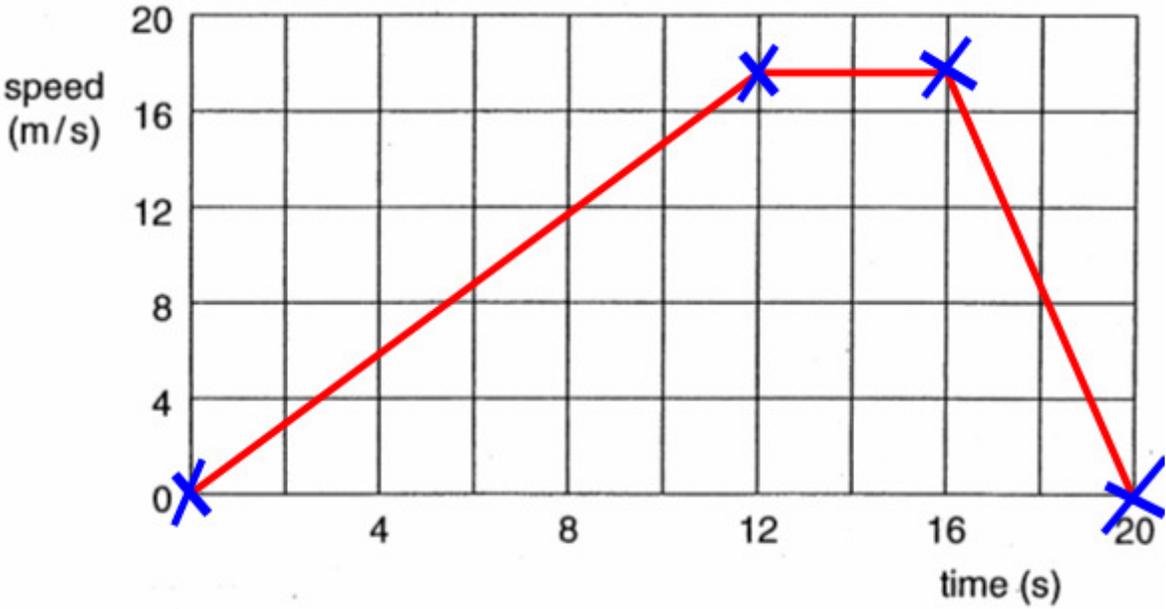
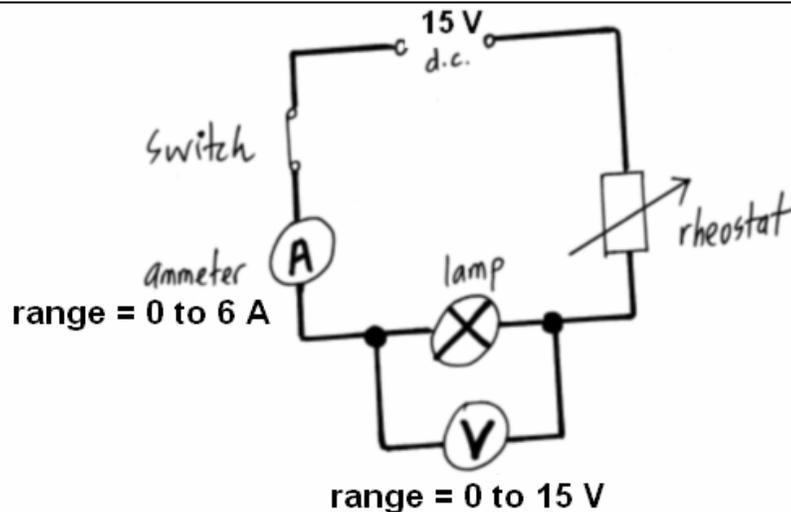


