VICTORIA JUNIOR COLLEGE
2021 JC2 PRELIMINARY EXAMINATION
Higher 2

Name : ______________________ CT group : ______________

PHYSICS

9749/01

Paper 1 Multiple Choice

24 September 2021
FRIDAY

Additional Materials: Multiple Choice Answer Sheet

2.30 pm to 3.30 pm (1 hour)

READ THESE INSTRUCTIONS FIRST

Write in soft pencil.
Do not use staples, paper clips, glue or correction fluid.
Write your name, CT group and index 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** in the separate Answer Sheet.

Read the instruction 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.

This document consists of **14** printed pages.

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 mol^{-1} K^{-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}

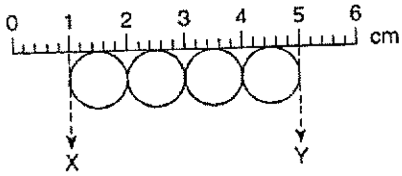
Formulae

uniformly accelerated motion,	$s = ut + (½)\,at^2$ $v^2 = u^2 + 2as$
work done on/by a gas,	$W = p\Delta V$
hydrostatic pressure,	$p = \rho g h$
gravitational potential,	$\phi = -\dfrac{GM}{r}$
temperature	$T/K = T/°C + 273.15$
pressure of an ideal gas	$p = \dfrac{1}{3}\dfrac{Nm}{V}\langle c^2 \rangle$
mean translational kinetic energy of an ideal gas molecule	$E = \dfrac{3}{2}kT$
displacement of particle in s.h.m.,	$x = x_o \sin \omega t$
velocity of particle in s.h.m.,	$v = v_o \cos \omega t$ $= \pm\omega\sqrt{(x_o^2 - x^2)}$
electric current	$I = Anvq$
resistors in series,	$R = R_1 + R_2 + \ldots$
resistors in parallel,	$1/R = 1/R_1 + 1/R_2 + \ldots$
electric potential,	$V = Q/4\pi\varepsilon_o r$
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,	$\lambda = \dfrac{\ln 2}{t_{\frac{1}{2}}}$

1 Which of the following answers gives a reasonable estimate of the number of water molecules present in a cup? *The mass number of oxygen is 16.* The mass of the water is approximately 200 g.

A 10^{17} **B** 10^{20} **C** 10^{25} **D** 10^{29}

2 A student attempts to measure the diameter of a steel ball by using a metre rule to measure four similar balls in a row.



The student estimates the positions on the scale to be as follows.

X: (1.0 ± 0.2) cm

Y: (5.0 ± 0.2) cm

What is the diameter of a steel ball together with its associated uncertainty?

A (1.0 ± 0.1) cm
B (1.0 ± 0.2) cm
C (1.0 ± 0.24) cm
D (1.0 ± 0.4) cm

3 Ball **A** was dropped from the top of a tall building. At the same instant, an identical ball **B** was thrown downward from the same point. Neglecting the effects of air friction, what can be said of their accelerations while they were falling?

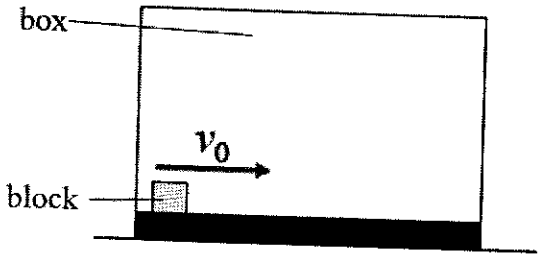
A Their accelerations are equal.

B Ball **A** has the greater acceleration.

C Ball **B** has the greater acceleration.

D It is impossible to tell since their accelerations vary greatly.

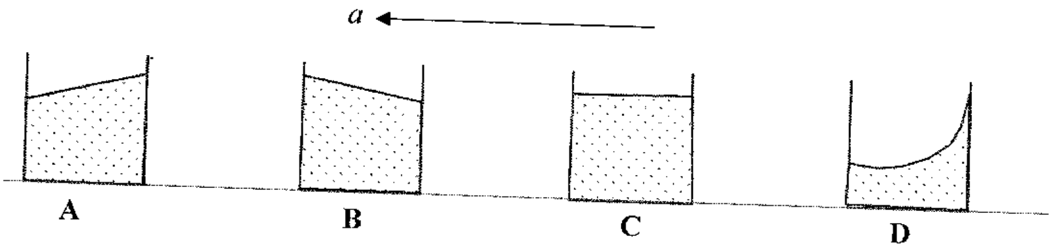
4



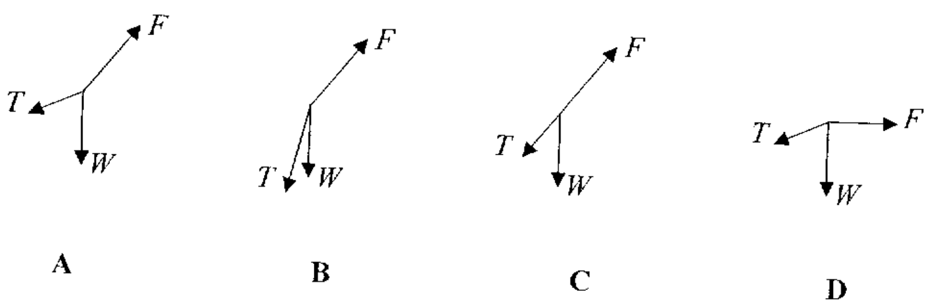
A big box of mass M is resting on a horizontal smooth floor. On the bottom of the box, there is a small block of mass m. The block is given an initial speed v_0 relative to the floor, and starts to bounce back and forth between the two walls of the box. What is the final speed of the box when the block has finally come to rest in the box?

