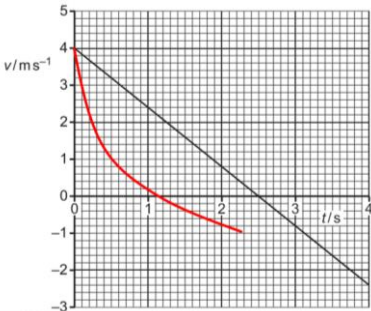


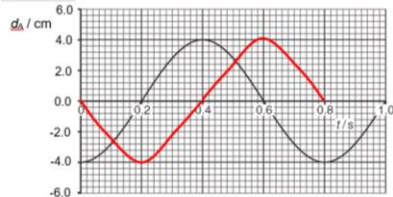
2023 SEC 4 PRELIMINARY EXAMINATION

Paper 1

1	B	2	B	3	C	4	D	5	C
6	A	7	D	8	D	9	D	10	A
11	B	12	A	13	C	14	A	15	D
16	B	17	A	18	C	19	C	20	A
21	B	22	A	23	A	24	D	25	D
26	C	27	B	28	B	29	B	30	C
31	C	32	D	33	A	34	D	35	A
36	C	37	A	38	C	39	A	40	C

Paper 2 Section A

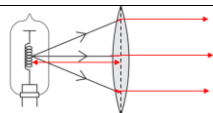
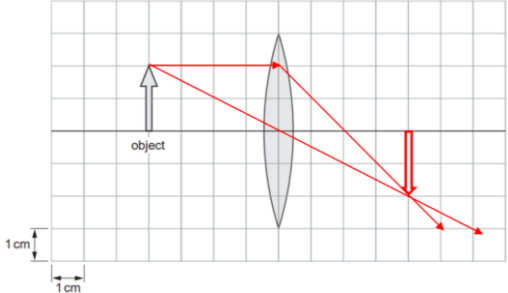
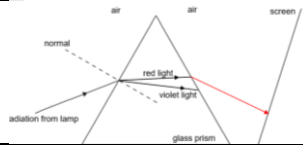
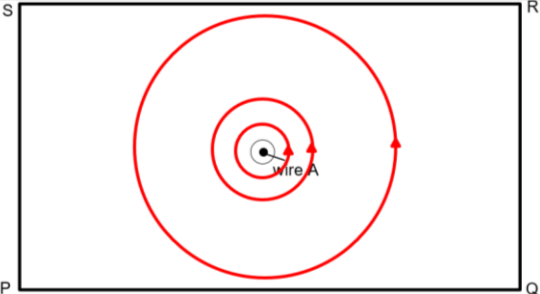
S/N	Mark Scheme	Remarks
1ai	displacement = area under graph [formula] = $\frac{1}{2} (2.50) (4.0)$ [B1] = 5.0 m [B1]	
1aii	Acceleration due to gravity = gradient of graph = $(0.0 - 4.0) / (2.5 - 0.0)$ [B1] = -1.6 m/s^2 Deceleration = 1.6 m/s^2 [B1]	
1bi	 Decreasing + -ve gradient; $v = 0.0 \text{ m/s}$ before $t = 2.5 \text{ s}$ [B1]	
1bii	Air resistance = W = mg [formula] = $7.5 (1.6)$ = 12 N [B1]	
2a	$F_{\text{net}} = ma$ [formula] $F - W = ma$ $F - mg = ma$ $F - (2.8 \times 10^6) (10) = (2.8 \times 10^6) (1.4)$ [B2] $F = 3.2 \times 10^7 \text{ N}$ or $3.19 \times 10^7 \text{ N}$ [B1]	$W = mg$ & $F = ma$ calculations are one mark each
2b	Mass of rocket decreases (as fuel is used up) [B1] Value of g on rocket decreases (as rocket rises) [B1] □	
3ai	Point where (all) the weight (of the object) appears to act [B1] (regardless of the orientation of the object).	
3aii	No, because centre of gravity of XY is not at the (geometric) centre (or 2.0 m mark) of rod. [B1]	
3b	Taking moments about (pivot) P, Sum of clockwise moments = sum of anticlockwise moments $M = F \times d$ [formula – all above] $(3.0 - 2.5) (2.90) + 44 (0.60) = F (1.10)$ [B1] $F = 25.3 \text{ N}$ [B1]	
3c	Resultant moment clockwise (when sphere is not in water) OR Larger anticlockwise moment due to F (needed to balance larger clockwise moment). [B1] Shifting P to the right increases perpendicular distance from (line of action of) F to P/pivot. [B1]	Accept if discuss about smaller clockwise moment due to weight of sphere and / or rod

