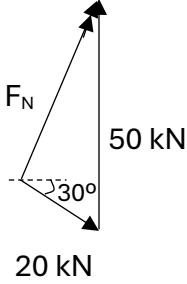


Answers to 2025 4E PHYSICS PRELIM PAPER 2

Sf and unit - unlimited

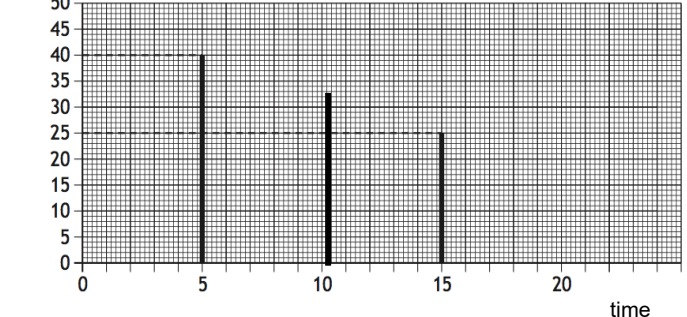
Qn	Answer	Marks	Comments
1	 correct diagram magnitude between 40 to 48 kN angle between 18° to 26°	[1] [1] [1]	
2a	At equilibrium, Clockwise moment = Anti-clockwise moment $W \times d_1 = F \times d_2$ $F = (2.2 \times 10 \times 11)/24$ $= 10 \text{ N}$	[1] [1]	
b	- <u>Since the centre of gravity is at the pivot, there is no perpendicular distance between the line of action of its weight to the pivot</u> - <u>no resultant moment / turning force acting on sculpture</u>	[1] [1]	
3a(i)	$P_l = h\rho g = 1.0 \times 1.6 \times 10^4 \times 10 = 1.6 \times 10^5 \text{ Pa}$ $P = P_l + P_{\text{atm}} = 1.6 \times 10^5 + 1.0 \times 10^5$ $= 2.6 \times 10^5 \text{ Pa}$	[1] [1]	
(ii)	$F = PA = 2.6 \times 10^5 \times 4.0 \times 10^{-4} = 100 \text{ N (2s.f)}$	[1]	Full ecf
b	- <u>the liquid in tube falls</u> - liquid in tube <u>stop falling and remains at a certain height</u> - <u>pressure of liquid inside the tube is equal to atmospheric pressure / pressure of liquid inside tube is originally higher than pressure of liquid in container immediately beneath glass sheet</u>	[1] [1] [1]	

4a	$E_p = mgh = 16 \times 10 \times 1.8 = 290 \text{ J (2sf)}$	[1]	
b	$P = E / t = 288 / 4.5 = 64 \text{ W}$	[1]	
c	<u>Total energy remains the same in the system</u> Some energy from the chemical potential store of the motor is transferred <u>by propagation of wave to the surroundings / to internal store of the conveyor belt</u>	[1] [1]	
5a	M - gamma ray Uses: Radiotherapy / sterilization of medical equipment / killing germs in food / detecting defects in manufacturing / treat cancer through Gamma knife radio surgery / kill cancer cells through directing gamma rays at tumours N - microwaves Uses: satellite communication / microwave oven / wi-fi signals / radar / mobile phone communication / cancer treatment / global positioning system	[1] [1]	
b(i)	<u>Cell death or mutations leading to diseases or organ failure or cancerous growth</u>	[1]	
(ii)	X-rays may <u>interact with a particular atom or molecule and knocks an electron out from it, resulting in a charged ion /</u> <u>High frequency X-rays can penetrate deep into body to create ion</u> <u>The ion may hinder a certain chemical reaction which affects a particular cell process, affecting the specific biological system</u>	[1]	
6a	Critical angle of a diamond is the <u>angle of the incidence in the diamond</u> (optically denser medium) when the <u>angle of refraction in the air</u> (optically less dense medium) is <u>90°</u> .	[1]	
b(i)	$n = \sin i / \sin r = \sin 35 / \sin 15$ $= 2.2 \text{ (2sf)}$	[1] [1]	
(ii)	$n = 1 / \sin c$ $2.22 = 1 / \sin c$ $c = 27^\circ \text{ (2sf)}$	[1]	
c(i)	75°	[1]	
(ii)	<u>Angle of incidence is greater than critical angle</u> and light is travelling from <u>optically denser to less dense</u> <u>Total internal reflection</u> is taking place	[1] [1]	

