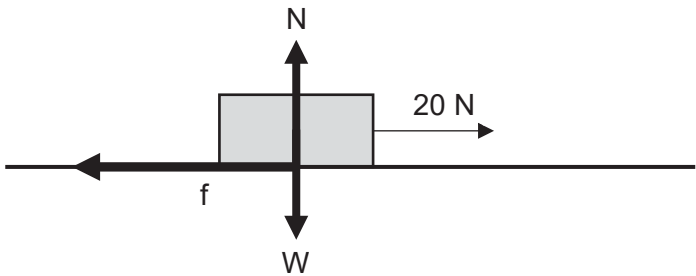
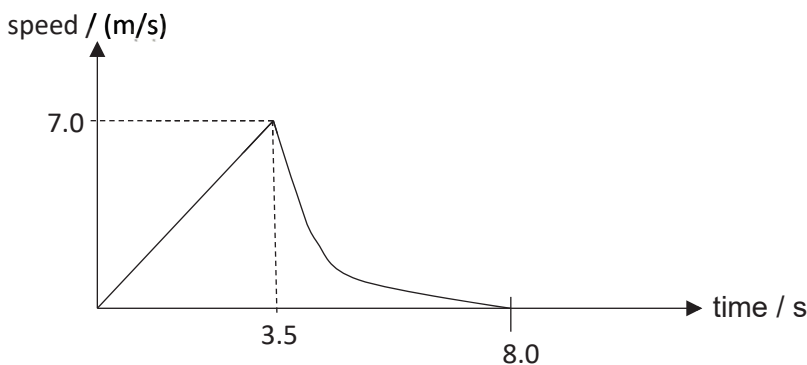


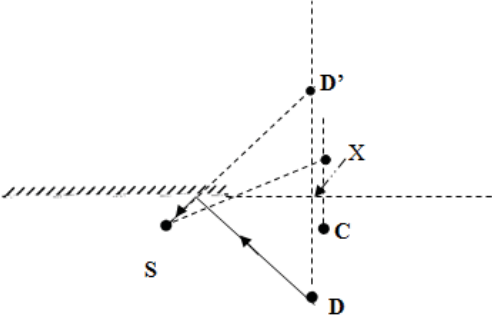
Section A MCQ

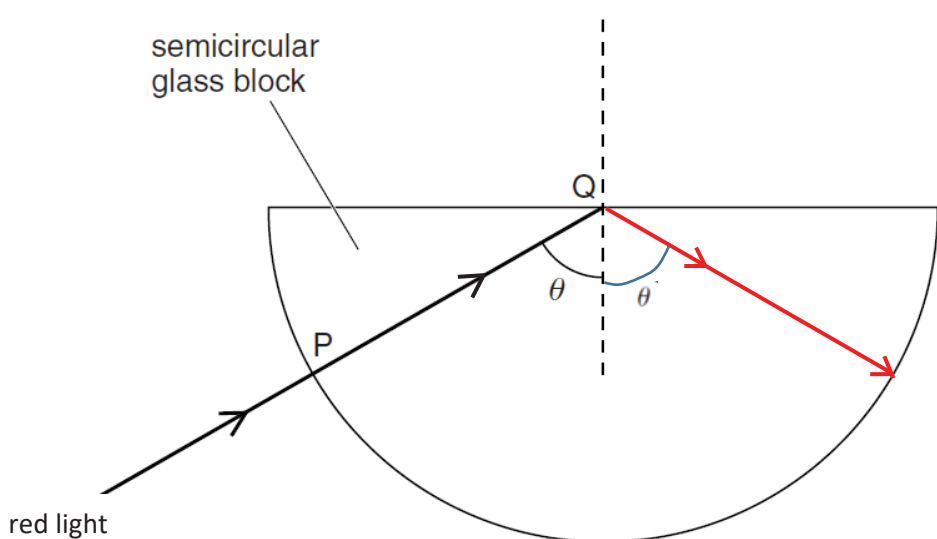
1	2	3	4	5	6	7	8	9	10
A	A	C	A	D	C	C	B	A	B
11	12	13	14	15	16	17	18	19	20
D	C	D	A	B	A	A	B	C	C

