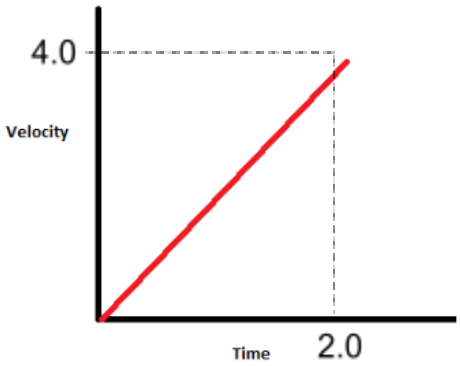
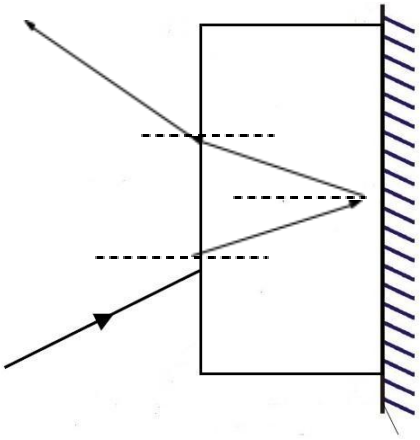
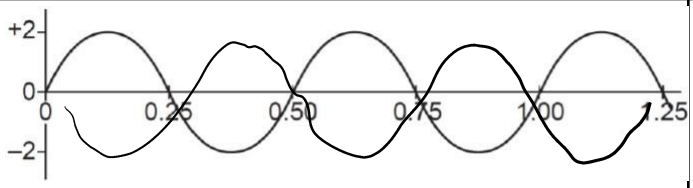
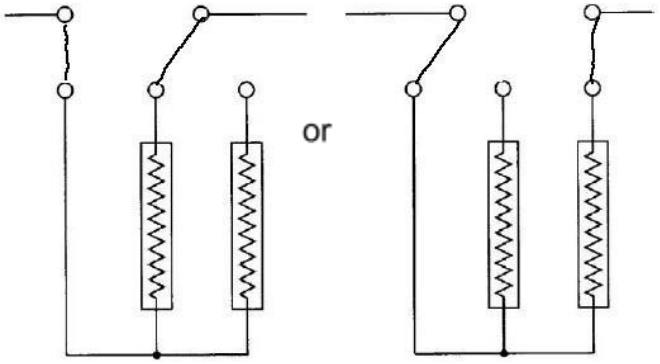
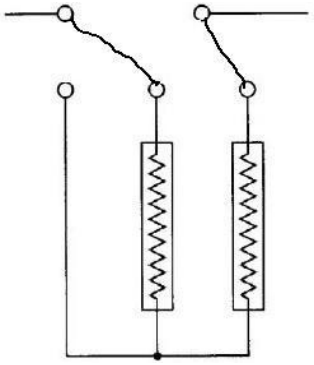
Sec 4 Pure Physics Prelim Marking Scheme (Paper 2)

Section A

Qn	Answer	Marks	Remarks
1(a)	According to Newton's First Law, if the forces acting on the ball are balanced, the ball would either be stationary or move with constant velocity, without any acceleration. / According to Newton's Second Law, the acceleration of the ball is the result of a resultant force acting on the ball. Hence, the forces acting on the ball are unbalanced.	1	Accept explanation based on either 1st or 2nd Law. No mark awarded for just stating "unbalanced"
1(b)	$a = (v - u) / t$ $2.0 = v / 2.0$ $v = 4.0$ m/s	 1	
1(c)	 s = (1/2) x 2.0 x 4.0 = 4.0 m	1 1	Ecf marks can be awarded
2(a)	Force exerted by Man B = 100 x 10 – 600 = 400 N	 1	
2(b)	Let the distance between the CG of the rod and man A be d. Taking moment about man A, 1000 x d = 400 x 6.0 d = 2.4 m or Taking moment about the CG of the rod, 600 x d = 400 x (6.0 – d) d = 2.4 m	 1 1 1 1	Ecf marks can be awarded