A 0 **B** v_0 **C** $\frac{M}{M+m}v_0$ **D** $\frac{m}{M+m}v_0$

5 A cup of water is placed in a car under constant acceleration to the left, as shown. The following figures show four shapes of the water . Which one is correct?



6 A kite is held stationary under the influence of three forces: the tension T in the string, the force F of the wind and the weight W of the kite. Which one of the following force diagrams could be correct?



7 When a horizontal force F is applied to a trolley over a smooth horizontal surface of distance x, its kinetic energy changes from 2 J to 6 J.

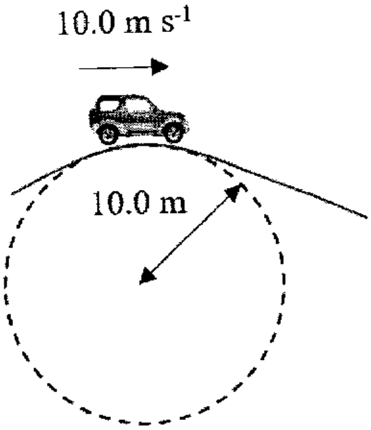
If a force $2F$ is applied to the trolley over a distance of $2x$, what will be the final kinetic energy of it? Assume the original kinetic energy of the trolley is 2 J.

A 12 J **B** 16 J **C** 18 J **D** 24 J

8 Many galaxies have a supermassive black hole at its core. Studies of stars that orbit close to the centre of our Milky Way galaxy's central black hole, Sagittarius A* can yield the approximate mass of the black hole. One star, S4714, is as of 2020, the record holder of closest approach. Given that it orbits with a period of 12 years and at a radius of 1.3×10^{14} m, what is the approximate mass of Sagittarius A*?

A 5.0×10^{8} kg **B** 9.1×10^{36} kg **C** 2.7×10^{45} kg **D** 8.3×10^{51} kg

9 A car drives over a hump with a circular radius of 10.0 m at a speed of 10.0 m s^{-1}.



A 250 g mass is suspended vertically from the ceiling of the car by a spring of force constant 25.0 N m^{-1}.

What happens to the spring as the car passes over the hump?

	While passing over hump
A	Shortens by 10 cm
B	Shortens by 20 cm
C	Lengthens by 10 cm
D	Lengthens by 20 cm

10 A sinusoidal transverse wave is travelling along a rope. Any point on the rope

A moves in the same direction as the wave

B moves periodically with a different frequency from that of the wave

C moves periodically perpendicular to the direction of the wave

D moves circularly with a different speed from that of the wave

11 **Fig. 11.1** shows the variation with displacement x of the velocity v of a simple harmonic oscillator. **Fig. 11.2** shows the variation with time t of the net force F acting on the oscillator.

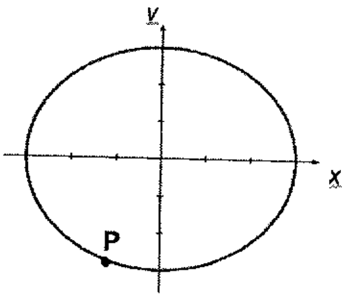


Fig. 11.1

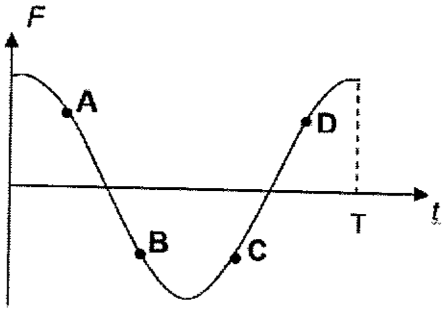


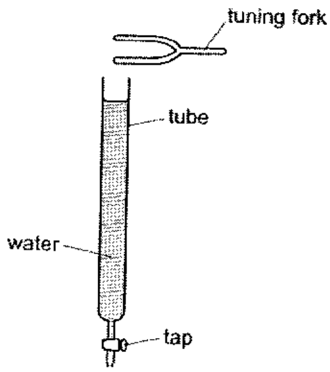
Fig. 11.2

Which of the points in **Fig. 11.2** corresponds to the state of motion represented by point P in **Fig. 11.1**?

12 One mole of monoatomic neon gas has a mass of 20.2 g.
What is the root mean square (r.m.s.) speed of a neon atom at 30 °C?

