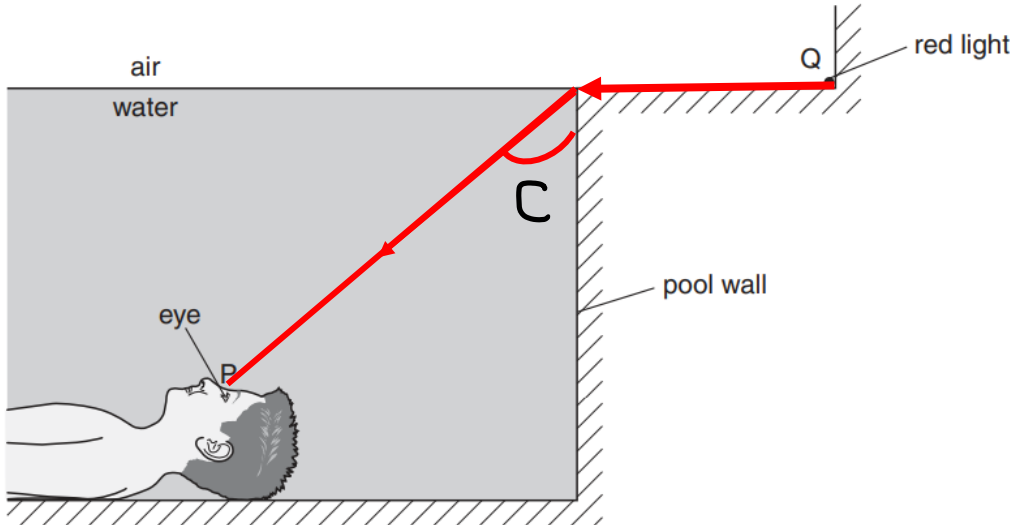
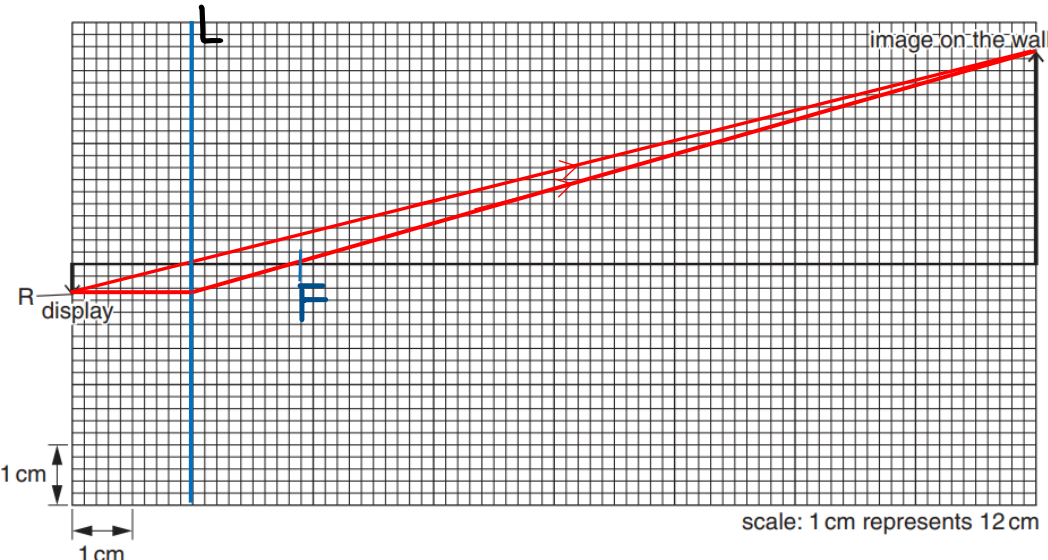


2024 EXP PHYSICS PRELIMS – Marking Scheme

1ai	Pressure due to the mercury column is greater than the atmospheric pressure. This pushes the mercury out of the tube / (resultant) force downwards and mercury flows out of the tube	[1] [1]
1aii	Vacuum / empty space	[1]
1b	Atmospheric pressure = $h \rho g$ and h in metres ρ : density of the mercury g : gravitational field strength h : height of the mercury column (above the mercury level in dish or clearly labelled on Fig 1.2)	[1] [1]
2a	Ray to be drawn. Critical angle marked C (<i>Angle of refraction in this ray diagram</i>). 	[1] [1]
2b*	For angle of incidence = 90° or incident ray to be horizontal , angle of refraction is equal to critical angle & cannot be smaller than that For light to travel to the corner, it needs to travel horizontally before reaching the water. At the corner light refracts, its angle of refraction is equal to critical angle and can't be smaller due to the formula $n = \frac{1}{\sin C}$.	[1] [1]
2c	$n = \frac{1}{\sin C}$ $= 1 / (\sin 49)$ $= 1.33$	[1] [1]