SECONDARY FIVE NORMAL ACADEMIC SCIENCE (PHYSICS) 5116
NOV 2002 GCE 'O' LEVEL PAPER 2
SUGGESTED ANSWERS

Question	Suggested Answer
1a	Velocity is a vector quantity that depends on both direction and magnitude. When the direction changes, velocity changes.
1b	Yes. There is a rate of change of velocity, meaning that there is acceleration.
2a	Apply $v = u + a t = 0 + (1.5) (12) = 18 \text{ m/s}$ Points to plot are (0,0), (12,18), (16,18), (20,0) Straight line (not single line, a few lines) joining all the points 
2b(i)	$F = m a = (800 \text{ kg}) (1.5 \text{ m/s}^2) = 1200 \text{ N}$ <i>Note the constant acceleration of 1.5 m/s^2</i>
2b(ii)	$F = m a = (800 \text{ kg}) (0 \text{ m/s}^2) = 0 \text{ N}$ <i>Note that for constant speed, acceleration is zero</i>
3a	Frequency = 40 teeth x 15 revolutions per second = $40 \times 15 = 600 \text{ Hz}$
3b	$v = f \lambda$ $\lambda = v / f = 340 / 600 = 0.567 \text{ m} \approx 0.57 \text{ m}$ <i>Remember to use your answers to 3a.</i>
4a	Since the light bends away from the normal axis in medium P, the optical density of P is lower than the optical density of Q. P must be air, and Q is glass since glass is optically denser than air.
4b	$n = \frac{c}{v}$ $n = \frac{3.0 \times 10^8}{2.1 \times 10^8} = 1.43 \approx 1.4$
5a	Taking moments about the pivot at the 50-cm mark, for equilibrium, by Principle of Moments, $M_{acw} = M_{ccw}$ $(40 \text{ cm})(m_A)(g) = (30 \text{ cm})(100)(g)$ [W = F = m g] $m_A = 75 \text{ g}$ <i>No need to convert to S.I. units for moments calculation</i>

5b	The weight of the metre rule is at the 50-cm mark, and its perpendicular distance from the pivot is zero, so by $M = F d$, $d = \text{zero}$, $M = \text{zero}$, there is no moment due to the weight of the metre rule about the pivot.
5c	Spring balance measures the total weight $W = mg = \frac{75+120+100}{1000} \times 10 = 2.95 \text{ N}$
6a	Fuse connected in the live wire. Switch connected in the live wire. Earth wire connected to the metal casing of the device. Live wire connects to the top wire of the heating element. Neutral wire connects to the bottom wire of the heating element.
6b	Live: 230 V and 3.5 A Neutral: 0 V and 3.5 A Earth: 0 V and 0 A
7	Out of syllabus
8	Out of syllabus
9a	Place the thermometer into a filter funnel of pure melting ice at one atmospheric pressure, which is at 0°C . Confirm temperature of pure melting ice with another accurately calibrated thermometer. Check to see if the marking of the thermometer to be checked coincides with its 0°C marking. Place the thermometer in the steam above pure boiling water at one atmospheric pressure, which is at 100°C . Confirm temperature of pure steam with another accurately calibrated thermometer. Check to see if the marking of the thermometer to be checked coincides with its 100°C marking.
9b(i)	Sensitivity refers to the ability to detect small changes in temperature. To increase the sensitivity, we have to have a larger bulb so that the volume of mercury in the bulb increases. We also need to have a narrower bore (capillary tube). For a unit change in temperature, the larger volume of mercury expanded due to a larger bulb, for the same expansion rate, will force a larger volume of mercury up the bore, and the difference in height of the mercury level would be larger. Similarly, for a narrower bore, the same volume of mercury forced up the bore would display a larger difference in height of mercury level.
9b(ii)	Responsiveness refers to the speed in which the thermometer reacts to changes in temperature. To increase the responsiveness, we have a thinner glass wall of the bulb, or by having a smaller bulb (holding less mercury). A thinner glass wall of the bulb allows for faster conduction of heat through the glass wall into and out of the mercury in the bulb. A smaller volume of mercury also implies that less time is needed to produce a smaller quantity of heat energy needed to expand/contract the smaller volume of mercury.



$$P = I V$$

$$I = P / V = 60 / 12 = 5.0 \text{ A}$$

Since the rated current is 5.0 A, we use an ammeter with a range of 0 to 6 A

Step 1:

Connect the circuit as shown in the diagram

Step 2:

Adjust the variable resistor (rheostat) to its maximum resistance, and then close the switch. Record down the current (ammeter reading) and the voltage across the lamp (voltmeter reading).

Step 3:

Adjust the resistance of the rheostat to 7 other different values, and obtain the corresponding readings of current and voltage across the lamp.