A 19 m s^{-1} **B** 190 m s^{-1} **C** 610 m s^{-1} **D** 370 000 m s^{-1}

13 A long tube, filled with water, has a tap fitted at its base, as shown. A tuning fork is sounded above the tube and the water is allowed to run gradually out of the tube.



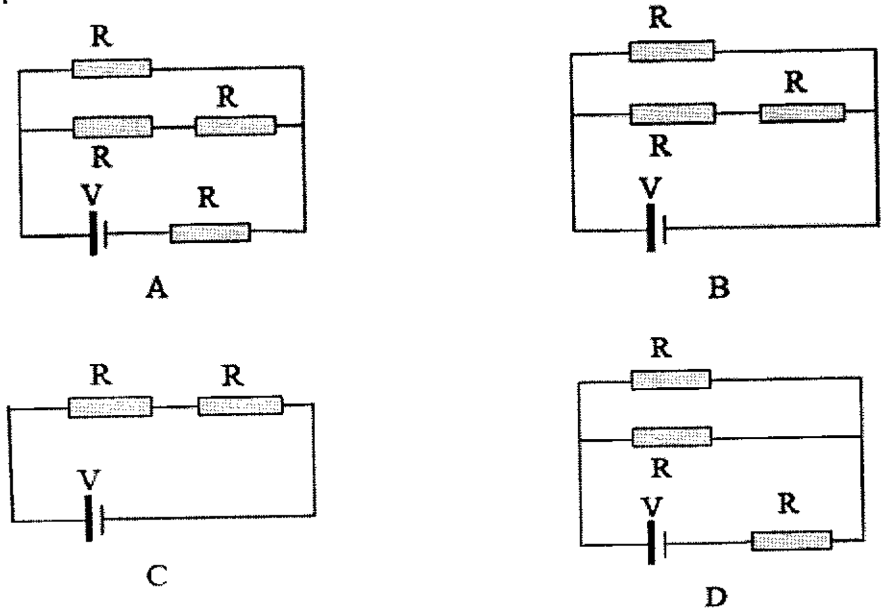
A loud sound is heard at intervals as water runs out of the tube. The change in water level between loud sounds is 32 cm. What is the wavelength of the sound in the tube?

A 16 cm **B** 32 cm **C** 64 cm **D** 128 cm

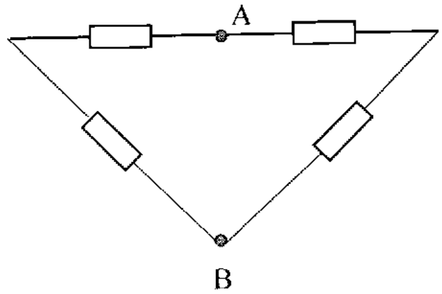
14 Light of wavelength λ is incident normally on a diffraction grating for which the slit spacing is 3.9λ. What is the maximum number of diffracted images?

A 3 B 6 C 7 D 9

15 Four circuits are shown below. The batteries all have the same voltage V and all resistors have the same resistance R. In which circuit does the battery produce the most power?



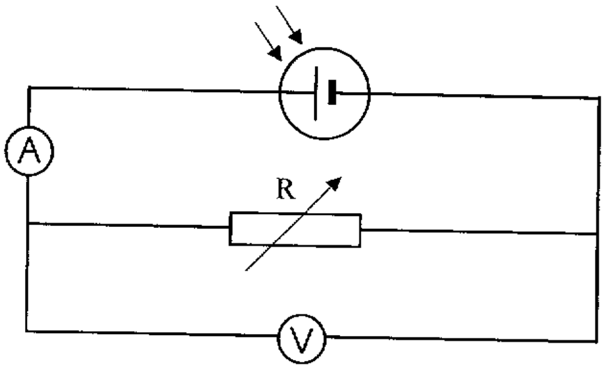
16 Four identical resistors, each of resistance R, are connected as shown in the diagram below.