4a	Same volume for two different temperatures. [B1] Volume does not <u>vary continuously</u> with temperature. [B1]	
4bi	Kinetic energy of the gas particles increases (with temperature). [B1] Force and frequency of collisions of gas particles on walls of container increases. [B1] Force per unit area (and hence pressure) of gas increases. [B1]	
4bii	Conduction [B1] Flask particles vibrate and collide against gas particles (causing them to vibrate and collide more often). [B1]	
5a	Change in mass = $120 - 80 = 40 \text{ g}$ [B1] $L_v = IVt_2 = m (l_v)$ [formula] $2.0 (12) (3750) [B1] = 40 (l_v)$ [B1] $l_v = 2250 \text{ J / g}$ (or $2.25 \times 10^6 \text{ J / kg}$) [B1]	
5b	Large amount of energy needed to overcome (large) intermolecular forces (of attraction) between liquid molecules in order to separate them. OR Energy is needed for the steam to do work against the surrounding air. [B1]	
6a	f $= 1 / T$ [formula] $= 1 / 0.8$ [B1] $= 1.3 \text{ Hz}$ or 1.25 Hz [B1]	
6b	Correct shape [B1] 	
6c	The first trough on Fig. 6.2 [B1]	
6d	Shorter wavelength (compared to Fig. 6.2) [B1] Speed of wave decreases at shallower depth (while frequency remains constant). [B1]	<i>If mention frequency changing, - 1 m</i>
7a	(from L to R) microwave / infra-red / ultra-violet/X rays/gamma rays Any 2 correct [B1] All correct [B2]	
7bi	The process where one or more electrons are (added/removed) from a neutral atom by the action of radiation. [B1] infra-red radiation OR microwaves [B1]	<i>Must be from answer in (a)</i>
7bii	Heating/raising temperature of the cells [B1]	
8a	Electric field lines directed away from sphere (or from positive to negative). [M1] Hence, it is positively charged. [A1]	
8b	Tangent to curve in correct position and direction [B1]	
8c	(Drawing) negative charges drawn on the inside of the metal box [B1] As the box is earthed, electrons from earth are attracted to the inside of the box as unlike charges attract. [B1] (Alternative: Electrons are attracted to the inside of the metal box as unlike charges attract. As the metal box is earthed, electrons from earth flow to the metal box to neutralise the positive charges on the outside)	
9ai	Coil / wire cuts magnetic field (of magnet) OR changing magnetic field	

	(through coil) OR changing magnetic flux linkage between coil and magnet [B1] electromotive force induced by Faraday's Law (of electromagnetic induction) [B1]	
9aai	(plane of coil) Horizontal OR in position shown in diagram [B1] Coil cutting magnetic field the fastest / Greatest (rate of) change in magnetic flux linkage (between coil and magnet) [B1]	
9b	(Induced) current in magnetic field (of magnet) experiences a force [B1] Direction of force opposes the change causing it (ie force by student to rotate generator) by Lenz' Law [B1]	

Paper 2 Section B

10ai	Thermistor with correct circuit symbol. [B1] Resistance increases (non-linearly OR at decreasing rate) as temperature decreases (or resistance decreases as temperature increases). [B1]	
10aai	Temperature of the bulb increases and hence, the resistance of the bulb increases. [B1]	
10b	Solenoid is an electromagnet when current flows through solenoid. [B1] It attracts the soft iron connected to the compressor (closing the gap or forming a closed circuit from the live wire to the compressor). [B1]	
10ci	8 A to 13 A	
10cii	The current is large when it is just switched on (or calculate). [B1] Causes overloading of circuit if other appliances are connected (in parallel) to the same electrical socket. [B1]	
10ciii	Energy used = Pt [formula] = 0.180 (24) = 4.32 kWh [B1] Cost = \$0.32 (4.32) = \$1.38 [B1]	
11ai	$E = mgh$ [formula] = (0.20) (10) (0.60) [B1] = 1.2 J	
11aai	By conservation of energy, $E = \frac{1}{2}mv^2$ [formula] $1.2 = \frac{1}{2}(0.20)(v^2)$ $v = 3.5 \text{ m/s}$ [B1]	
11aiii	Will not change [B0] Speed of block is independent of mass. [B1]	Can show by calculation
11b	Velocity is a vector and speed is a scalar. [B1] Direction of the block changes. [B1]	
11ci	Kinetic energy of block to gravitational potential energy of block and thermal energy of slope (and block) [B1]	
11cii	Work done against friction = Energy at E – Energy at F $F(d) = 1.2 - mgh$ [formula] $F(0.35) = 1.2 - 0.2(10)(0.25)$ [B1] $F = 2.0 \text{ N}$ [B1]	

EITHER		
12ai	All three rays are horizontal [B1]	
12aii	Double-headed arrow drawn between point of divergence of the 3 rays of light and the optical centre of lens. [B1]	
12bi	Two correct principal rays [B1] Correct position and size of real image (same size and distance from lens as object) [B1]	
12biii	Larger [B1]	
12ci	Bend away from normal after exiting prism [B1]	
12cii	Greater because violet light bends more towards normal / has a smaller angle of refraction / travels more slowly [B1]	
12di	$i = 90^\circ - 25^\circ = 65^\circ$ $n = \sin i / \sin r$ $1.54 = \sin 65^\circ / \sin r$ $r = 36^\circ$ (or 36.1°) [B1]	
12dii	Largest possible angle of incidence at the inner wall is the critical angle c (and hence cannot exceed c). [B1]	
OR		
12ai	 Three concentric circles of increasing distance apart [B1] Anticlockwise direction [B1]	
12aii1	The current in wire B produces a magnetic field. [B1] The interaction of the magnetic fields of wire A and B produces a force on wire B. [B1]	
12aii2	To the left or from wire B to wire A. (arrow must start from point on wire B that lies in plane PQRS) [B1]	
12aii3	Same magnitude (on both wires). [B1] Forces on both wires are equal and opposite by Newton's Third Law. [B1]	
12bi	Shade faces BCGF and ADHE [B1]	
12bii	The potential difference gives rise to an electric field. [B1] The electric field exerts an electric force on the electrons (towards face ADHE or because like charges repel). [B1]	