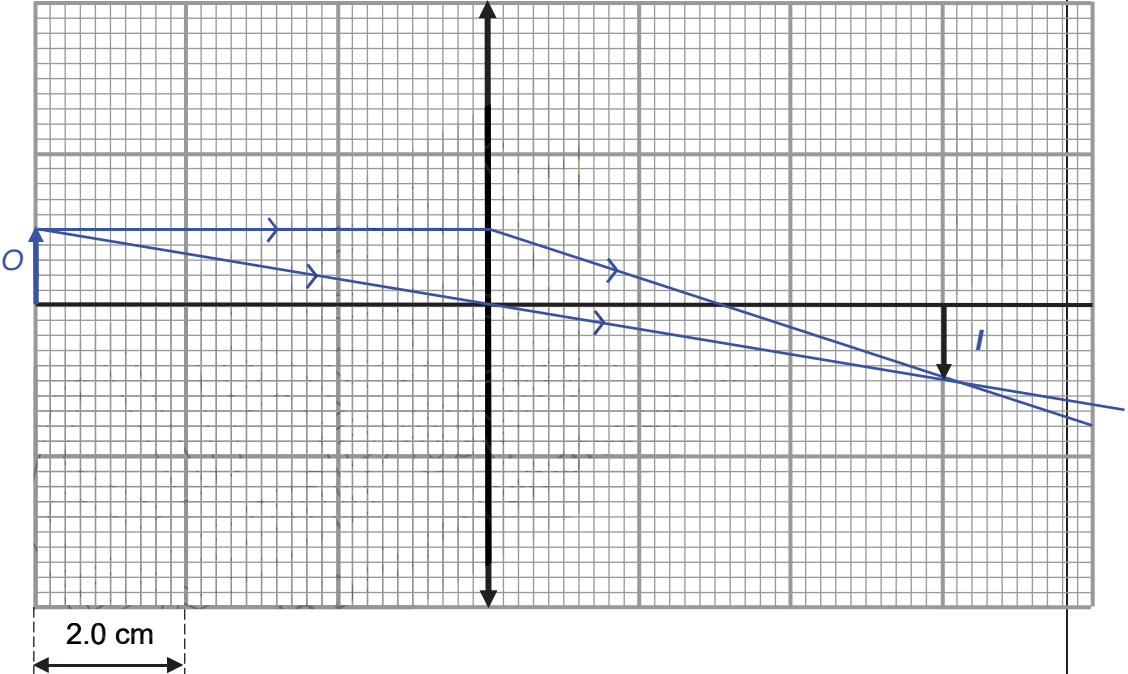
Section B

No	Answer	Mark
1a	 Missing any type of force or labelling of force – 0m. Friction must be drawn between surfaces. Normal force starts from the surface. Weight must start from the C.G.	A1
1b	$F_r = F - f$ $5.3 \times 2 = 20 - f$ $f = 9.4 \text{ N}$	M1 A1
1c	$V = 2 \times 3.5$ $= 7.0 \text{ m/s}$	M1 A1
1d	 Shape of graph – 1m Labelling (ecf from 1 (c)) - 1m, must show all the numbers correctly	B1 B1

2a	The clockwise moment <u>about P</u> due to the weight of the stool is equal to The anti-clockwise moment <u>about P</u> due to Force F. Or The sum of clockwise moment is equal to the sum of anticlockwise moment <u>about P</u> (same pivot) *answer must make reference to question and mention pivot P as part of answer.	B1
2b	$\text{SAM} = \text{SCM}$ $F \times d = W \times d$ $F \times 0.4 = (30)(0.06)$ $F = 4.5 \text{ N}$ Students who work in cm instead of m also accepted.	M1 A1
2c	The stool will be more stable as the centre of gravity is lower to the ground. (The line of action of its weight falls within the base, hence it will not topple) (The moment of its weight will always create a countering moment to restore stool to its original position whenever it is displaced.)	B1 Or B1
3a	loss in GPE = mgh = (0.6)(10)(0.3) = 1.8 J	M1 A1
3b	GPE = KE mgh = $\frac{1}{2}mv^2$ $v = \sqrt{2gh}$ = $\sqrt{2(10)(1.5)}$ = 5.48 m/s or 5.5 m/s	M1 A1
3c	Energy = WD d = Energy/Force = mgh/3 = (0.6)(10)(1.5)/2.5 = 3.6 m	M1 A1
4a	P = F/A = mg / A = (60 x 10) / 2.4 x 10⁻³ = 250 000 Pa	M1 A1
4b	<u>Pressure</u> exerted by the tyre is <u>bigger</u>.	B1

	Since pressure is force per unit area, when the force which is the weight of the bicycle and rider is the same while the <u>area of contact decrease</u>, pressure increases. *students answer must be clear to indicate the relationship between <u>contact area</u> and pressure. *surface area not accepted	B1
5		
ai	Marking of D' accurately ($DX = D'X$).	A1
aii	Reflected ray from mirror to S and Virtual dotted lines from D' to mirror. DX and DX' must be dotted Incident ray from D to mirror. Correct indication of arrow	B1 B1
5b	No Mirror is too short to reflect any light from Carl to Sarah's eyes / The reflected rays from the mirror cannot reach Sarah	A1 M1 C.A.O
6a	Y: Ultraviolet radiation Z: Infrared radiation	B1 B1
6bi	Microwaves	B1
6bii	Gamma rays	B1
7a	Angle of incidence is 0° / Light ray lies along the normal / light ray is perpendicular to the surface of the glass.	B1
7b	$c = \sin^{-1} (1/1.5)$ $= 41.8^\circ$ or 42°	M1 A1