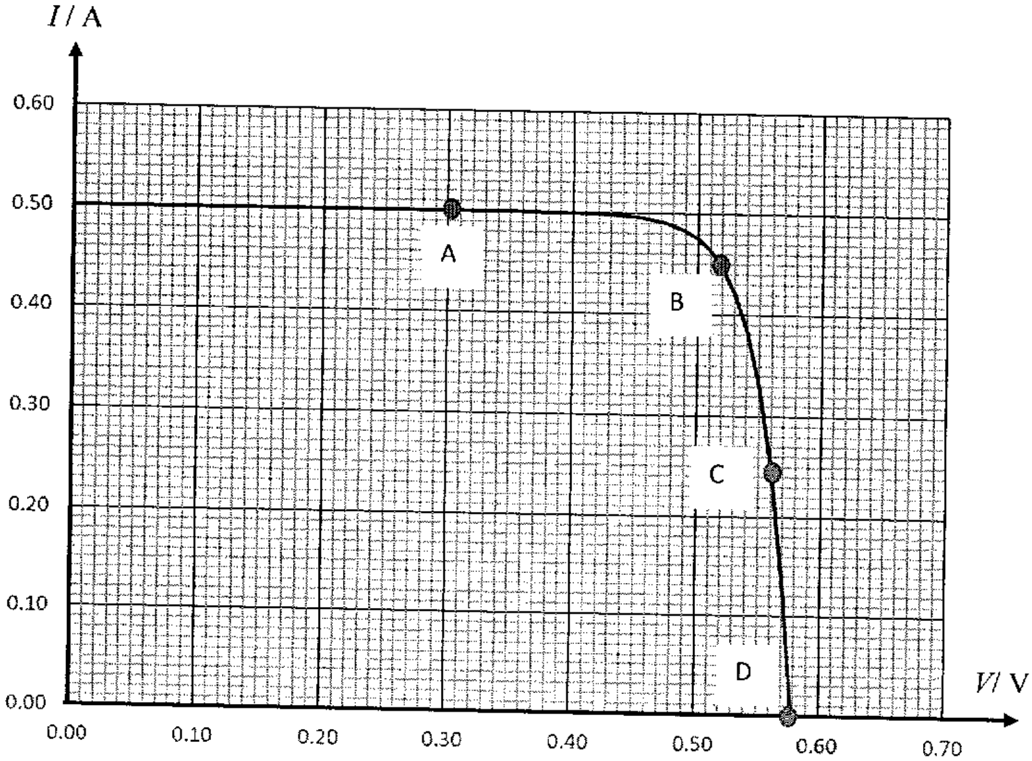
What is the effective resistance between points A and B?

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

17 A photovoltaic cell is connected to a variable resistor R as shown below.

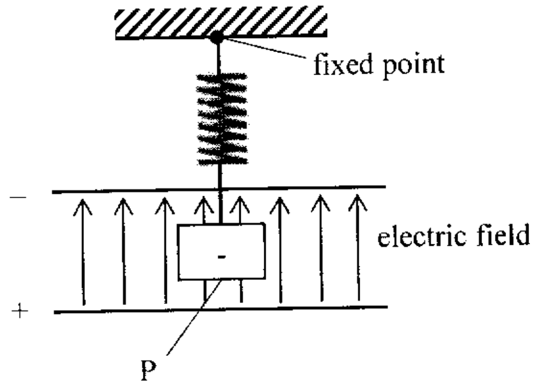


As the resistance of the variable resistor is adjusted, the current I and voltage V recorded by the ammeter and voltmeters are recorded. The variation with the voltage V of current I is shown in the graph below.



Approximately at which point is the power delivered to the resistor a maximum?

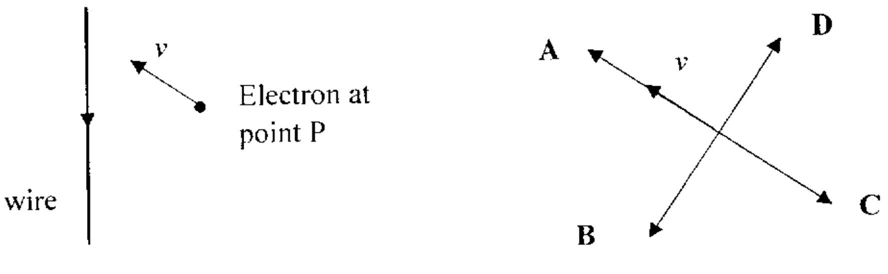
18 A spring, suspended from a fixed point, carries a negatively charged body P which hangs in a vertical electric field.



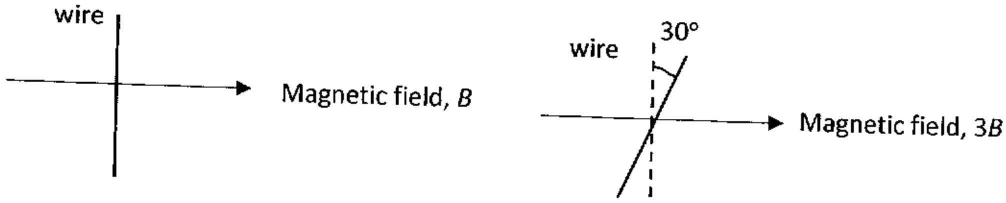
What happens to the elastic potential energy and to the electric potential energy of the system as P is lowered?

	elastic potential energy	electric potential energy
A	decreases	decreases
B	decreases	increases
C	increases	decreases
D	increases	increases

19 A long straight wire carries a current as shown. The wire lies in the plane of the page. What is the direction of the magnetic force experienced by an electron moving with speed v at point P near the wire? The electron at P is moving in the plane of the page in the direction shown. Neglect earth's magnetic field.



20 A straight, horizontal, current-carrying wire lies at right angles to a horizontal uniform magnetic field B. The field exerts a vertical force of 8.0 mN on the wire. The wire is rotated, in its horizontal plane, through 30° as shown. The flux density of the magnetic field is increased to $3B$.

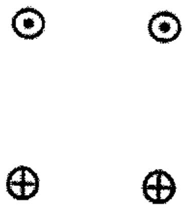


Plan view

What is the new vertical force on the wire?