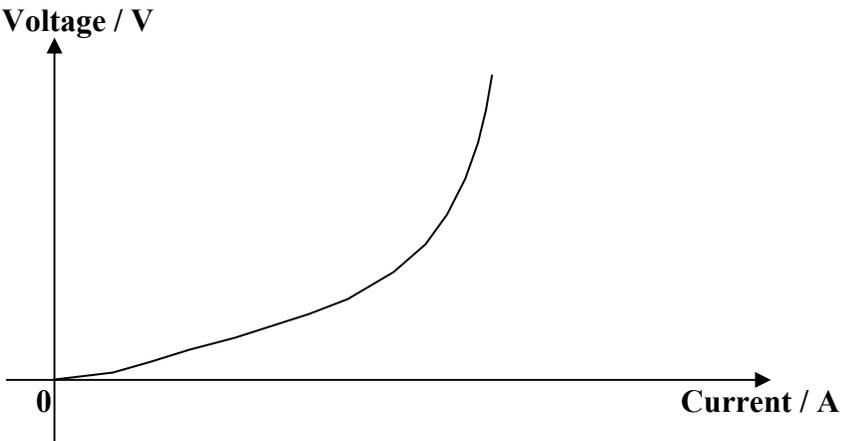
Step 4:

Tabulate all readings in a table.

Voltage / V	Current / A

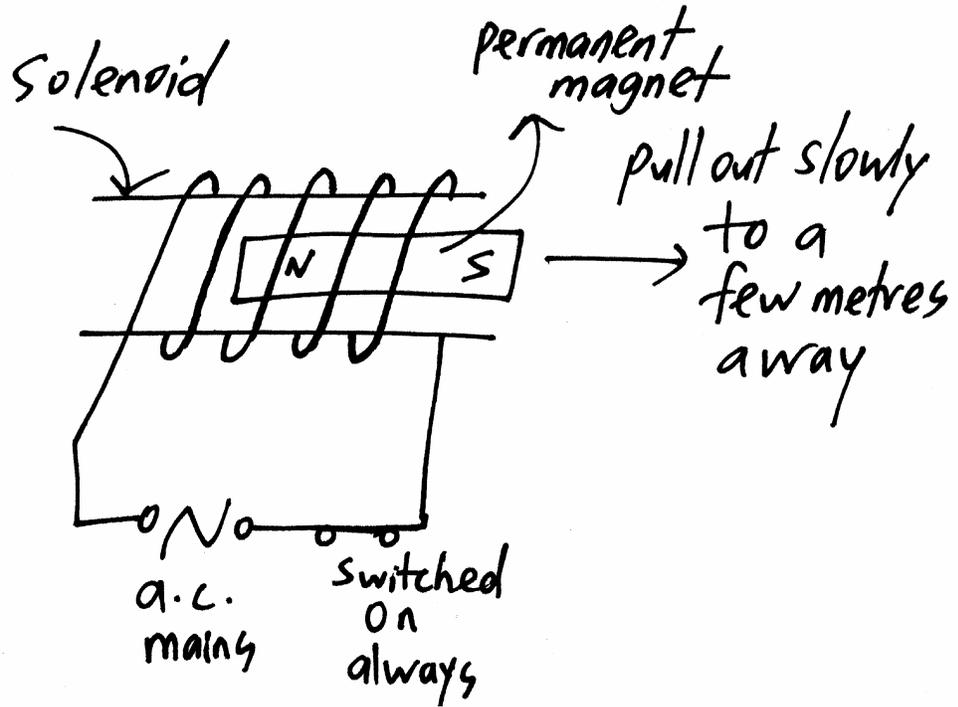
Step 5:

Plot a graph of voltage / V (vertical axis) against current / A
Draw the line of best fit through the points.