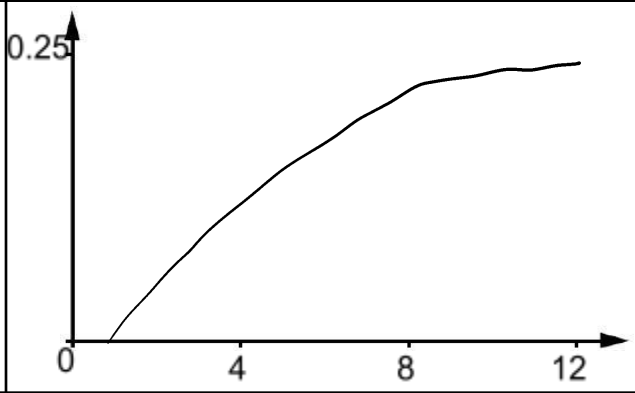
3(a)	Pressure of gas B = 120 000 – 13 600 x 10 x 0.08 = 109 000 Pa (3 s.f.)	 1 1	1 mark can be awarded for calculating the pressure difference
3(b)	H_1 would decrease while H_2 would increase. Black is a better absorber of infrared radiation than white, hence the temperature of gas A would increase faster than that of gas B, resulting in an even greater pressure difference between gas A and gas B,	1 1 1	
4(a)	Initial GPE = final KE $mgh = (1/2)mv^2$ 300 x 10 x 8 = (1/2) x 300 x v^2 v^2 = 160 v = 12.6 m/s	 1 1	
4(b)	average retarding force x 0.5 = 300 x 10 x 8 average retarding force = 48 000 N	1 1	
5(a)	The air molecules in the cylinder are in continuous and random motion, colliding with the walls of the cylinder. The average force exerted by the air molecules on a unit area of the cylinder gives rise to a pressure in the cylinder.	 1 1	
5(b)	The volume of air in the cylinder decreases, causing an increase in the number of air molecules per unit volume. The air molecules collide with the walls of the cylinder more frequently, causing the force exerted per unit area to increase, and hence increasing the pressure in the cylinder.	1 1	
6(a)	sin 27° / sin r = 1.50, r = 17.6° angle of incidence at CD = angle of reflection = angle of incidence back at AB = 18° angle of refraction at AB = 27° 	1 1	For the angle of incidence at AB, accept 26°to 28°

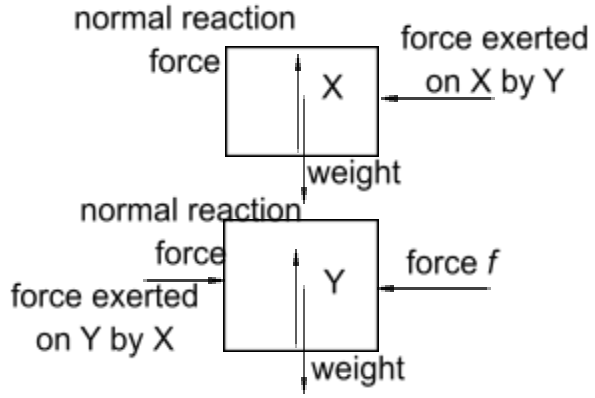
6(b)	sin c = 1 / 1.50, c = 41.8° The angle of incidence when the light ray leaves AB is , which is smaller than the critical angle. Hence, total internal reflection does not happen.	1 1	
7(a)	When the object distance is twice the focal length of the lens, the image distance is also twice the focal length of the lens. From the graph, the object distance and image distance are equal at 3.0 cm. Hence, the focal length of the length is 3.0 / 2 = 1.5 cm.	1 1	No mark awarded if no information is quoted from the graph
7(b)	When object distance = 2.0 cm, image distance = 4.2 cm. Magnification = 4.2 / 2.0 = 2.1	 1 1	Accept ray diagram method
8(a)	According to the question, the corks move up and down as the wave passes. This shows that the water particles move in a direction perpendicular to the direction of the water wave, and this is a characteristic of transverse wave.	 1	No mark awarded if no information is quoted from the question
8(b)(i)	Speed = wavelength / period = 8.0 / 0.50 = 16 cm/s or 0.16 m/s	 1	
8(b)(ii)	 Same amplitude and period. When A is at the crest, B is at the trough.	1	
9(a)	1. Ultrasound waves are longitudinal waves, while microwaves are transverse waves. 2. Ultrasound waves cannot travel in vacuum, while microwaves can travel in vacuum. 3. Ultrasound waves require a medium to travel, while microwaves do not require any medium to travel. 4. Ultrasound waves travel at about 330 m/s in air, while microwaves travel at 3 x 10^8 m/s in air.	1 1	Do not accept 2 and 3 as two differences. Accept any other valid differences
9(b)	Total time = 6000 / 1500 + (36 000 000 + 40 000 000) / 3 x 10^8 = 4.25 s (3 s.f.)	1 1	

