

2024 Secondary 4 Physics 6091 Prelim (Suggested marking scheme)

Question	Key Marking Points	Marks
1(a)	From Point A to C, the acceleration decreases. From C to D, the stone decelerates at a constant rate.	1 1
1(b)	The falling stone experiences an upward air resistance. It increases with increasing speed. As downward weight remains constant, the downward resultant force decreases. By $F = ma$, acceleration decreases.	1 1 1
1(c)	When velocity is constant, acceleration is zero and gradient of the speed-time graph is zero. From point A to C, where the stone is falling in the air, there is no part of the graph where gradient is zero.	1

Question	Key Marking Points	Marks
2(a)	Clockwise moment = $165 \text{ N} \times 1.20 \text{ m}$ $= 198 \text{ Nm}$ or 19800 Ncm	1 1
2(b)(i)	The clockwise moments about O increases. As the man moves up the ramp, the perpendicular distance from his line of action of weight to pivot O increases. By moment = $F \times d$, with weight constant, moment increases.	1 1
2(b)(ii)	Point O	1
2 b)(iii)	About pivot T, there are two anticlockwise moments by the weight of the ramp and by the weight of man. As the ramp is in equilibrium, there must be a clockwise moment exerted by ground on ramp at point O to balance the sum of clockwise moments.	1 1

Question	Key Marking Points	Marks
3(a)	When the balloon hits student B, some energy in the kinetic store of balloon is transferred to internal store of the balloon and internal store of the surroundings. The energy in the kinetic store of the balloon decreases. No energy is created or destroyed, the total energy of the isolated system is constant.	1 1 1
3(b)	$WD = Fd$ $F = mg$ $WD = 1.6 \times 10 \times 5.0$ $= 80 \text{ J}$	1 1

3(c)	$E = \frac{1}{2} mv^2$ $v = \sqrt{(2 \times 80 / 1.6)}$ $= 10 \text{ m/s}$	1 1
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Question	Key Marking Points	Marks
4(a)	any two from: • ray from top / bottom of object, parallel to principal axis, refracted through right-hand principal focus • straight ray from same point on object through optical centre • ray that (seems to) come from left-hand principal focus through same point of object and refracted parallel to principal axis rays traced back to intersection AND intersection / image labelled I	2 1
4(b)	virtual AND <i>any one from</i> : • cannot be projected on a screen • (real) light (ray) does not pass through image • light only seems to come from image • Image is on the same side as the object	 1
4(c)	Any two: Real, inverted, smaller size	1 1

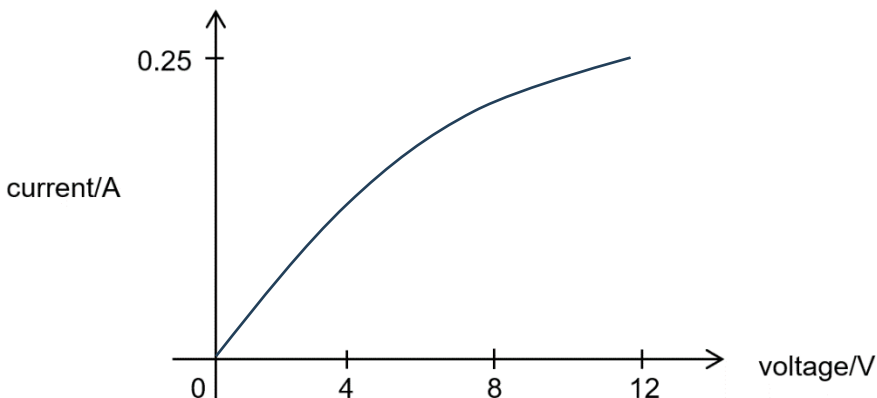
Question	Key Marking Points	Marks
5(ai)	F atmosphere exerts on piston $P = pA$ $= 1.0 \times 10^5 \times 70 \mu$ $= 1.0 \times 10^5 \times 70 \times 10^{-6}$ $= 7.0 \text{ N}$	 1
5(aii)	F oil exerts on piston $P = pA$ $= 4.0 \times 10^5 \times 70 \mu$ $= 4.0 \times 10^5 \times 70 \times 10^{-6}$ $= 28 \text{ N}$	 1 1
5(aiii)	$F = 28 - 7.0$ $= 21 \text{ N}$	 1
5(b)	I disagree. By pascal's principle, the pressure at piston P is equal to the pressure at piston Q. By $P = F/A$, with a larger cross-sectional area, force by piston Q is larger than F .	1 1

Question	Key Marking Points	Marks
6(a)	The glue particles are rubbed against the nozzle and gains electrons as it flows out thus causing charging by friction.	1 1
6(b)	All the glue droplets have like charges and would repel each other and thus spread out evenly.	1
6(c)	When sand on the conveyor belt passes between the metal plates, electrons will be attracted to the bottom positively charged plate, leaving <u>induced positive charges</u> at the top of the sand. Since the glue on the paper is negatively charged, sand moves upwards as unlike charges attract.	1 1

Question	Key Marking Points	Marks
7(a)	As the <u>direction of the electric current/voltage changes</u> , each end of the iron core <u>alternates between north and south pole</u> . The <u>near end</u> of the iron rod is <u>induced with an unlike pole</u> . Unlike poles attracts. As the poles of the bar magnet <u>remains unchanged</u> . The force on the bar magnet will <u>alternate between attractive and repulsive</u> , as like poles repel and unlike poles attract.	1 1 1
7(b)	Period = 0.02 s Frequency = $1 / 0.02$ = 50 Hz	1
7(c)(i)	Wavelength = v / f = $330 / 240$ = 1.4 m	1
7 (c)(ii)	The <u>vibration/ amplitude of the cone decreases</u> as the current decreases, hence <u>softer</u> . Ignore low frequency.	1 1