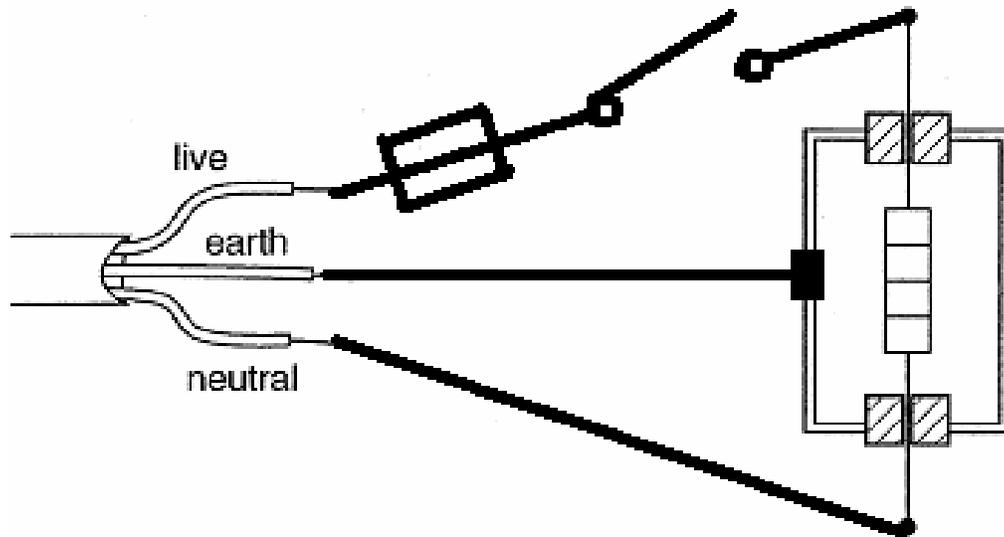
	<p>Rated voltage: 12 V Range of voltmeter: 0 to 15 V</p> <p>Rated current: 5.0 A Range of ammeter: 0 to 6 A</p>
10b	 <p>As the lamp heats up when operated at its rated power and rated voltage, its resistance increases, and since $R = V / I = \text{gradient of the voltage-current graph}$, the gradient of the graph increases.</p> <p>As current increases, the increase in voltage increases. The lamp no longer obeys Ohm's law (because of the heating effect causing temperature to rise).</p>
11a	I would count the number of initially un-magnetised iron nails that the electromagnets can hold up. The stronger electromagnet would be able to hold up more iron nails and overcome a larger downward force (weight of iron nails held up).
11b(i)	The electromagnet would become stronger as the larger number of turns created a stronger magnetic field.
11b(ii)	There would be a decrease in the current in the turns of coil due to increased resistance, and the decrease in current would lead to a decrease in the strength of the electromagnet.
11c	Iron is able to lose magnetism much faster and much more easily than steel when the current is switched off. Also, iron is able to gain magnetism much faster and more easily than steel when the current is switched on.

11d

a.c. supply (mains)
Pulling out the permanent magnet slowly from inside the solenoid
Circuit is switched on throughout the experiment.



6a



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SUGGESTED ANSWERS

Question	Answer	Suggested Explanation
1	B	Every second, the speed increases by 10 m/s.
2	C	Centre of gravity is the lowest when most of the mass is concentrated at the bottom.
3	B	Density = mass ÷ volume It is the mass per unit volume of the material.
4	D	Taking moments about pivot P, for equilibrium, by Principle of Moments, Sum of anti-clockwise moments about pivot is equal to the sum of clockwise moments about the same pivot
5	B	$P = I V = W / t$ $P = F s / t = (2000)(10) / 20 = 1000 \text{ W}$
6	B	Melted solid (liquid) was allowed to cool. Hence, XY shows the freezing of the liquid (mix of liquid and solid state) at the melting point of the solid.
7	D	Conduction is caused by molecular vibrations and collisions, leading to a transfer of kinetic energy via collisions.
8	A	$v = f \lambda$ $\lambda = v / f = 3.0 \times 10^8 / 6.0 \times 10^7 = 5.0 \text{ m}$ $v = c = 3.0 \times 10^8 \text{ m/s}$
9	C	Magnifying glass: virtual, upright and magnified image Pair → virtual must be upright also. Pair → Real must be inverted also.
10	A	Angle of incidence = P (air to glass, so bends towards normal axis) Angle of refraction = R $n = \frac{\sin(\text{bigger angle})}{\sin(\text{smaller angle})}$ $n = \frac{\sin P}{\sin R}$
11	D	Pitch depends on frequency of vibration. Higher pitch means higher frequency Loudness depends on amplitude of vibration. Higher loudness means higher amplitude
12	A	Induced magnets → implies attraction → implies unlike poles attract
13	D	Definition of e.m.f. as found in textbook
14	A	p.d. = +10 – 0 = 10 V $I = V / R = (10 - 0) / 2000 = 0.0050 \text{ A} = 5 \text{ mA}$
15	B	$A_1 = A_2 =$ series current (same series current) Since $V = I R$, larger R implies larger V. So V2 is larger than V1.
16	C	Fuse and switch must be in the live wire and not the neutral wire. This is to make sure that the appliance is not charged at a high voltage when the fuse blows and also when the switch is opened.
17	D	$E = P t = I V t = (3 \text{ A})(4 \text{ V})(10 \text{ s}) = 120 \text{ J}$
18	D	Out of syllabus
19	C	Out of syllabus
20	C	Nucleon number (for nucleus) = number of protons + number of neutrons