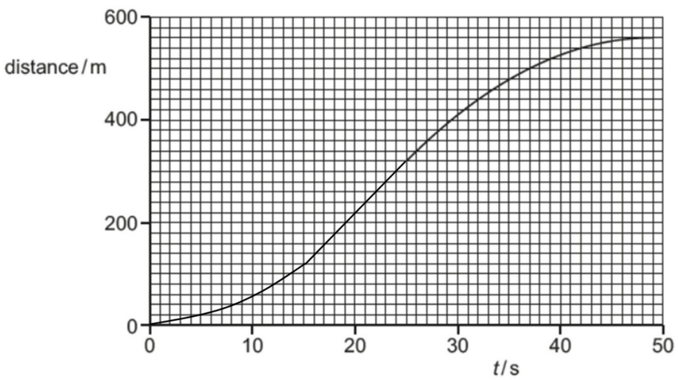
Riverside Secondary School
Prelim Examination 2022
Science for Sec 4E

Solutions and Marking Scheme

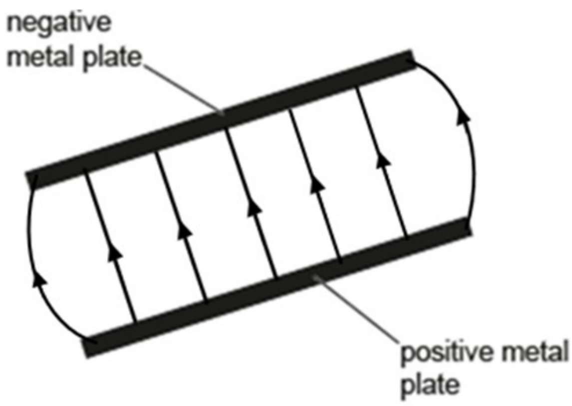
*Deduct **HALF** mark per question or per part of a question for incorrect significant figures given.*
*Deduction is capped at **maximum 2 marks** per section.*

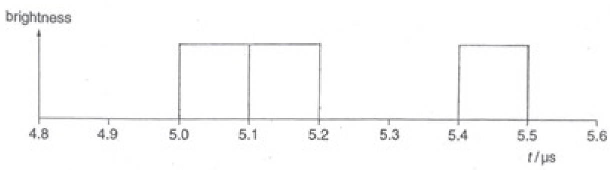
Section A (50 marks)

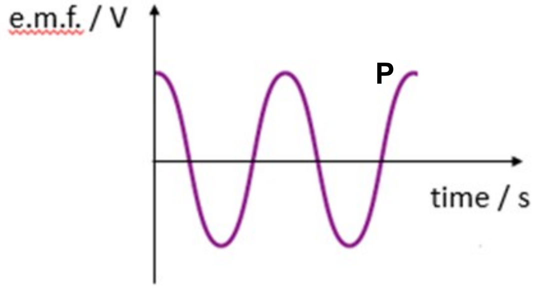
Qn	Answer	Marks	Remarks
1a	• Measure the time taken for 20 complete movements using a stopwatch. Let the time taken be t_1. • Repeat the timing of 20 complete movements using the stopwatch. Let the time taken be t_2. • Calculate the average time taken, <t>, for 20 complete movements. <t> = $\frac{t_1 + t_2}{2}$ • Calculate the average time taken for one complete movement. Average time = $\frac{\langle t \rangle}{20}$	[1] [1] [1]	Can accept 10 movements
1b	the distance moved in the direction of the force along the track	[1]	
2a	 0 to 15 s – curve with increasing gradient to 120 m 15 s to 25 s – straight line from 120 m to 320 m	[1] [1]	