Question	Key Marking Points	Marks
8(a)	would be unaffected/little affected (by carton/contents)	1
8(b)	barium-139 - decays quickly which means that the radioactive material will lose its activity relatively fast, reducing long-term radiation exposure and making it safer to handle and dispose of after use. strontium(-90) - long-term, stable radiation without the need for frequent source replacement.	1 1

8(c)	more	1
	less	1
	more	1

Question	Key Marking Points	Marks
9(a)	The rate of flow of charges is 0.25 coulomb per second. Or 0.25 coulombs of charges flow through the lamp in 1 second.	1
9(b)	R limits or reduces the current.	1
	Without R, the filament lamp can blow as current flowing through it could be beyond 0.25 A.	1
	or	1
	R reduces the potential difference across the lamp. Without R, the filament lamp can have p.d. of 18 V across it and this will blow the lamp.	1
9(c)(i)	 Curved line from origin with decreasing slope till 12 V, 0.25 A plotted point.	1
9(c)(ii)	The graph for the fixed resistor has constant gradient. This is because a fixed resistor has a constant resistance OR it is an ohmic conductor OR it does not get heated up as p.d. across it increases.	1 1
9(d)(i)	$I = V/R$ $= 12/50$ $= 0.24 \text{ A}$	1 1
9(d)(ii)	Current in R = 0.25 A + 0.24 A = 0.49 A	1
9(d)(iii)	P.d. across R = 18 - 12 = 6.0 V	1
9(d)(iv)	$R = V/I = 6.0 / 0.49 = 12 \Omega$	1

Question	Key Marking Points	Marks
10(a)	The relationship between potential difference and current is directly proportional.	1
10(b)	Thermal energy supplied = IVt $= (8)(4)(500)$ $= 16\,000\text{J}$	1
10(c)(i)	Specific latent heat of fusion of ice is the amount of energy transferred <u>per unit mass</u> of a substance to <u>change between the solid and liquid states</u> , <u>at constant temperature</u> .	1 1
10(c)(ii)	$Q = m l_f$ $(3.5)(7.0)(500) = 39.5 l_f$ $l_f = 310\text{ J/g}$	1 1
10(d)(i)	Efficiency = $(m l_f) / Q \times 100$ $= 14.9 \times 336 \times 100 / 4000$ $= 125\%$	1 1
10(d)(ii)	It shows that energy is transferred from the <u>internal stores of both the surroundings and heater</u> to <u>the internal store of the ice</u> . Or Energy is <u>gained</u> from the surroundings.	1
10(d)(iii)	The filter funnel could be <u>lagged</u> and <u>covered</u> to prevent the ice from absorbing heat from the surrounding.	1

Question	Key Marking Points	Marks
11(a)	When the current exceeds the fuse rating, the wire in the fuse melts/blows. This opens the circuit and protects the circuit from electrical fire	1 1
11(b)	Show operating current of fan = 1.25 A Show operating current of heater = 10.417 A Total operating current = 11.667 A As the total operating current is higher than 11 A, fuse will blow. (only award if there is calculation)	1 1
11(c)	Fuse should be connected to live wire. Earth wire should be connected to metal casing of heater coil	1 1
11(d)	Total I drawn = $1.25 + 10.42 = 11.67 \text{ A}$ Effective $R = V/I$ $= 240 / 11.67$ $= 21 \text{ or } 20.6 \Omega$ OR $R_{\text{coil}} = V^2 / P$ $= 240^2 / 2500$ $= 23.04 \Omega$ $R_{\text{lamp}} = V^2 / P$ $= 240^2 / 300$ $= 192 \Omega$ $R = (1/(240^2/2500) + 1/(240^2/300))^{-1}$ $= 21 \text{ or } 20.6 \Omega$	1 1 1 1
11(e)	Total $P = 2.5 + 0.3 = 2.8 \text{ kW}$ Total $E = 2.8 \times 0.25 \times 30 = 21 \text{ kWh}$ total cost = $21 \times 0.25 = \$5.25$	1 1

Question	Key Marking Points	Marks
12(a)(i)	South pole	1
12(a)(ii)	Current travels from A to B	1
12(a)(iii)	downward direction on the side CD. Either The magnetic field set up by current flowing in CD and the solenoids interact with each other. The combined field above the coil is stronger than the field below, the force acts towards the weaker field and points downwards. Or Ensure thumb, index finger and middle finger are perpendicular to one another. Point middle finger from C to D (current direction), index finger from R to S (magnetic field direction), the thumb should point downwards to indicate the force direction.	1 1 1 1 1
12(b)(i)	$M_{\text{resultant}} = F_{\text{resultant}} \times d$ $0.10/2 = F_{\text{resultant}} \times 0.025$ $F_{\text{resultant}} = 2.0 \text{ N}$	1 1
12(b)(ii)	The moment is always positive, hence it turns in one direction only.	1
12(c)	Part E is the split ring commutator. The split ring communicator changes the direction of the current flowing in the coil every half a rotation . This causes a constant downwards resultant force on the left side of the coil and constant upward resultant force on the right side. Hence the coil continues to rotate in the anti-clockwise direction.	1 1