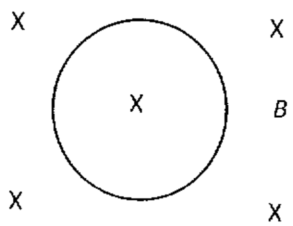
A 7.0 mN **B** 12 mN **C** 21 mN **D** 24 mN

21 An electric current flowing through a wire produces a magnetic field around the wire. Four wires carrying identical currents are shown placed at the corners of a square. Each wire produces a field of flux density B at the centre of the square.The symbol ⊕ indicates a current flowing along the wire into the page, and the symbol Θ indicates a current flowing along the wire pointing out of the page. What is the magnetic field at the centre of the square?



A 0 **B** 2.8 B **C** 3.2 B **D** 4.0 B

22 A circular loop of wire of electrical resistance R and radius r is oriented with its plane perpendicular to a magnetic field B as shown. What must be the rate of change of the magnetic flux density in order to produce a current I in the loop?



A $IR/\pi r^2$ **B** $I\pi r^2/R$ **C** $IR/\pi r$ **D** $I\pi r/R$

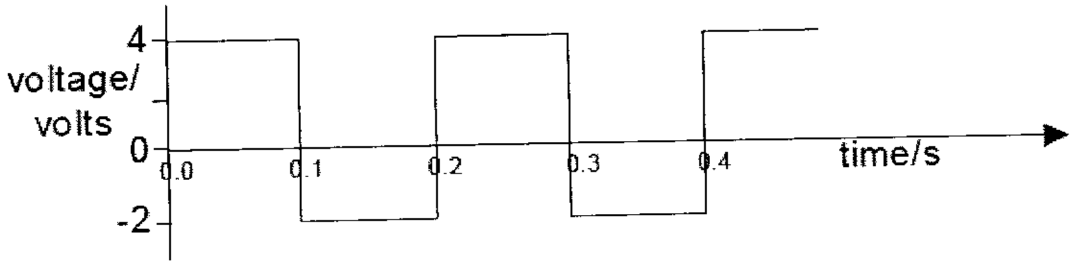
23 A square loop of copper wire is initially placed perpendicular to the lines of a constant uniform magnetic field of flux density 5.0×10^{-3} T. The area enclosed by the loop is $0.20\ m^2$. The loop is then turned through an angle of 60°. The turn takes 0.10 s. The average e.m.f. induced in the loop during the turn is

A 1.3 mV **B** 5.0 mV **C** 8.7 mV **D** 10 mV

24 An alternating potential difference $V = V_0 \sin(\omega t)$ is applied across a resistor in a circuit, causing a current $I = I_0 \sin\omega t$ to flow in the resistor. The mean power dissipated in the resistor is

A $V_0 I_0 \sqrt{2}$ **B** $\frac{V_0 I_0}{2}$ **C** $\frac{V_0 I_0}{\sqrt{2}}$ **D** zero

25 A 20 Ω resistor is connected to an AC power supply with a voltage output that varies from 4V to –2V at equal time intervals as shown on the graph below. What is the average heating power dissipated in the resistor?



A 0.20 W **B** 0.50 W **C** 0.80 W **D** 1.0W

26 An electromagnetic radiation of constant frequency is incident on a metal surface.

Which statement explains why the photoelectric current from the metal surface is proportional to the intensity of the incident electromagnetic radiation?

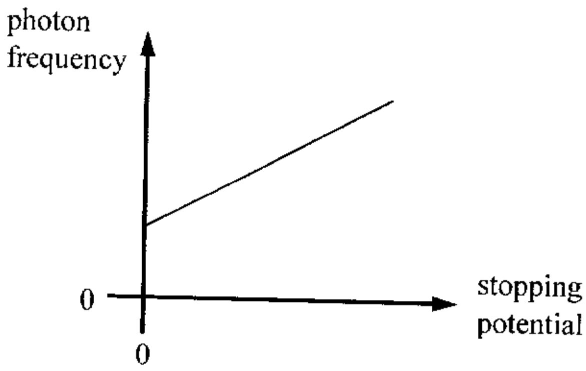
A Radiation of greater intensity overcomes the metal's work function energy allowing more electrons to escape.

B Radiation of greater intensity causes the metal surface to get warm and so emit more electrons.

C Radiation of greater intensity means more photons per second strike the metal surface.

D Radiation of greater intensity consists of photons of greater energy.

27 A photoelectric experiment is conducted by shining electromagnetic radiation of various frequencies on a metal surface. The graph shows the variation of incoming photon frequency with stopping potential of the photoelectrons for the metal surface.



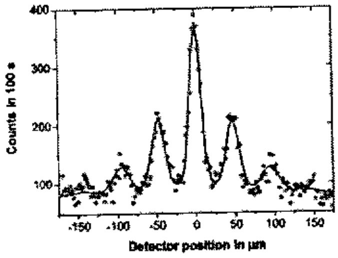
What changes, if any, would occur in the graph for a metal of lower work function?

	gradient	**y-intercept**
A	lower	lower
B	higher	higher
C	same	lower
D	same	higher

28 In order to produce X-rays of wavelength 0.20 nm, what is the minimum potential difference through which an electron in an X-ray tube must be accelerated to impinge upon the target metal?

