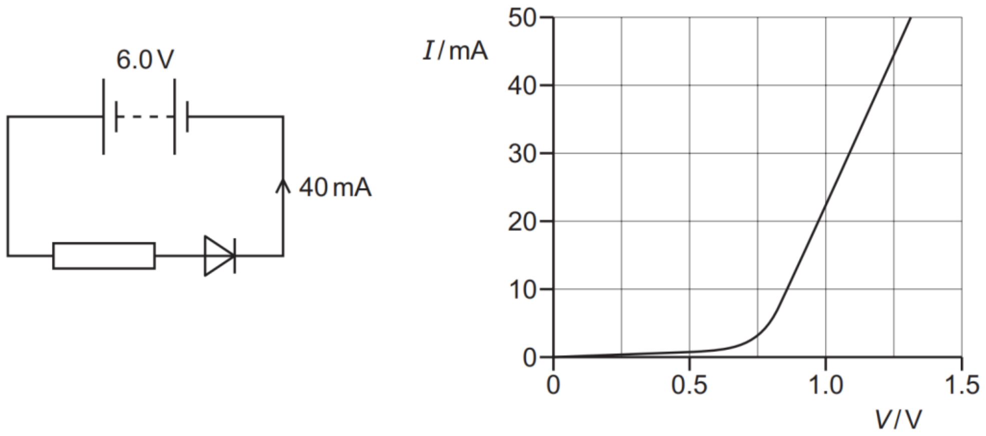
A 8X **B** 4X **C** 2X **D** X

19 A beam of monochromatic light of wavelength 600 nm is incident normally on a diffraction grating that has 3.0×10^5 lines per metre.

What is the total number of images produced by light transmitted through this grating?

A 5 **B** 8 **C** 9 **D** 11

20 A fixed resistor and a diode are connected in series to a battery of electromotive force 6.0 V and negligible internal resistance. The graph shows the variation with potential difference V of the current I for the diode.



The current in the diode is 40 mA.

What is the resistance of the fixed resistor?

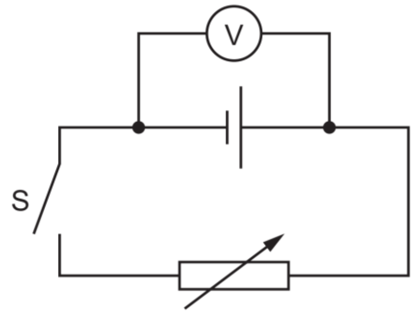
A 30 Ω **B** 120 Ω **C** 150 Ω **D** 180 Ω

21 An electrical cable consists of seven strands of copper wire, each of diameter 0.30 mm, connected in parallel. The resistivity of copper is 1.72×10^{-8} Ω m. The current in the cable is 13 A.

What is the potential difference between two points on the cable a distance of 1.0 m apart?

A 0.0045 V **B** 0.11 V **C** 0.45 V **D** 3.2 V

22 A cell that has internal resistance is connected to a switch S and a variable resistor. A voltmeter is connected between the terminals of the cell, as shown.



When switch S is open, the variable resistor is adjusted to have a value of 8.0 Ω, the voltmeter reads 1.5 V.

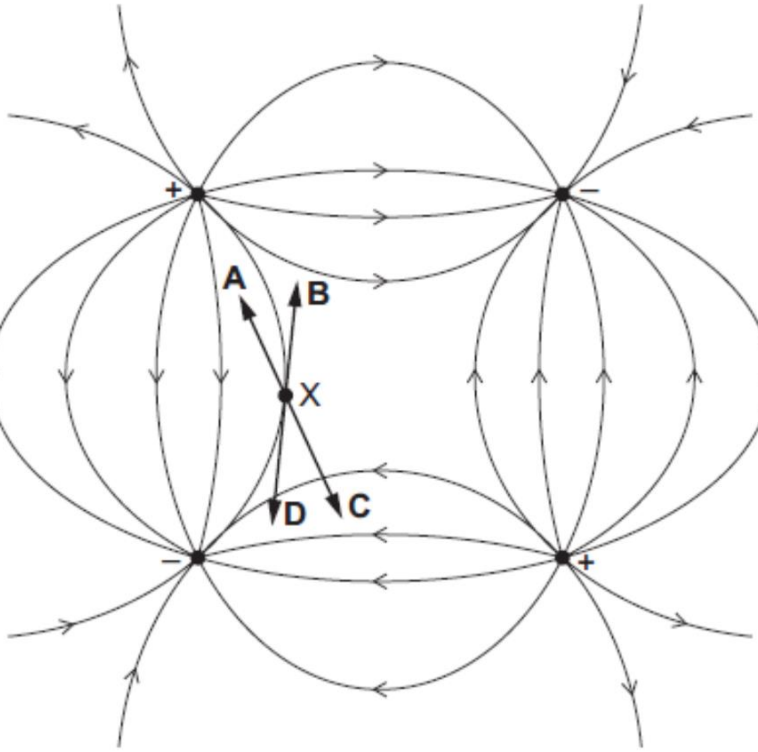
The switch is then closed and the variable resistor is adjusted to have a resistance of 4.0 Ω. The voltmeter now reads 0.75 V.