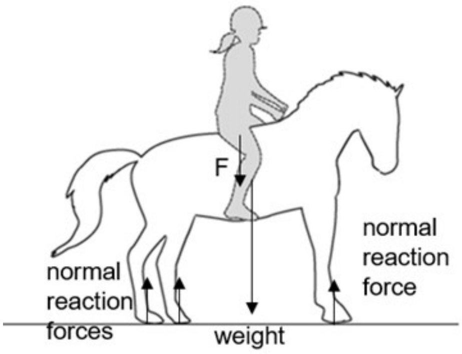
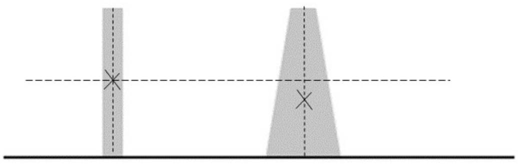
2b	Kinetic energy = $\frac{1}{2} \times 1.8 \times 10^5 \times 20^2$ = 3.6×10^7 J	[1] [1]	
2ci	Work done is the product of the force and the distance moved in the direction of the force.	[1]	
2cii	Distance = 560 - 320 = 240 m	[1]	
2ciii	Acceleration = $\frac{0 - 20}{24}$ = - 0.83 m/s^2 Force while train decelerates = $1.8 \times 10^5 \times 0.83$ = 1.5×10^5 N (2 sf) OR $3.6 \times 10^7 = F \times 240$ F = $.5 \times 10^5$ N (2 sf)	[1] [1]	Accept 1.49×10^5 N (3 sf)
3ai	Weight is the force of gravity acting on the object.	[1]	
3aii	Mass = $2.6 \times 10^3 \times 0.15 \times 2.0 \times 10^{-2}$ = 7.8 kg Weight = 7.8 x 10 = 78 N	[1] [1]	
3b	Resultant force = $(1.3 \times 10^5 – 1.0 \times 10^5) \times 0.15$ = 4500 N Direction of force is outwards	[1] [1] [1]	
3c	Pressure = 12 x ρ x 10 9.6×10^4 = 12 x ρ x 10 ρ = 800 kg/m^3	[1] [1]	
4ai	Moment = 25 x 0.72 = 18 Nm	[1]	
4aii	Work done = 25 x $\frac{2\pi \times 0.72}{4}$ = 28. 3 J (3 sf)	[1] [1]	

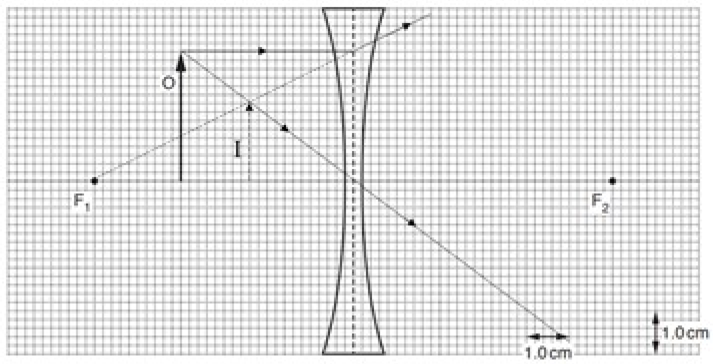
	Or Work done = 25 x $\frac{4.5}{4}$ = 28. 1 J		
4b	The moment of force P about hinge is greater than the moment of force F about the same hinge. Since the perpendicular distance of the line of action of P to hinge is greater than F, hence the door rotates.	[1] [1]	
5a	The initial temperature of the oil is higher. The rate of temperature decrease will be higher / the oil loses energy faster when hotter.	[1] [1]	
5b	The attractive forces between molecules draw the molecules closer. Hence, the potential energy of the molecules decreases. The potential energy lost is the thermal energy lost to the freezer. Hence, the temperature of the oil remained constant from t = 3600 s to t = 10 800 s.	[1] [1] [1]	
5ci	$Q = ml_f$ $= 45 \times 10^{-3} \times 5.7 \times 10^4$ = 2600 J (2 sf)	[1] [1]	
5cii	Rate = $\frac{2600}{10\,800 - 3600}$ = 0.36 J/s	[1]	ecf allowed
5d	The specific heat capacity of oil in the liquid state is less than oil in solid state. The temperature decreases of oil in liquid state decreases more quickly. Or The rate of decrease of temperature of oil in solid state is slower than that for liquid state because the specific	[1] [1]	

	heat capacity for oil in solid state is higher than that for oil in liquid state.		
6a	Electrical energy to light energy and thermal energy	[1]	
6b	Current decreases Voltage decreases Power decreases	[1]	No half mark
6ci	Total current = 0.50 + 2.0 = 2.50 A Total R = $\frac{12}{2.5}$ = 4.8 Ω	[1] [1]	
6cii	The cross-sectional area of the filament with greater resistance is smaller / smaller radius / smaller diameter	[1]	
7a	 At least one arrow on the electric field lines 1 M Field lines equally spaced out 1 M At least 4 field lines drawn	[2]	
7bi	The negative charges on the grains move towards the positively charged metal plate. Unlike charges attract.	[1]	
7bii	The top layer of grains, being positively charged, are attracted to the negatively charged plate.	[1]	
7c	Energy = 2000 x 4.0 x 10^{-4} = 0.80 J (2 sf)	[1] [1]	

