Section A

1	(a)	F = ma 145000 – 40000 = 60000a a = 105000 / 60000 = 1.75 m / s^2	[1] [1]
	(b)	a = (v – u) / t t = (v – u) / a = (60 – 0) / 1.75 = 34.3 s or 34 s	[1] [1]
	(c)	distance = ½ x 34.3 x 60 = 1030 m	[1] [1]
	(d)	Air resistance increases as the speed of the aircraft increases. Thus, the total resistive forces acting against the aircraft will increase with its speed.	[1]
2	(a)	W = mg = 60 × 10 = 600 N	[1] [1]
	(b)	When he pushes the floor, his body rises and <u>moves through a distance in the same direction as the force F</u>, hence work is done.	[1]
	(c)	Moment due to the weight about his toe = 600 N x 0.80 m = 480 Nm	[1] [1]
	(d)	By Principle of Moments, taking moments about his toes, F x 1.15 m = 480 F = 417 N or 420 N total upward force = total downward force F + R = W 417 + R = 480 R = 63 N or 60 N	[1] [1] [1]
	(e)	The force exerted by the hand on the floor.	[1]
3	(a)	F = pressure x area F = 1.2 x 10^6 x 5.0 x10^{-5} = 60 N	[1] [1]

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	(b)	**Pressure in oil remains the same**. ($F_1/A_1 = F_2/A_2$) There is a **greater cross-sectional area** at the brake pads. Thus a **larger force** will be applied.	[1] [1]
	(c)	**Bubbles of air** are highly **compressible**. Hence, some pressure is used to compress the bubbles and **the pressure is not fully transferred to S**.	[1] [1]
4	(a)	Air molecules are moving around randomly and at high speeds. They **collide or hit the walls** of the cylinder thus **exerting a force** on walls, resulting in pressure.	 [1] [1]
	(b)	Molecules are now closer / spaced more compactly / more molecules per unit volume / less space to move. They collide **more frequently** with the wall of chamber, causing higher pressure	 [1] [1]
5	(a)	**Unlike charges attract**. The **negative charges on the teeth** are attracted to the **positively charges on the plaque**.	[1]
	(b)(i)	When the hand is holding to the positively charged handle, **the excess electrons on the tooth are attracted to the handle** and neutralised. More electrons continue to be transferred to the handle due to the high positive charge. Since the **teeth have more positive charges than negative charges**, the teeth become positively charged.	[1] [1]
	(ii)	As **opposite charges attract,** the **positively charged plaque is attracted to the negatively charged bristles** of the toothbrush OR it is **repelled by the positively charged teeth** since **like charges repel**.	[1] [1] [1] [1]
	(c)	Q = It = 0.00015 x 5 x 60 = 0.045 C	 [1] [1]
6	(a)(i)	$I = \frac{12}{8000}$ $I = 1.50\times10^{-3}$ A	 [1] [1]
	(ii)	$V = 1.50\times10^{-3}\times3300$ $V = 4.95$ V	[1] [1]
	b	When brightness decreases, the **resistance of LDR increases**.	

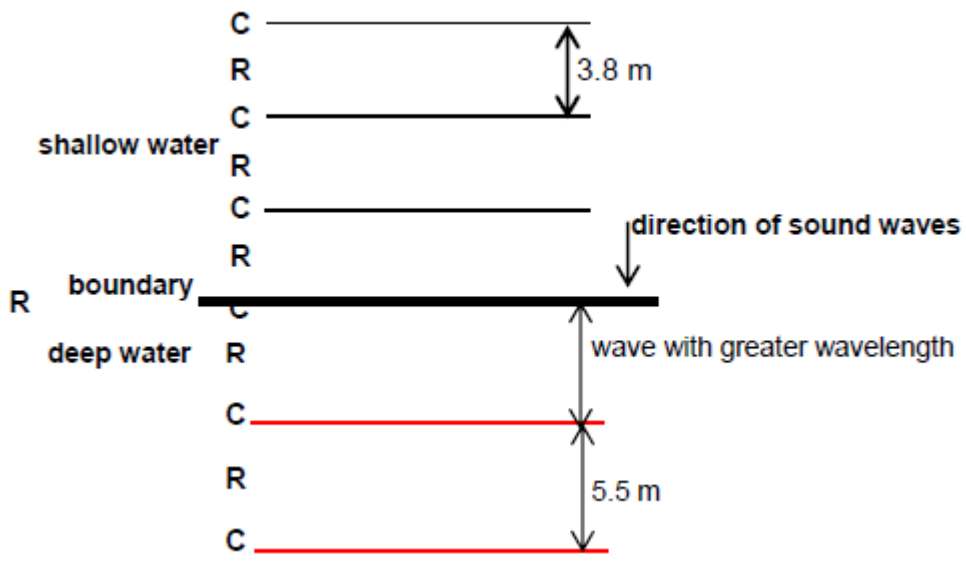
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		Since total resistance increases, the **current flowing through the series circuit decreases**. Since **V = RI**, **potential difference across the fixed resistor decreases**. Since e.m.f. is equal to the sum of p.d. across fixed resistor and p.d. across LDR, **potential difference across LDR increases**.	[1] [1]
7	(a)	X = Live wire Y = Neutral wire Z = Earth wire	[1]
	(b)	$P = V^2/R$ $R = V^2/P = 220^2/100 = 484\ \Omega$ $I = V / R_{total}$ $= 220 / (484 \times 3)$ $= 0.15$ A or 0.152 A	 [1] [1]
	(c)	When a fault occurs and causes the live wire to touch the **metal casing the metal casing will be live**. This is dangerous as anyone who contacts the metal casing will be electrocuted as there is **no earth wire to provide a path of almost zero resistance for the current to flow to earth** instead of to the user.	[1] [1]
8	(a)	$V_s = (44000 / 4000) \times (25 \times 10^3)$ $V_s = 275$ kV or 275 000V	 [1] [1]
	(b)	$I_pV_p = I_sV_s$, $100 \times 10^6 = I_s \times 275\ 000$ $I_s = 364$ A (3 s.f.)	 [1] [1]
	(c)	Electrical power is transmitted at a **high voltage**. The transmission **current** will be **low**. This **reduces power loss** due to heating effect (joule heating) in the transmission cables.	[1] [1]