What is the internal resistance of the cell?

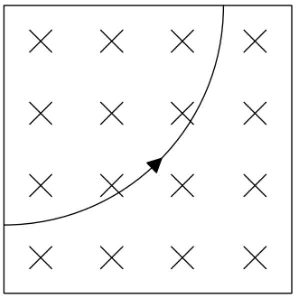
A 1.0Ω **B** 2.0Ω **C** 4.0Ω **D** 8.0Ω

23 The diagram shows an electric field pattern caused by two positive and two negative point charges of equal magnitude placed at the four corners of a square.

In which direction does the force act on an electron at point X?



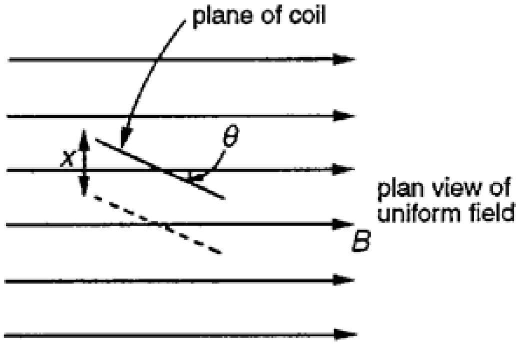
24 A particle is in a region of uniform magnetic field. The field is directed into the plane of the page. The path of this particle is shown in the figure below.



What is this particle and what is the direction of the electric field for it to pass through with no deflection?

	This particle is	Direction of electric field is
A	a positive ion	upwards
B	a positive ion	downwards
C	an electron	upwards
D	an electron	downwards

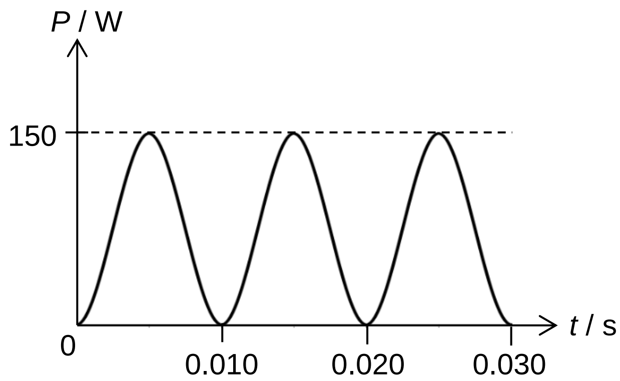
25 A plane coil of wire containing N turns each of area A is placed so that the plane of the coil makes an angle θ with the direction of the uniform magnetic field of flux density B. The coil is now moved through a distance x in time t to the position shown dotted.



What is the e.m.f. induced in the coil?

A zero **B** $NAB\dfrac{x}{t}$ **C** $NABx\dfrac{\cos\theta}{t}$ **D** $NABx\dfrac{\sin\theta}{t}$

26 The graph shows the variation with time t of the power P dissipated in a resistor of resistance 6.0 Ω when it is connected to an alternating supply.



Which equation represents the sinusoidal alternating current through the resistor?

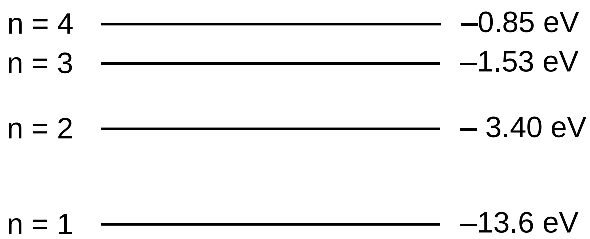
A $I = 5.0 \sin 100\pi t$

B $I = 5.0 \sin 200\pi t$

C $I = 25 \sin 100\pi t$

D $I = 25 \sin 300\pi t$

27 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.