A. 3.22 kV **B.** 4.22 kV **C.** 5.22 kV **D.** 6.22 kV

29 The figure below shows the experimental results of a double-slit experiment performed using buckminsterfullerenes or buckyballs for short, which are actually spherically arranged molecules of carbon 60 (C_{60}).



If neutrons, each of mass 720 times less than a buckyball with the same kinetic energies as the buckyballs are used to do the experiment, the fringe spacing will

A increase by 720 times

B increase by $\sqrt{720}$ times

C decrease by 720 times

D decrease by $\sqrt{720}$ times

30 A SARS-CoV-2 virus of mass 8.0×10^{-16} kg is moving with a speed of (3.0 ± 0.2) µm s^{-1}. What is the minimum uncertainty in the measurement of the position of the virus?

A 2×10^{-9} m **B** 4×10^{-12} m **C** 5×10^{-27} m **D** 10×10^{-53} m

VICTORIA JUNIOR COLLEGE

SUGGESTED SOLUTIONS TO 2021 H2 PHYSICS PRELIM PAPER 1

Q1

1 mol of water molecules has a mass of 0.018 kg.

Mtd1:

Number of molecules is

$N = \frac{M}{M_m} N_A = \frac{0.200}{0.018}(6.02 \times 10^{23})$

$N \approx 6.7 \times 10^{24} \approx 10^{25}$

Mtd2:

Water is H_2O, so the mass number is 16+1+1 = 18.

$N = \frac{M}{M_{watermolecule}} = \frac{0.200}{18u} = \frac{0.200}{18 \times 1.66 \times 10^{-27}} = 6.69 \times 10^{24} \approx 10^{25}$

Ans: C

Q2

Diameter of four balls = (Y-X) ± (ΔY+ΔX) = (4.0 ± 0.4) cm

Diameter of one ball = $\frac{(4.0 \pm 0.4)}{4}$ = (1.0 ± 0.1) cm

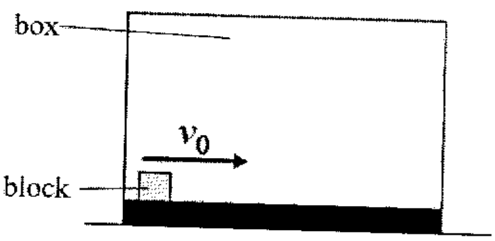
Ans: A

Q3

Ball B will travel faster than ball A. However, both balls will be subject to the same gravitational acceleration.

Ans: A

Q4



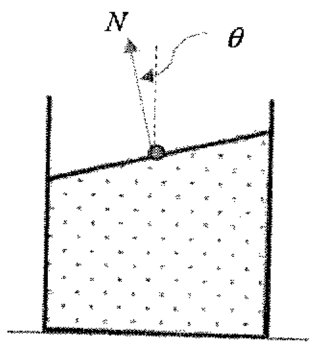
Taking right as the positive direction, the initial momentum of the box-block system relative to the floor is mv_0. After several collisions with the walls of the box, the block comes to rest in the box. The box, however, is still moving. The final momentum of the box-block system is $(M + m)v$ where v is the final speed of the box-block system. From conservation of momentum, $mv_0 = (M + m)v$

Or $v = \frac{m}{M+m} v_0$

Note that although the KE of the system is not conserved, the total momentum is.

Ans: D

Q5



Option A: Consider a molecule on the water surface. The surrounding water exerts a normal force N on the molecule. For horizontal motion, using N2L, $N\sin\theta = ma$ where m is the mass of the molecule.

Option B is for the case of the cup of water decelerating when moving towards the left.

Option C is when the cup of water is stationary or moving at constant velocity.

Option D is for the case where the cup is being spun in circular motion about an axis left of the cup.

Ans: A

Q6
For equilibrium, the lines of action of the 3 forces must intersect at a point. When joined head to tail, the 3 forces should be able to form a closed triangle.

Ans: A

Q7
By Work-energy Theorem, work done by the force W = gain in kinetic energy ΔK
Thus Fx = 6-2 = 4

$$\frac{\Delta K'}{\Delta K} = \frac{W'}{W} = \frac{(2F)(2x)}{Fx} = 4$$

$$\Delta K' = (4)(4) = 16\ \text{J}$$

Hence, final kinetic energy = 16 + 2 = 18 J

Ans: C

Q8

$$F_c = F_g$$

$$mr\omega^2 = \frac{GM_{blackhole}m}{r^2}$$

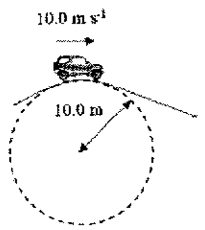
$$M_{blackhole} = \frac{r^3}{G}\left(\frac{2\pi}{T}\right)^2$$

$$= \frac{(1.3\times10^{14})^3}{6.67\times10^{-11}}\,\frac{4\pi^2}{(12\times365\times24\times60\times60)^2}$$

$$= 9.1 \times 10^{36}\ \text{kg}$$

Ans: B

Q9



When the car is moving on a level road, tension in spring = weight of mass

$$T = mg$$

$$ke_0 = mg \qquad -(1)$$

where e_0 = equilibrium extension of spring.