10(a)	When the switch is closed, <u>electrons from L will flow to the earth</u> as the positive terminal of the high voltage supply is connected to it. As a result, <u>L becomes positively charged</u>.	1 1	
10(b)	After the switch is closed, the positively charged L would <u>attract the electrons in S, causing them to move to its left side. The left side of S now has excessive negative charges, and excessive positive charges are on its right side</u>. <u>The force of attraction</u> between L and the negative charges on S is <u>stronger than the force of repulsion</u> between L and the positive charges on S, therefore, <u>S would move towards L</u>.	1 1	Accept S would touch L by induction
11(a)	Method 2:  Method 3: 	1	
11(b)	Power = 240^2 / 40 x 2 = 2880 W	1 1	
11(c)	The least costly method is when the two coils are connected in series. Power = 240^2 / 80 = 720 W = 0.72 kW Cost = 0.72 x 1.75 x 20 = 25.2 = 25 cents or $0.25	 1 1	Accept conversion from J to kWh

12(a)	B: north pole, C: south pole	1	
12(b)	Anticlockwise	1	Ecf mark can be awarded
12(c)	Using Fleming's left hand rule, the forefinger / index finger points to the right as the magnetic field is from B to C, the second finger / middle finger points into the page as current flows from P to Q, and the thumb points downwards. The force acting on PQ is downwards, and the force acting on RS is upwards since the current is in the opposite direction as PQ, causing the coil to turn anticlockwise.	1 1	Ecf mark can be awarded
12(d)	The split-ring commutators reverse the direction of current in the coil after it turns 180°. As a result, when PQ is rotated to the right, the force acting on PQ would be upwards, and when RS is rotated to the left, the force acting on RS would be downwards, and the coil would continue to turn in the anticlockwise direction.	1 1	

Section B

Qn	Answer	Marks	Remarks
13(a)		2	1 mark for the point (12, 0.25), 1 mark for the correct shape
13(b)	The current-voltage graph for a fixed resistor would be a straight line passing through the origin. This is because a fixed resistor is an ohmic conductor with fixed resistance / obeys Ohm's Law, therefore the gradient of the graph is constant. However, a filament lamp is a non-ohmic conductor with varying resistance / does not obey Ohm's Law, therefore the gradient of the graph is not constant.	1 1	Deduct 1 mark if the gradient of the graph is not described

13(c)	When the brightness of the torchlight increases, the <u>resistance of the LDR decreases</u>. This causes the <u>current in the circuit to increase</u>, hence the potential difference across R increases.	1 1	Accept explanation with potential divider formula, provided the formula and the terms in it are clearly specified
13(d)(i)	Current = 12 / 5 = 0.24 A	1 1	
13(d)(ii)	Current through R = 0.24 + 0.25 = 0.49 A Resistance = (18 – 12) / 0.49 = 12.2 Ω (3 s.f.)	1 1	Award 1 mark if the p.d. across R is correctly calculated Ecf mark can be awarded
14(a)		4	2 marks each 1 mark for the forces, 1 mark for the labels
14(b)	Forces in an action-reaction pair must <u>act on different bodies</u>.	1	
14(c)(i)	Acceleration = 28 / (3.0 + 4.0) = 4.0 m/s^2	1 1	
14(c)(ii)	Force = 3.0 x 4.0 = 12 N	1 1	
14(d)	The blocks would move with <u>constant velocity</u>.	1	
15(a)	The aluminium atoms <u>near the heating element gain thermal energy and vibrate more vigorously</u>. They <u>collide with their neighbouring particles, transferring energy to them and make them vibrate more vigorously</u> as well. The <u>free electrons in aluminium also transfer the thermal energy to the colder part of the aluminium rod through electron diffusion</u>, causing the aluminium rod to be heated quickly.	1 1 1	

15(b)	Power = 230 x 9 = 2070 W	1 1	
15(c)	In one second, E = 2070 x 1 = 2070 J Let the mass of water be *m*. 4200 x *m* x 70 + 2 260 000 x *m* = 2070 *m* = 8.10 x 10^{-4} kg (3 s.f.)	 1 1 1	
15(d)	As the temperature of steam is lowered to the condensation point, the <u>steam molecules continues to lose energy</u>, and get much closer to each other. <u>The bonds between the molecules are strengthen</u>, and the molecules are able to move within the water body only.	 1 1	