

YIO CHU KANG SECONDARY SCHOOL - MARKING SCHEME

Exam: Prelim 2024

Subject: 6091 Physics

Level: 4E

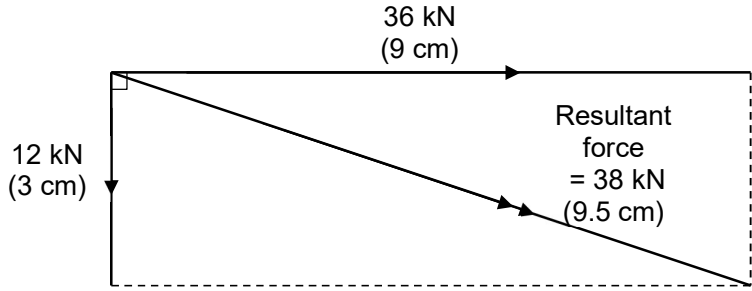
PAPER ONE (MCQ)

1.	C	21.	D
2.	C	22.	D
3.	C	23.	A
4.	B	24.	D
5.	C	25.	A
6.	A	26.	A
7.	D	27.	C
8.	B	28.	A
9.	A	29.	B
10.	C	30.	D
11.	C	31.	A
12.	C	32.	C
13.	A	33.	A
14.	B	34.	C
15.	A	35.	B
16.	B	36.	C
17.	D	37.	C
18.	D	38.	D
19.	C	39.	A
20.	A	40.	B

PAPER TWO Section A

(Note: All answers must be given in **2/3 s.f.** and with **correct unit**)

1.	(a)	The positive velocity indicates that the bungee jumper is travelling downwards, while the negative velocity shows that he is travelling upwards. <i>or</i> They indicate that the bungee jumper is traveling in the opposite directions.	[1]
	(b)	$a = (v - u) / t$ $= (14 - 0) / 1.4$ $= 10 \text{ m/s}^2$	[1] formula / working [1]
	(c)	4.0 s	[1]
	(di)	<u>Tension</u> (in the cord) and <u>weight</u> (of the man)	[1] both answers
	(dii)	- The <u>tension in the cord</u> is larger than the weight of the man. - Thus, there is a <u>resultant upwards force</u> acting on the man and he accelerates upwards at position D.	[1] [1]
Total:			7

2.			
	Appropriate scale (e.g. 1 cm : 4000 N) <u>and</u> vector diagram showing 12 kN, 36 kN and resultant force in correct directions (with arrows).		[1]
	Resultant force = 9.5 cm x 4000 = 38 000 N $\pm$ 1000 N		[1]
	Angle = $18^\circ \pm 2^\circ$		[1]
Total:			3

3.	(a)	- Feature: The box is made of expanded polystyrene which has pockets of trapped air. - Explanation: Air is a poor thermal conductor, thus minimising heat transfer into the box by conduction. - Feature: The cold pack attached to the cover will cool the air near the top of the box. - Explanation: Cold air sinks due to convection and will effectively cool the interior of the box. - Feature: The cover serves as a lid for the box. - Explanation: This minimises the heat transfer by the warm surrounding air via conduction or radiation.	[4] any 2 features & explanation
	(b)	The exterior of the box may be wrapped with aluminium foil. (Accept any other reasonable suggestions)	[1]
Total:			5

4.	(ai)	Ultrasound is sound with frequencies above the upper limit of the human audible range / above 20 kHz.	[1]
	(aia)	$2 \times \text{distance} = \text{speed} \times \text{time}$ $\text{distance} = \frac{1}{2} \times (1500) \times (0.03 \times 10^{-3})$ $= 0.0225 \text{ m}$	[1] formula / working [1]
	(bi)	$f = v / \lambda$ $= 3.0 \times 10^8 / 2.0 \times 10^{-9}$ $= 1.5 \times 10^{17} \text{ Hz}$	[1] formula / working / speed [1]
	(bii)	Excessive exposure to X-rays can cause mutation / cancer / kill cells.	[1]
Total:			6

5.	(a)	$V_s = (V_p N_s / N_p)$ $= 25 \times 44000 / 4000$ $= 275 \text{ kV}$ $I_p V_p = I_s V_s,$ $100 \times 10^6 = I_s \times 275000$ $I_s = 363.6$ $= 364 \text{ A (3 s.f.)}$	[1] formula / working [1] formula / working [1]
	(b)	Electrical power is transmitted at a <u>high voltage</u> so that the transmission current will be <u>low</u>. This <u>reduces power loss</u> ($I^2 R$) in the transmission cables.	[1]
	(c)	$P_{\text{loss}} = I^2 R = 20\% \times 100 \text{ MW}$ $= 363.6^2 \times R$ $R = 151.3$ $= 151 \Omega \text{ (3 sf)}$	[1] ecf [1] ecf
Total:			6