When passing over a hump, the centripetal acceleration is downwards, so the net force is downwards. Hence, the spring shortens.

Centripetal force (downwards) = $mg - T_1$

$$\frac{mv^2}{r} = mg - T_1$$

$$\frac{mv^2}{r} = mg - ke_1$$

Using (1), we get:

$$\frac{mv^2}{r} = ke_0 - ke_1$$

$\therefore$ the decrease in the extension of the spring is:

$$e_0 - e_1 = \frac{mv^2}{kr}$$

$$e_0 - e_1 = \frac{0.250\times10^2}{25.0\times10.0} = 0.100\ \text{m}$$

$$= 10.0\ \text{cm}$$

So, the spring shortens by 10.0 cm.

Ans: A

Q10
The rope wave is a transverse wave. Particles on the rope therefore move in a direction perpendicular to the direction of propagation of the wave.

Ans: C

Q11
At point P, the displacement, x is negative and velocity, v is negative.

Since $a = -\omega^2x \Rightarrow F = ma = -m\omega^2x$, x negative will mean F is positive. B and C are no longer plausible.

Inferring from Fig. 1.2, a-t graph is a cosine graph, hence v-t graph should be a sine graph. Hence A is not possible since its velocity is positive.

Ans: D

Q12

According to Kinetic Theory, the average KE of an ideal gas atom is $K = \frac{3}{2}kT$.

Mass of a single Neon atom:

$$m = \frac{\text{molar mass}}{\text{Avogadro's constant}} = \frac{20.2 \times 10^{-3}}{6.02 \times 10^{23}} \text{ kg}$$

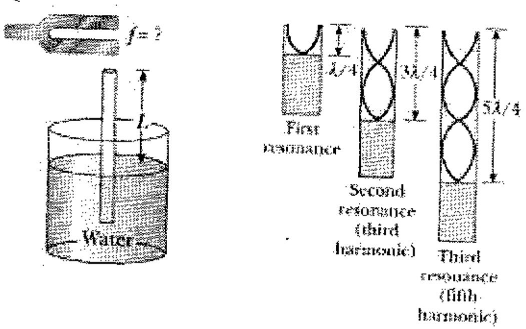
$$\frac{1}{2}m{v_{rms}}^2 = \frac{3}{2}kT$$

$$v_{rms} = \sqrt{\frac{3kT}{m}}$$

$$= \sqrt{\frac{3(1.38\text{x}10^{-23})(30+273)}{\frac{20.2 \times 10^{-3}}{6.02 \times 10^{23}}}} = 612 \approx 610 \text{ m s}^{-1}$$

Ans: C

Q13



For the first resonance, $L_1 = \frac{\lambda}{4}$

For the second resonace, $L_2 = 3\frac{\lambda}{4}$

For the third resonace, $L_3 = 5\frac{\lambda}{4}$

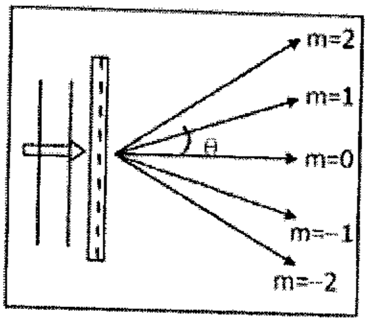
Generalising, the difference in length between two resonances or two loud sounds is $\Delta L = \frac{2\lambda}{4} = \frac{\lambda}{2}$

Hence $\lambda = 2\ (32) = 64$ cm

Ans: C

Q14

Diffraction grating formula: $m\lambda = d sin\theta$ where $m = 0,1,2,3,\ldots$



To get diffracted images, the angle θ between the stright-through direction and the diffracted image must be less than 90^0.

So $\theta < 90^0$ or sin $\theta < 1$. Hence $\frac{m\lambda}{d} < 1$

Or $\frac{m\lambda}{3.9\lambda} < 1$

This means $m < 3.9$, or the maximum order is 3.

The total number of images is 3+3+1 = 7

Ans: C

Q15

Option A: $R_{tot} = R + \frac{(2R)(R)}{2R+R} = \frac{5R}{3}$.

Power is $P_A = \frac{3V^2}{5R}$

Option B: $R_{tot} = \frac{(2R)R}{2R+R} = \frac{2R}{3}$.

Power is $P_B = \frac{3V^2}{2R}$

Option C: $R_{tot} = 2R$. Power is $P_C = \frac{V^2}{2R}$

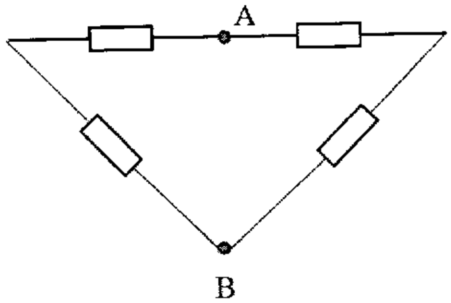
Option D: $R_{tot} = R + \frac{R}{2} = \frac{3R}{2}$.