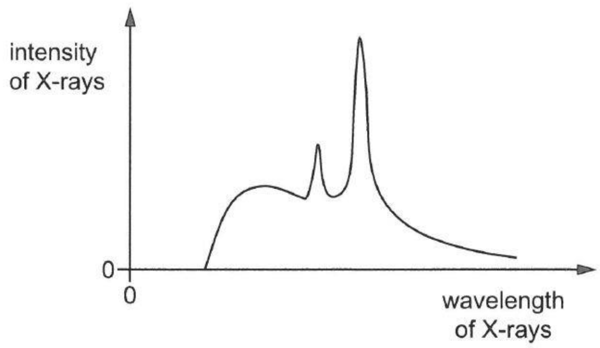


If electrons having kinetic energy of 12.5 eV are used to bombard cool hydrogen gas, how many spectral lines in the visible region can be obtained subsequently?

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

28 X-rays are produced when high speed electrons collide with a metal target. To attain the high speed, electrons are accelerated over a potential difference.

The graph illustrates how the intensity of X-rays varies with their wavelength when the target is tungsten.



The electrons are subsequently accelerated across a higher potential difference.

Which statement is correct?

A The minimum wavelength will decrease.
B The minimum wavelength will increase.
C The number of peaks will increase.
D The position of the peaks will move towards shorter wavelengths.

29 Nuclei of atoms can exist in excited states. When an excited nucleus returns to its state of lowest energy (the ground state), a γ-ray photon may be emitted.

The mass of a nucleus in its ground state is 59.9308 u. The energy of the photon emitted when this nucleus returns from an excited state to the ground state is 2.13×10^{-13} J.

What is the mass of the nucleus in the excited state?

A 59.9208 u **B** 59.9294 u **C** 59.9322 u **D** 59.9337 u

30 Antimony-124 undergoes radioactive decay, with a half-life of 60 days, to become tin-124. Tin-124 is stable.

Initially, a sample of antimony-124 contains no tin-124.

After what period of time will the ratio $\dfrac{\text{number of tin-124 nuclei}}{\text{number of antimony-124 nuclei}}$ equal 6?

A between 60 days and 120 days
B 120 days
C between 120 days and 180 days
D 180 days

[End of Paper]

JC2 Prelim (H2 Physics) Paper 1 Solutions

Qn	1	2	3	4	5	6	7	8	9	10
Ans	D	D	D	C	C	C	B	C	B	D

Qn	11	12	13	14	15	16	17	18	19	20
Ans	B	B	B	C	B	D	A	B	D	B

Qn	21	22	23	24	25	26	27	28	29	30
Ans	C	C	B	B	A	A	B	A	C	C

1 Ans: D

Depth of swimming pool ≈ 2m
Pressure at the bottom of the pool = $p_o + \rho gh$ = $\mathbf{10^5}$ + $(10^3)(10)2 = 10^5$ Pa

2 Ans: D

$$[E] = \frac{|Q|^n}{|k|}$$
$$\text{kg m}^2\text{ s}^{-2} = \frac{A^n\ s^n}{A^2\ s^4\ \text{kg}^{-1}\ \text{m}^{-2}}$$
$n = 2$

3 Ans: D

$d_2 - d_1 = 3.46$ mm
$\Delta(d_2 - d_1) = \Delta(d_2) + \Delta(d_1) = 0.03 + 0.02 = 0.05$ mm

$$\frac{\Delta(d_2 - d_1)}{d_2 - d_1} \times 100\% = \frac{0.05}{3.46} \times 100\% = 1.4\%$$

4 Ans: C

He decelerated in one direction and accelerated in the opposite direction at the same rate. Therefore the acceleration vector should be in the same direction before and after he made the U-turn.

5 Ans: C

Kinetic Energy = $p^2/ 2m$
Since both M and m have the same Kinetic Energy, $p^2 \alpha\ m$

$$\therefore \frac{{p_M}^2}{{p_m}^2} = \frac{M}{m}$$

$$\frac{p_M}{p_m} = \sqrt{\frac{M}{m}}$$

6 Ans: C

$F = \Delta p/\Delta t$
$5 = \Delta p/4$
$\Delta p = 20$

7 Ans: B

Since the weight of the contents in the cup remains the same, no change to the pressure at the bottom.