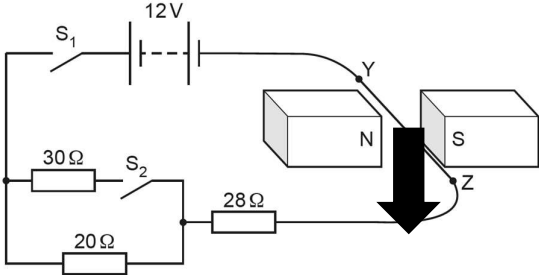
6.	(a)	The metal sphere will be positively charged.	[1]
	(b)	- Once released, the positively charged metal sphere will be <u>attracted</u> to the negatively charged plate Y since <u>unlike charges attract</u> and <u>like charges repel</u>. - Upon touching plate Y, the <u>negative charges from plate Y</u> will flow into the sphere. The sphere will become <u>negatively charged</u>. - The sphere will then swing towards plate X as it is repelled by plate Y since <u>like charges repel</u>. This process repeats.	[1] [1] [1]
Total:			4

7.	(a)	- As the metal bar moves upwards, it cuts the magnetic field lines <u>or</u> there is a change in magnetic flux. - An emf or current is thus induced in the circuit.	[1] [1]
	(b)	When the bar is moved upwards, according to Lenz's law, a <u>downward force</u> will be produced to oppose this movement. This opposing force is caused by the direction of the induced current.	[1]
	(c)	downwards: small <u>negative reading</u> to the right: <u>no reading</u>	[1] [1]
	(d)	Move the bar at a faster rate / use a wider magnet	[1] any one
Total:			6

8.	(a)	$I = V / R$ $= 240 / 60$ $= 4.0 \text{ A}$ Live = 4.0 A; Neutral = 4.0 A; Earth = 0 A	[1] formula / working [1] ecf
	(b)	The fuse will be overheated, melts and opens the circuit when the current exceeds the specified value.	[1]
	(c)	This ensures that the earth wire will redirect the current safely to the ground if the metal casing becomes "live" due to any fault in the wiring.	[1]
	(d)	$P = I \times V$ $= 4 \times 240$ $= 960 \text{ W}$ $= 0.96 \text{ kW}$ 45 minutes = 0.75 h $E = P t$ $= 0.96 \times 0.75$ $= 0.72 \text{ kWh}$ Monthly cost $= 0.72 \times \$0.20 \times 30$ $= \$4.32$	[1] formula / working for $P = IV$ [1] formula / working for $E = Pt$ / ecf [1] ecf
Total:			7

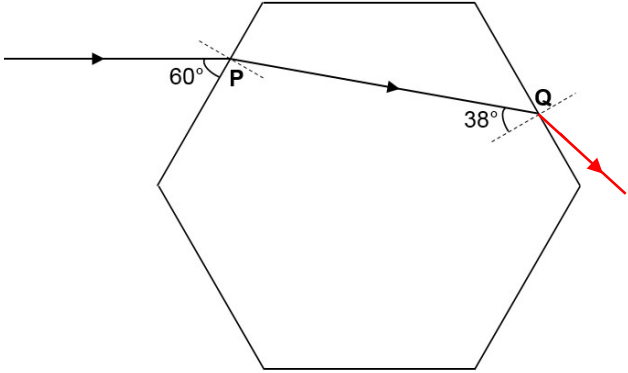
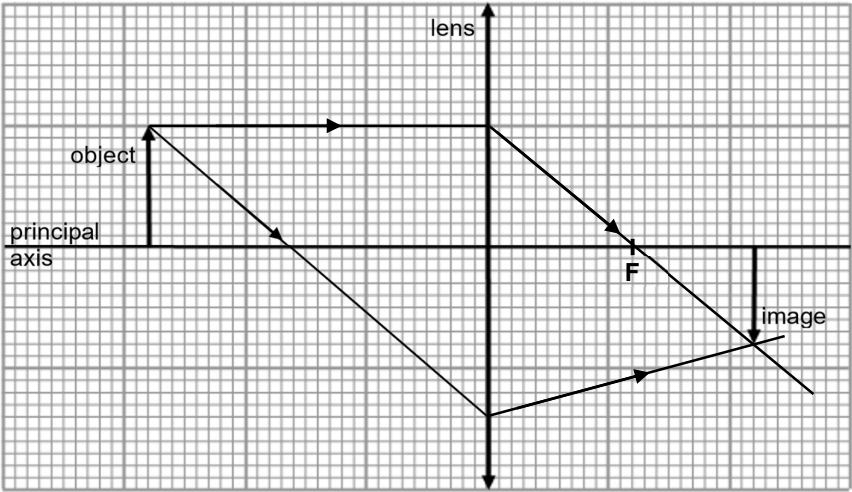
9.	(ai)	Isotopes are atoms of the same element with different numbers of neutrons but the same number of protons and electrons	[1]
	(aii)	T and Q <u>or</u> U and R	[1]
	(b)	W: 218 X: 84 Y: 4 Z: 2	[1] all correct
	(ci)	electron / beta particle	[1]
	(cii)	R gains one more proton and loses one neutron or S has one more proton and one less neutron	[1] [1]
Total:			6