7c	 Students should draw the light ray accurately (angle of reflection should be equal to θ)	B1
7d	Angle of incidence is greater than critical angle and light ray is travelling from optically denser to optically less dense medium (hence total internal reflection occurs)	B1 B1
7e	- From 47° to 41.8°, there is total internal reflection and angle of reflection decreases. - At critical angle, angle of refraction is 90° or light emerge along the air-glass boundary. - From slightly less than 41.8° to 30°, there is refraction and leaves the block at Q.	B1 B1 B1
8	The dust and ash particles will gain electrons from the fine wires and <u>become negatively charged</u>. As <u>unlike charges attract</u>, the <u>particles will be attracted to the plates with positive charge</u>.	B1 B1
9a	Potential difference across M = $10 - 4.26$ = 5.74 V $R = V/I$ = $5.74 / 1.92$ = 2.99Ω 3.0Ω	M1 A1
9b	$Q = It$ = 1.92×20 = 38.4 C or 38 C	A1
9c	Ammeter reading decreased. (Total resistance increased, by $V=IR$, current decrease) Voltmeter reading increased. (Since pd across M decreased with the decreased in total current, pd across presistor Y will increase)	B1

Section B		
10ai	$f = 1 / T$ $= 1 / (0.60 / 3)$ $= 5.0 \text{ Hz}$	A1
10aai	$v = f\lambda$ $= 5.0 \text{ Hz} \times (0.24 \text{ m} / 3)$ (ecf from (a)) $= 0.40 \text{ m/s}$	M1 A1
10bi	 Award 1 m for <u>both</u> ray drawn correctly. Do not penalize if arrows not drawn However deduct 1 mark for arrows drawn in wrong direction. (half box margin of error given) Award 1 m for object drawn and labelled correctly. Deduct 1 mark if object is not drawn or not labelled.	B1 B1
10bii	Virtual, upright and magnified *students must mention all 3 to be awarded marks, no partial marks given)	B1
10ci	The water particles vibrate in a direction parallel to the direction of the propagation of the wave motion passing on the energy to neighbouring water particles when they collide. The sound creates a series of compression and rarefactions in the layer of water particles between the dolphins.	B1 B1

10cii	By the relationship of velocity = frequency x wavelength, Since the frequency is equal in both medium and the <u>speed of sound in air is slower than in water</u> as molecules are further apart and takes a longer time to collide and transfer energy, the <u>wavelength in air will be shorter than in water</u>.	M1 A1 C.A.O
11ai	Cube R has the smallest mass. The cube with the smallest mass has the smallest product of density and volume ($m = \rho \times V$) Or The cube has the smallest density and volume.	A1 M1 M1
11aii	$m_v = \rho_v \times V_v$ $= (2 \times 2000 \text{ kgm}^{-3}) \times (1/2 \times 2.0 \text{ m}^3)$ $= 4000 \text{ kg}$ $W_v = m_v g$ $= 4000 \text{ kg} \times 10 \text{ N/kg}$ $= 40\,000 \text{ N}$	M1 A1
11bi	During section B, the liquid is freezing. <u>Strong intermolecular bonds are formed between neighbouring molecules and the molecules in the solid state have less potential energy. Energy produced is lost to the surrounding.</u> During this change of state from liquid to solid, the <u>kinetic energy</u> of the molecules <u>remain constant</u> so the temperature of the mixture remains constant.	B1 B1
11bii	Arrangement: From close and randomly pack to very close and regularly arranged. Motion: From sliding past one another to vibrating about their fixed positions.	B1 B1
11c	From 100 ° C to 4 ° C, density of water increases. From 4 ° C to 0 ° C, density of water decrease.	B1 B1
12a	Total current = $1000/240 + 200/240$ = 5.0 A Fuse rating = 6.0 A (accept answers from 6.0 A to 10 A)	M1 A1
12b	Total electricity used = $1 (40/60) + 0.2 (40/60)$ = 0.8 kWh Total cost = $0.8 \times 0.22 = \\$0.18$ (accept \$0.176)	M1 A1
12c	Resistance Q is three times more than P. (Do not accept Resistance Q higher than resistance P) The cross sectional area of a wire is inversely proportional to its resistance.	B1 B1
12di	Shiny surfaces are poor emitter of infrared radiation, retains heat for a longer time / reduces heat loss by radiation.	B1 B1

	*do not accept reflector	
12dii	Bottom of the electric kettle set up convection current to heat water quickly/ efficiently.	B1 B1