8 Ans: C

Force constant, $k = \frac{5.0}{0.1} = 50 \text{ N m}^{-1}$
Initial extension = $\frac{F}{k} = \frac{3}{50} = 0.06 \text{ m}$ and final extension = $\frac{F}{k} = \frac{2.5}{50} = 0.05 \text{ m}$
Change in E.P.E.= $\frac{1}{2}k{x_f}^2 - \frac{1}{2}k{x_i}^2 = \frac{1}{2}(50)(0.05)^2 - \frac{1}{2}(50)(0.06)^2 = -0.028 \text{ J}$

9 Ans: B

Lorry is accelerated from rest to a speed of 100 km h^{-1} .
Work done by lorry's engine = increase in lorry's K.E.
Friction has to be ignored as minimum time is to be considered

$$Pt = \frac{1}{2}mv^2$$
$$t = \frac{mv^2}{2P}$$

where v = 100 km h^{-1} = 27.78 m s^{-1}

$$\therefore t = \frac{(2000)27.78^2}{2\times 50000} = 15.4 \text{ s}$$

10 Ans: D

Considering 10.0 g alone, T_2 provides the centripetal force for it.
$T_2 = m\ r\ \omega^2$
= (0.010) (0.150 + 0.050) 6.28^2 = 0.079 N

Considering 21.0 g alone, $(T_1 - T_2)$ provides the centripetal force for it.
$T_1 - T_2$ = (0.021) (0.150) 6.28^2 = 0.124 N
T_1 = 0.203 N
Ratio = 0.203 / 0.079 = 2.6

11 Ans: B

$F_{net} = \frac{mv^2}{r} \Rightarrow mg - R = \frac{mv^2}{r}$

$R = mg - \frac{mv^2}{r}$

12 Ans: B

$\frac{GM_E/r_E^2}{GM_M/r_M^2} = 6$ ....(1) $\frac{\rho_E}{\rho_M} = \frac{M_E/(4/3)\pi r_E^3}{M_M/(4/3)\pi r_M^3} = \frac{5}{3}$ ....(2)

From (1), $\frac{M_E}{M_M} = \frac{6r_E^2}{r_M^2}$ ....(3)

Substitute (3) into (2), $\frac{6r_E^2}{r_M^2} \times \frac{r_M^3}{r_E^3} = \frac{5}{3} \Rightarrow \frac{r_E}{r_M} = 3.6$

13 Ans: B

Given: **Actual** gas pressure = pressure **gauge reading** (of 200 kPa) **+ atmospheric pressure** (of 100 kPa)
Thus initial actual gas pressure p_i = 200 + 100 kPa = 300 kPa, at initial temp of 25 ^{0}C
Assuming vol of tyre = const, actual gas pressure p $\propto$ T. Given T_f = 50^{0}C
$\rightarrow$ Final actual gas pressure $p_f = (T_f/T_i) \times p_i$ = (50 +273.15)/(25 + 273.15) x 300 kPa
= 325 kPa
Thus final pressure **gauge** reading = 325 – 100 = 225 kPa
Thus $\Delta p/p_i$ in the pressure **gauge** readings = (225 – 200)/200 =0.125
In terms of percentage, = 0.125 x 100% = 12.5 %

14 Ans: C

Since heat supplied Q = ML + Heat loss to environment, M= mass vaporized/loss
Power supplied P = **m**L + h where m = **rate** of loss of mass of liquid,
h = **rate** of heat loss to environment
Substituting, $P_1 = m_1 L + h$ eqn (1), $P_2 = m_2 L + h$ eqn (2)
(1) – (2) gives L = $\frac{P_1 - P_2}{m_1 - m_2}$

15 Ans: B

$\Delta U = Q + W$
= (+80) + (-100) = -20 J (B)

16 Ans: D

At point P, the displacement x is negative.
Since $a = -\omega^2 x \Rightarrow F = ma = -m\omega^2 x$.
A negative *x* will mean *F* is positive (B and C are eliminated as F is negative at these positions).
At point P, the velocity is negative.

Since a - t graph is a cosine graph, v - t graph will be a sine graph. Sketch this v-t graph on the same t axis as the given F-t graph. Can see that pt A has a positive velocity while pt D has a negative velocity. Hence ans is D.

17 Ans: A

For the object to remain in contact with the platform throughout the motion, its acceleration must not be greater than 9.81 m s^{-2}.

$$a_{\max} = \omega^2 x_0$$

$$x_0 = \frac{a_{\max}}{\omega^2} = \frac{a_{\max}}{(2\pi f)^2} = \frac{9.81}{(2\pi(1.5))^2} = 0.11\,\mathrm{m}$$

18 Ans: B

For a point source, intensity I $\propto$ 1/r^2 (1)
For all waves, intensity I $\propto$ (amp, A)^2 (2)
Thus, amplitude A $\propto$ 1/r
Substituting, 8X $\propto$ 1/r (A)
Final amplitude $\propto$ 1/(2r) (B)
(B)/(A): Final amplitude = 4X (B)

19 Ans: D

Given: λ = 600 nm. Deduce grating spacing d = 1/ (3.0 x 10^5) m
Total number of images = 2 $n_{highest}$ + 1 (1)
To det highest order of diffraction, $n_{highest}$:
From dsinθ = nλ, $\Rightarrow$ $n_{highest}$ = dsin90/λ = 5.6
Since n must be an integer, $n_{highest}$ = 5 (the largest integer which is smaller than 5.6)
Thus in (1): total number of images = (2 x 5) + 1 = 11 (D)

20 Ans: B

From graph, when current is 40 mA, p.d. is approximately 1.2 V.