10.	(a)	- The temperature difference between the substance and the freezer is decreasing. - The rate of heat loss from substance X to the surroundings is faster when it is at a higher temperature / slower when it is at a lower temperature.	[1] [1]
	(b)	- During cooling, the speed of the molecules decreases, thus there is a decrease in their energy in the kinetic store. - The energy in the potential store of the particles decreases as the average separation of the particles decreases.	[1] [1]
	(ci)	- Energy is transferred out of the liquid and the energy in the potential store of the molecules decreases to form intermolecular bonds. - The energy in the kinetic store remains constant and therefore temperature does not change.	[1] [1]
	(cii)	Q = $m l_f$ = $(0.045) \times (5.7 \times 10^4)$ = 2565 = 2570 J	[1] formula / working [1]
	(ciii)	P = Q / t = $2570 / 7200$ = 0.3569 = 0.357 J/s <u>or</u> 0.357 W (3 sf) or P = Q / t = $2565 / 7200$ = 0.35625 = 0.356 W (3 sf)	[1] ecf
	(d)	The specific heat capacity of X in its liquid state is lower than that of its solid state.	[1]
Total:			10

11.	(a)	The emf of the battery is of a constant positive value, while the a.c. supply changes direction / magnitude.	[1]
	(bi)	R_{total} $= R_1 + R_2$ $= 20 + 28$ $= 48 \, \Omega$ I $= V / R_{\text{total}}$ $= 12 / 48$ $= 0.25 \, \text{A}$	[1] formula / working for R_{total} [1]
	(bii)	- The current carrying wire YZ produces a magnetic field which - interacts with the magnetic field between the poles of the magnet which causes YZ to experience a force.	[1] [1]
	(biii)		[1]
	(ci)	R_{total} $= 28 + (1/30 + 1/20)^{-1}$ $= 28 + 12$ $= 40 \, \Omega$	[1] formula / working [1] ecf
	(cii)	- The force on YZ increases - as the total resistance of the circuit now decreases, causing the current flowing through YZ to increase.	[1] [1]
Total:			10

Section B

12.	(a)	Oil (liquids) are incompressible.	[1]
	(bi)	Pressure is the force acting per unit area.	[1]
	(bii)	P_{oil} $= F / A$ $= 4500 / 0.018$ $= 250\,000\text{ Pa}$	[1] formula / working [1]
	(biii)	F $= P \times A$ $= 250\,000 \times 1.4$ $= 350\,000\text{ N}$	[1] ecf
	(ci)	The pressure in the oil (liquid) increases with depth. <u>or</u> The weight of the oil that is above piston Y increases as the piston moves downwards.	[1]
	(cii)	Increase in P $= h\rho g$ $= 0.50 \times 900 \times 10$ $= 4500\text{ Pa}$	[1] formula / working [1]
	(d)	- As the waste is compressed, the volume of trapped air decreases. - The frequency of collision between the air molecules and the walls of the plastic bags increases, thus increasing the pressure of the trapped air.	[1] [1]
Total:			10

13.	(ai)	$n = \sin i / \sin r$ $1.42 = \sin 30^\circ / \sin r$ $1 \times \sin 30^\circ = 1.42 \times \sin r$ $r = 20.616^\circ$ $= 20.6^\circ$ (3 sf)	[1] formula / working [1]
	(aii)	The critical angle is the angle of incidence in the optically denser medium for which the angle of refraction in the optically less dense medium is 90° .	[1]
	(aiii)	$n = 1 / \sin c$ $1.42 = 1 / \sin c$ $c = \sin^{-1}(1/1.42)$ $= 44.766^\circ$ $= 44.8^\circ$ (3 sf)	[1] [1]
	(aiv)		[1] ray bends away from normal
	(bi)		[1] complete given ray [1] construct rays to locate F [1] F
	(bii)	The image formed is <u>magnified, upright and virtual</u>	[1]
Total:			10