7a	$R_{\text{eff}} = (1/1.5 + 1/6.0)^{-1} = 1.2 \, \Omega$ $I = V / R_{\text{eff}}$ $= 12 / [1.3 + 1.2]$ $= 4.8 \, \text{A}$	[1] [1]	
b	As temperature increases, the <u>resistance of the thermistor decreases</u> . <u>Effective resistance across 1.5 ohm resistor and Z decreases.</u> The <u>ratio of 1.3 ohm resistor to total resistance increases /</u> <u>since $V = \frac{1.3}{\text{total resistance}} \times \mathcal{E}$, causes the p.d. across to increase,</u> <u>hence causing the p.d. across the voltmeter to increase.</u>	[1] [1]	
c(i)	The permanent magnet would <u>induce the side of object A closer to the permanent magnet with a S-pole.</u> Since <u>unlike poles attract</u> , object A would move towards the magnet and fall in container Y.	[1] [1]	
(ii)	Steel is a <u>hard magnetic material</u> and it <u>loses magnetism slowly</u> .	[1]	
8a	- <u>magnetic field of the coil interacts with the parallel magnetic field of the permanent magnet,</u> - <u>producing an upward force on the right side of the coil and a downward force on the left side of the coil.</u> - <u>By Fleming's Left Hand Rule, magnetic field is directed to right and current in coil is away from A / towards B</u>	[1] [1] [1]	
b	<u>stronger magnetic field / soft magnetic material concentrate magnetic field lines, resulted in stronger force</u>	[1]	
c(i)	$P = IV$ $1200 = I (230)$ $I = 5.2 \, \text{A}$	[1] [1]	
(ii)	<u>8A fuse</u> <u>A fuse rating of 5A is lower than the working current and the fuse will melt.</u> <u>A fuse rating of 13A is much higher than the working current.</u> <u>When the current is too high but not melting the fuse yet, the motor may be overheated.</u>	[1] [1]	
9a(i)	Use gloves and tongs to pick up radioactive materials / wear protective clothing / accept other possible answers	[1]	

(ii)	For controlling exposure to ionising radiation / prevent leakage of radiation to surroundings / protect people from harmful effects of radiation	[1]	
(iii)	${}_{-1}^0\beta$ ${}_0^0\gamma$	[1] [1]	
b(i)	Nuclear radiation in the environment without a known radioactive source	[1]	
(ii)	Count rate from 58 $\rightarrow$ 29, Half-life = 66 s or Count rate from 29 $\rightarrow$ 15, Half-life = (134 – 66) s = 68 s Range = 60 - 72 s	[1] [1]	
10a(i)	<u>magnetic field lines of iron bar cuts the flat coil or magnetic flux / field change in the flat coil</u> due to alternating current <u>induces an e.m.f.</u>	[1] [1]	
(ii)	<u>larger rate of change of field / flux in the flat coil or larger rate of cutting of field lines in the flat coil</u>	[1]	
b(i)	<u>Soft magnetic material / easily magnetized and easily demagnetized / concentrate magnetic field lines within itself and improves links between primary and secondary coil.</u>	[1]	
(ii)	$V_s / V_p = N_s / N_p$ $V_s = (50 / 800) 240$ $= 15 \text{ V}$	[1] [1]	
(iii)	Efficiency = (Output power / input power) x 100 % $= (3.2 \times 15 / 0.22 \times 240) \times 100 \%$ $= 91 \%$	[1] [1]	
(iv)	By increasing voltage, the current can be lower Power loss in wires, $P = I^2 R$. Power loss will be reduced.	[1] [1]	
11a(i)	<u>Air trapped</u> inside corrugated cardboard, is a <u>poor conductor of energy / poor thermal conductor</u>	[1]	
(ii)	<u>Mug N</u> has lower heat capacity, <u>absorbed lesser energy per unit temperature rise</u> <u>Lesser energy from coffee will be transferred away by mug</u>	[1] [1]	

b(i)	Conduction and convection cannot occur Energy from gas <u>will not be transferred</u> through the glass wall to the surrounding.	[1] [1]	
(ii)	- <u>average speed of particles decreases</u> as average kinetic energy decreases - the particles <u>collide with the walls of the container less frequently</u> , exerting lesser force per unit area on the walls.	[1] [1]	
c(i)	$Q = mc\theta = 40 (0.39)(25+196)$ $= 3400 \text{ J (2sf)}$	[1] [1]	
(ii)	$Q = ml$ $3447.6 = m (200)$ $m = 17 \text{ g (2sf)}$	[1]	
12a(i)	Distance = area under the graph $830000 = \frac{1}{2} (11000) t$ $t = 150 \text{ s}$	[1] [1]	
(ii)	$a = \frac{v-u}{t} = \frac{11000-0}{150}$ $= 73 \text{ m/s}^2$	[1] [1]	Ecf
(a)(iii)	$F_N = ma = F - W$ $F - (22000 \times 10) = 22000 (73)$ $F = 1\,800\,000 \text{ N}$	[1] [1]	
(b)	Rocket exhaust <u>exert a force against the rocket</u> , It is <u>equal in magnitude and opposite in direction</u> .	[1] [1]	
(c)	$F_N = T - W$, F_N increases since weight decreases $F_N = ma$, <u>mass decreases</u> <u>Acceleration increases</u>	[1] [1]	
13a	Layer of steel molecules are displaced Transmit through <u>a series of compression and rarefaction</u> <u>Direction of vibration is parallel to the direction of travel</u>	[1] [1]	
b	<u>Maximum displacement of the pulse from rest position is reduced/smaller.</u>	[1]	
c(i)	<u>15 μs</u> since the <u>distance travelled by the pulse is further</u> before reflecting.	[1]	

(ii)	$v = 2d / t$ $5200 = 2d / (15 \times 10^{-6})$ $d = 0.0390 \text{ m}$	[1] [1]	
(iii)	Some of the sound waves are <u>reflected away in other direction</u> / <u>absorbed by steel</u> / <u>not reflected back and instead transmit through the steel block.</u>	[1]	
(iv)	amplitude of reflected pulse  - amplitude is between 25 – 40 μV - time is approximately between 5 – 15 μs	[1]	
d	<u>density of solids is higher</u> than that of liquids therefore particles of steel are <u>closer together</u> than seawater particles. molecules can <u>pass on the energy</u> from one molecule to the next <u>faster</u>	[1] [1]	