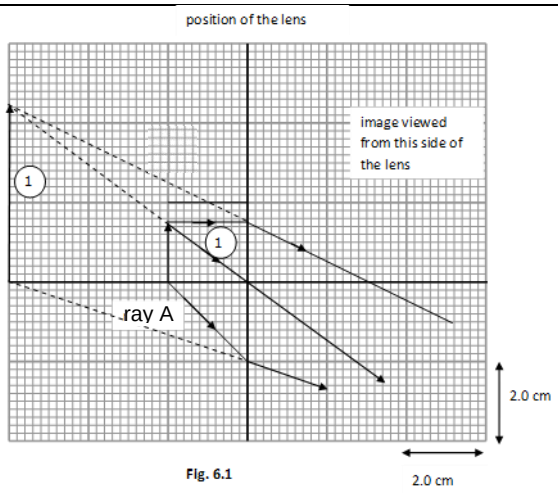
Section B

9	(a)(i)	From the graph, when f = 400 Hz, λ = 1.4-1.6 m at temperature 20 °C, v = f λ	

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		= 400 × (1.4~1.6) or 400 x 1.5 = 560-640 m / s or 600 m / s	[1]
	(ii)	λ = 3.6-3.9 m at temperature 40 °C v = f λ = 400 × (3.6~3.9) or 400 x 3.8 = 1440~1560 m / s or 1520 m / s	[1]
	(b)	The **speed of sound increases** as the temperature increases. This is due to a **larger wavelength** at higher temperature. Or The **speed of sound increases** as the temperature increases. At higher temperature, the water molecules have **more kinetic energy and vibrate more vigorously**, making it easier for the series of compressions and rarefactions to pass through.	[1] [1] [1] [1]
	(c)(i)	Longitudinal	[1]
	(ii)	At constant temperature, frequency remains constant. Since the wavelength increases in deeper water, the speed increases in deeper water.	[1] [1] [1]
	(iii)	Larger wavelength in deep water. Indicate wavelengths.  	[1] [1]
10	(a)(i)	Ray 1: Since the **angle of incidence is 0°** (or along the normal), it emerges from the surface **without refraction**. Ray 2: It undergoes **refraction** as its **angle of incidence is smaller than the critical angle**.	[1] [1]

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		Ray 3: It undergoes **total internal reflection** as is **angle of incidence is bigger than the critical angle**.	[1]
	(ii)	$c = \sin^{-1}(1/1.33)$ $= 48.753$ $= 48.7^{o}$ or 49^{o}	[1] [1]
	(b)(i)	A virtual image is an image that cannot be formed on a screen	[1]
	(ii)	 Fig. 6.1	[2]
	(iii)	focal length = 3.0 cm	[1]
	(iv)	ray A : see (ii)	[1]
11	(a)(i)	The nucleus has a **different number of neutrons / mass number / nucleon number**. It has the **same number of protons / same atomic number**.	[1]
	(ii)	It is not an isotope **and** Q has a different proton number / atomic number	[1]
	(b)i	technetium–99	[1]
	(b)ii	only gamma detected outside body **EITHER** half-life / 6 hours is short **and** less damage (to others / long term) / loses radioactivity quickly **OR** half-life / 6 hours is long enough for isotope to reach site and be detected / long enough to examine patient / does not need to be replaced	[1] [1]
	(c)i	any **two** from:	

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		number of protons decreases by two number of neutrons decreases by two **or** number of nucleons decreases by four	[1] [1]
	(ii)	background radiation (detected) **or** source of background radiation mentioned (e.g. cosmic rays; radiation in the air)	[1]
	(iii)	alpha-particles are absorbed by the air (between the source and detector) alpha-particles travel less than 10 cm (in air)	[1] [1]
12	(a)	When heated, the hot water expands, becomes **less dense and rises**. The **colder, denser water at the top sinks** to replace it, forming **convection currents**.	[1] [1] [1]
	(b)i	P = IV Q/t= IV Thermal energy, Q = IVt = (9.6)(230)(3.5 × 60) = (2 208)(210) = 463 680 = 4.6×10^5 J (2 s.f.)	 [1] [1]
	ii	*Q = mc$\Delta\theta$* *463 680 = (1.6)(4200)($\Delta\theta$)* *Change in temperature, $\Delta\theta$ = 69* *Maximum possible temperature of water = 22 + 69 = 91 ℃ (2 s.f.)*	[1] [1]
	c	White colours are **poor emitters of infrared radiation**, hence there will be **less heat loss to the surroundings**.	[1]
	d	Thermal energy is used to **do work to increase the potential energy** of the molecules, so as to **overcome the inter-molecular forces** and separate the molecules far apart.	[1] [1]

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