Power is $P_D = \frac{2V^2}{3R}$

Hence the battery in circuit B produces the most power.

Ans: B

Q16



The two resistors left of A and B are in series with effective resistance $2R$. Similarly the two resistors right of A and B are in series, also with resistance $2R$. The two resistors left of A and B and the two resistors right of A and B are in parallel. Hence

$$\frac{1}{R_{AB}} = \frac{1}{2R} + \frac{1}{2R} = \frac{1}{R}$$

Therefore $R_{AB} = R$

Ans: B

Q17

Based on power $P = VI$, it can be deduced that maximum power is delivered to the resistor approximately at point B on the I-V characteristic of the photovoltaic cell.

Ans: B

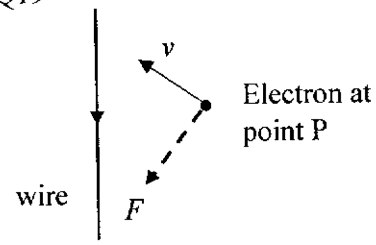
Q18

Initially, the spring is already extended due to weight of P and the downward electric force. When P is lowered, the spring is extended further and therefore, elastic potential energy of the system increases.

A negatively charged object moved towards the positive plate will experience a loss in electric potential energy.

Ans: C

Q19



The magnetic field due to the wire points out the page at P using RHGR. Apply FLHR on the electron, with the conventional current opposite to the velocity of electron. The magnetic force points perpendicularly to v, in the direction B.

Ans: B

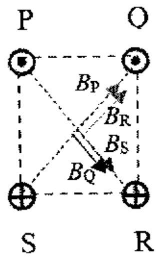
Q20

Originally, $F = BIL$, $8.0 = BIL$ .... (1)

Now, $F' = (3B)IL\cos 30^\circ \approx 21$ mN

Ans: C

Q21



B

The resultant field at the centre of the square $= 2B\cos 45^0 + 2B\cos 45^0 = 2.8B$ directed to the right.

Ans: B

Q22

Induced emf $= IR = AdB/dt = \pi r^2(dB/dt)$

$dB/dt = IR/\pi r^2$

Ans: A

Q23

Average induced emf = change in flux linkage/time $= (BA - BA\cos 60^\circ)/t$

$= 5.0\times 10^{-3}\times 0.20(1-\cos 60^\circ)/0.10 = 5.0$ mV

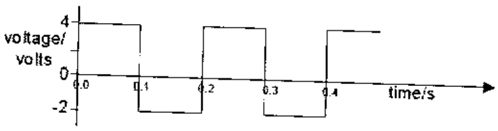
Ans: B

Q24

Mean power $\langle P \rangle = V_{rms} I_{rms} = \frac{V_0}{\sqrt{2}}\frac{I_0}{\sqrt{2}} = \frac{V_0 I_0}{2}$

Ans: B

Q25



$V_{rms} = \sqrt{\frac{\int_0^T V^2 dt}{T}} = = \sqrt{\frac{(4^2)(0.1)+(-2)^2(0.1)}{0.2}}$

= 3.16 V

$< P > = \frac{V_{rms}{}^2}{R} = \frac{3.16^2}{20} = 0.50$ W

Ans: B

Q26

$I = \frac{P}{A} = \frac{Nhf}{tA}$. So for constant frequency f above thresold, $\frac{N}{t} \propto I$. A greater light intensity means more photons per second striking the metal surface. This would result in more electrons emitted per second and a greater photoelectric current.

Ans: C

Q27

Using $hf = eV_s + \phi$

$f = (e/h)\, V_s + \phi/h$

The gradient e/h remains unchanged. The y-intercept ϕ/h becomes lower as ϕ is lower.

Ans: C

Q28.

Using the Duane-Hunt Rule, $Ve = \frac{hc}{\lambda}$

$V = \frac{(6.63\text{x}10^{-34})(3.0\text{x}10^{8})}{(0.20\text{x}10^{-9})(1.6\text{x}10^{-19})}$

= 6.22 kV

Ans: D

Q29

$E = \frac{1}{2}mv^2 \Rightarrow p = \sqrt{2mE}$

$\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE}} \propto \frac{1}{\sqrt{m}}$

Double slit formula: $\Delta y = \frac{\lambda D}{d}$

The fringe spacing Δy for double-slit experiment is proportional to λ, thus

$\Delta y \propto \frac{1}{\sqrt{m}}$

$\frac{(\Delta y)_n}{(\Delta y)_{C_{60}}} = \sqrt{\frac{m_{C_{60}}}{m_n}} = \sqrt{720}$

Ans: B

Q30

$\Delta p = m\Delta v = (8.0\text{x}10^{-16})(0.2\text{x}10^{-6})$

$= 1.6 \text{ x } 10^{-22}$ kg m s^{-1}

HUP : $\Delta p \Delta x \gtrsim h$

So $\Delta x \gtrsim \frac{6.63 \text{ x}10^{-34}}{1.6 \text{ x } 10^{-22}} = 4.1 \text{ x } 10^{-12}$ m

$\approx 4 \text{ x } 10^{-12}$ m

Ans: B