Therefore, p.d. across resistor = 6.0 – 1.2 = 4.8 V

R = V/I = (4.8)/(0.040) = 120 Ω

21 Ans: C

For 1 strand:

$$R = \frac{\rho l}{A} = (1.72 \times 10^{-8})\frac{1.0}{\pi\left(\frac{0.3 \times 10^{-3}}{2}\right)^2} = 0.2433\ \Omega$$

For 7 strands in parallel:

$$\frac{1}{R_{ll}} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} + \frac{1}{R} + \frac{1}{R} + \frac{1}{R} + \frac{1}{R}$$

$$R_{ll} = \frac{R}{7} = \frac{0.2433}{7} = 0.03476\ \Omega$$

V = IR_{ll} = (13)(0.03476) $= 0.4519\,V$

22 Ans: C

When switch is open:

V = E – I r

1.5 = E – (0)r

E = 1.5 V

When switch is closed:
V = E – I r

0.75 = 1.5 – (0.75/4.0)r

r = 4.0 Ω

23 And: B

Direction of E-field = direction of force acting on a **positive** charge placed at that position. This is taken to be a tangent if the field line is a curve.

Thus force acts on the electron (a negative charge) in the opposite direction along the tangent drawn at X.

24 Ans: B

The centripetal force on the particle when entering is upwards hence magnetic force is upwards.
Using Fleming's left hand rule, current is in the same direction as the velocity of the particle, so it must be positively charged.
If direction of magnetic force is upwards, electric force on that positive charged particle must be downwards so electric field must also be downwards.

25 Ans: A

There is no change of flux linkage

26 Ans: A

$$I = I_0 \sin \omega t = \sqrt{\frac{P_0}{R}} \sin \frac{2\pi}{T} t = \sqrt{\frac{150}{6.0}} \sin \frac{2\pi}{0.020} t$$
$$I = 5.0 \sin 100\pi t$$

27 Ans: 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)
n = 3 to n = 1: $\lambda = 1.24 \times 10^{-6} /(13.6 - 1.53) = 1.03 \times 10^{-7}$ m (not visible, outside 400nm to 700nm)
n = 2 to n = 1: $\lambda = 1.24 \times 10^{-6} /(13.6 - 3.40) = 1.22 \times 10^{-7}$ m (not visible, outside 400nm to 700nm)

28 Ans: A

$h\,c / \lambda_{min} = e\,V_a$

Since the accelerating voltage has increased, the minimum wavelength will decrease.

29 Ans: C

$\Delta m\, c^2$ = Energy of photon emitted
$(m_{excited} - 59.9308\text{ u})\, c^2 = 2.13 \times 10^{-13}$ J
$(m_{excited} - 59.9308\text{ u}) = 2.366667 \times 10^{-30}$ **kg**
Since 1 u = 1.66 x 10^-27 kg, $(m_{excited} - 59.9308\text{ u}) = 0.0014257$ **u**
$m_{excited} = 59.9322$ u (C)

30 Ans: C

Given half-life = 60 days & tin-124 is stable.
After one half-life: $N_{Ant} : N_{Tin} = 1:1$
After 2 half-lives:
$N_{Ant} : N_{Tin} = 1:3$ since N_{Ant} = ¼ Initial number of Antimony &
N_{Tin} = ¾ of Initial number of Antimony
After 3 half-lives: $N_{Ant} : N_{Tin} = 1:7$ since $N_{Ant} = \frac{1}{8}$ Initial number of Antimony
$N_{Tin} = \frac{7}{8}$ of Initial number of Antimony
Thus $\frac{number\ of\ tin-124\ nuclei}{number\ of\ antimony-124\ nuclei}$ = 6 occurs betw 2 & 3 half-lives,
ie betw 120 & 180 days. (C)
Alternatively, we can calculate the actual number of days as shown:
Since Tin is **stable**, $N_{Ant} + N_{Tin}$ = initial number of Antimony, N_o
After time t: $N_{tin} = 6\, N_{Ant}$, we can deduce $\frac{N_{Ant}}{N_o} = \frac{1}{7}$
Substitute into eqn $N = N_0\, e^{-\lambda t}$ for Antimony, t = 168 days.