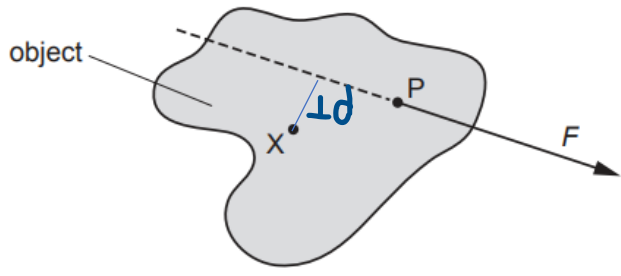
3a	Magnified, inverted, real <i>Marker's feedback:</i> <i>inverted is not equivalent to laterally inverted.</i> <i>Many failed to compare the differences between object and image as they deduce directly by looking the image arrow only.</i>	[1]
3b	- straight ray from R to top of image - ray crosses principal axis, vertical line drawn & L labelled - parallel ray to principal axis from R to lens refracted to top of image - ray crosses principal axis, marked as F  scale: 1 cm represents 12 cm	[1] [1] [1] [1]
4a	$I = Q / t$ $0.0016 = 7.2 / t$ $t = 4500s$	[1] [1]
4bi*	Reading on ammeter 2 remains unchanged. Potential difference across the resistor N remains the same when LDR resistance changes due to the pd across N is not affected by the LDR	[1] [1]
4bii	Time taken for 7.2C to pass through ammeter is increased. Resistance of LDR increases, effective resistance of the circuit increases that decreases current flow in ammeter 1. <i>(This is missing in most answers.)</i>	[1] [1]
5ai	$I = V/R$ $= 12 / (20 + 28)$ $= 0.25 A$	[1] [1]

5aii	Magnetic field between the poles of magnet interacts with the magnetic field due to the current in YZ <i>Marker's feedback:</i> - Many candidates are still confused with the concept of Force acting on current-carrying conductor in a magnetic field vs concept of electromagnetic induction (generating emf using motion of a conductor in a magnetic field). Pls revise Chapter 20 & 21 thoroughly again. - This question is testing on the concept of force acting on a current-carrying conductor in a magnetic field. Applying FLHR. - It has nothing to do with the concept of electromagnetic induction. Hence terms like flux linkage is incorrectly used.	[1]
5aiii	Force is acting downwards / towards the bottom of the paper Using Fleming's left hand rule, index finger points to the right while middle finger points from Z to Y. Thumbs points downwards that represents force. <i>Marker's feedback:</i> Some failed to indicate the direction where the fingers point to.	[1] [1]
5b	Effective resistance of circuit decreases. (48Ω to 40Ω) Current increases and force increases.	[1] [1]
6ai	Alternating current flows the coil, it becomes an electromagnet with alternating poles. This results in continuous attraction and repulsion with the cylindrical magnet. <i>Marker's feedback:</i> - Weaker candidates are confused with the concept of electromagnetic induction (generating emf using motion of a conductor in a magnetic field). - This question is on the basics of electromagnet (form by AC supply) and repulsion & attraction between 2 poles. - It has nothing to do with the concept of electromagnetic induction. Hence terms like Lenz's law is incorrect. - Reject: AC supply reverses the direction of current. "Reverses" does not imply constant changing direction.	[1] [1]
6aii	Air particles around the cone vibrates in the direction parallel to the direction of sound travel An alternate series of compressions and rarefactions are formed in the air <i>Marker's feedback:</i> - Poorly attempted although this question is tested many times since Sec 3! - Reject: transmit vibration / transmit sound waves / sound particles	[1] [1]