8a	There is a flow of electrons in the wire as they are attracted to the positive terminal K from the negative terminal J. Direction of convention current is from K to J.	[1] [1]	
8b	Direction of F is downwards. Using Fleming's left hand rule. When the first finger points in the direction of the magnetic field and the second finger points in the direction of the current, the thumb will point in the direction of the force.	[1] [1]	
9a	$n = \frac{c}{v} = \frac{3.0 \times 10^{8}}{\left(\frac{1000}{5.0 \times 10^{-6}}\right)}$ $= 1.5$ OR $n = \frac{c}{v} = \frac{3.0 \times 10^{8}}{\left(\frac{2000}{10.0 \times 10^{-6}}\right)}$ $= 1.5$	[1] [1]	
9b	$1.5 = \frac{\sin 35^{0}}{\sin r}$ $\sin r = \frac{\sin 35^{0}}{1.5}$ $r = 22^{o}$	[1] [1]	
9ci	Rays 1, 2 and 3 spend 10.0 μs, 10.3 μs and 10.8 μs in the cable respectively. As the pulse that enters the cable lasts 0.1 μs, each pulse that leaves the cable also lasts 0.1 μs.	[1]	
9cii	 **Fig. 9.4**	[2]	1 M for same brightness 1M for drawing the pulses of light at the correct time
9ciii	time between pulses = 0.9 μs	[1]	

	number of pulses per second = $\frac{1}{0.9 \times 10^{-6}}$ $= 1.1 \times 10^{6}$ pulses	[1]	
9civ	Over long distances, there is an increase in time (or distance) for the pulses that leave the cable. Hence, there is an overlap of pulses if use to transmit data at high rate.	[1]	
10ai & 10aii	 Label x-axis and y-axis 1 M 2 complete cycles with constant amplitude and period 1 M (graph can start from trough instead of peak) P can be the peak or the trough 1M	[2] + [1]	
10aiii	Amplitude/ e.m.f. increases Frequency of the current increases or period decreases	[2]	
10b	There will be an alternating current in the primary coil. A changing magnetic field is created in the core which links with the secondary coil / A magnetic field cuts the secondary coil continuously A e.m.f. is induced in the secondary coil	[1] [1] [1]	
10c	For a given power, the current in the transmission cable will be low when the voltage is high. Hence, the thermal energy loss in cables will be minimized. ($P = I^2R$)	[1] [1]	

EITHER			
11ai	 weight of horse in mid-section of horse and labelled force upwards on at least two legs and labelled force downwards on saddle area labelled F	[3]	
11aii	There is an equal and opposite force that the horse exerted upwards on the rider.	[1] [1]	
11bi		[1]	No half mark
11bii	The centre of gravity of the fence will be lower and the line of action of the weight of the fence will fall outside the base at a bigger angle of tilt.	[1]	
11c	3000 = 520 x 10 x h h = 0.58 m maximum height above the ground = 1.4 + 0.58 = 2.0 m (2 sf)	[1] [1] [1]	

OR			
ai	6.0 cm	[1]	
aii	 Drawing of 2 rays 2M Label of image I and dotted image drawn 1M Minus 1 M for missing arrow / solid image	[3]	
aiii	height = 1.8 cm	[1]	Accept 1.7 cm to 1.9 cm
aiv	Magnification = $\frac{1.8}{3.0}$ = 0.6	[1]	ecf allowed
av	A real image can be projected on the screen Light can pass through a real image Virtual images are upright.	[2]	Any 2
b	The speed of light becomes slower in glass. The wavefronts travel a shorter distance in the same time or left-hand side of wavefront slows down first before the rest of the other wavefronts. Hence, it changes direction.	[1] [1]	