6b	Note is louder. (not changed frequency)	[1]
7a	Helium nucleus, particle that consists of 2 protons and 2 neutrons / it has low penetrating power / high ionising ability <i>Reject: Helium atom</i>	[1]
7b	β -particles has weaker ionising effect OR β -particles has high penetrating power that penetrates through the smoke particles / not able to ionised air particles.	[1]
7c	Negative ions are attracted to the left plate while positive ions are attracted to the right plate, closing the circuit.	[1]
7d	${}^{241}_{95}\text{Am} \rightarrow {}^4_2\text{He} + {}^{237}_{93}\text{Np}$ Correct nuclide notation for Am Correct nuclide notation for He and Np with correct arrow direction <i>Reject: γ for gamma radiation. It should be written as γ.</i>	[1] [1]
8ai	Due to a <u>change in the magnetic flux linking the coil</u> , an emf is induced. <i>Reject: changing magnetic field.</i> <i>Accept: changing magnetic field through the coil.</i>	[1]
8aii	Iron core helps to concentrate the magnetic field lines / increase emf generated	[1]
8b	When N-pole is approaching the coil P, there will be an induced current flowing in coil P to repel the approaching N-pole. (induced current formed to oppose the change) Hence, induced current will have to flow in Fig. 8.1 so that N-pole is on the right side of coil P by applying right hand grip rule.	[1] [1]
9ai	6000 turns	[1]
9aii	$N_{PQ} = 110 / 240 \times 6000$ $= 2750$ turns	[1] [1]
9bi	X on the live wire	[1]
9bii	Live wire has the highest potential / voltage. The position will allow the appliance to be completely disconnected from the high potential to avoid potential electrocution to user. <i>Marker's feedback:</i> <i>This is a commonly misinterpreted question. It is to test your understanding why fuse must be placed on a live wire and not on a neutral wire. It also NOT to test on the function of the fuse. Hence, read the question carefully!</i>	[1] [1]
9c	These devices have double insulation.	[1]

10a	Oil is hotter initially and temperature difference is greater. <i>Reject: Take more energy to cool from 0 to 100 °C.</i>	[1]
10bi	-10°C	[1]
10bii	Oil is solidifying and intermolecular forces is strengthening. Internal potential store decreases, Internal kinetic store remains unchanged.	[1] [1]
10ci	$Q = m \times l_f$ $= 0.045 \times (5.7 \times 10^4)$ $= 2.6 \times 10^3 \text{ J}$ (<i>accept 2/3 s.f.</i>)	[1] [1]
10cii	$P = E / t$ $= (2.6 \times 10^3) / (10800 - 3600)$ $= 0.361 \text{ W}$	[1]
10d	Specific heat capacity of liquid oil is smaller than that of solid oil. Temperature decreases more quickly in liquid state OR with the same amount of time, temperature change for liquid is greater than solid (<i>must mention with time comparison</i>)	[1] [1]
11ai	Rate of change of displacement / change in displacement per unit time	[1]
11aii	The direction is opposite <i>Reject: describing with reference to starting point (you must be confused with displacement)</i>	[1]
11aiii	Acceleration, $a = (v - u) / t$ (substitute any 2 points coordinates during 1 st 1.4s) $= 10 \text{ m/s}^2$	[1] [1]
11aiv	4.0 s	[1]
11av	Upward force / tension / elastic force in cord is greater than the weight of the man Resultant force is upwards.	[1] [1]
11bi	KE at C = 5000 J Elastic PE = 20000 J	[1] [1]
11bii	Difference GPE = mgh $5000 = 50 \times 10 \times h$ $h = 10 \text{ m}$	[1] [1]

Section B

12a	 Identify perpendicular distance on the diagram. Moment = $F \times \text{perpendicular distance}$	[1] [1]
12b	For an object to be in equilibrium, Sum of clockwise moment about a pivot is equal to the sum of anticlockwise moment about the same pivot.	[1] [1]
12ci	$W = mg$ $= 8 \times 10$ $= 80 \text{ N}$	[1]
12cii	Point where the whole weight of an object seems to act <i>Reject: "on an object" , "in an object"</i>	[1]
12ciii	Moment = Weight of ladder $\times 0.90 \text{ m}$ $= 80 \times 0.90$ $= 72 \text{ Nm clockwise}$	[1]
12civ	Total anti-clockwise moment = $87 \times 1.3 = 113.1 \text{ Nm}$ Total clockwise moment = Total anti-clockwise moment $72 + F(0.54) = 113.1$ $F(0.54) = 41.1$ $F = 76.1 \text{ N}$ downwards	[1] [1]

13a	Molecules are very close with little or no gaps. Strong intermolecular forces between molecules. These make liquid incompressible.	[1] [1]
13bi	$P = F / A$ $= 4500 / 0.018$ $= 250\,000\text{ Pa}$	[1] [1]
13bii	Total $P = 100\,000 + 250\,000$ (<i>accept e.c.f.</i>) $= 350\,000\text{ Pa}$	[1]
13biii	$F = 350\,000 \times 1.4$ $= 490\,000\text{ N}$	[1]
13c	$P = h\rho g$ $= 0.50 \times 900 \times 10$ $= 4500\text{ Pa}$	[1] [1]
13d	Volume of trapped air decreases Molecules collide with the walls of bag more frequently Exerting greater force per unit area	[1] [1]