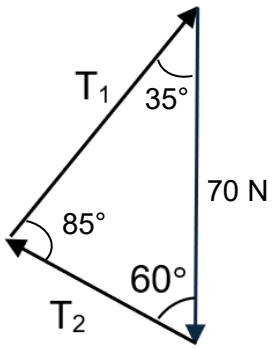
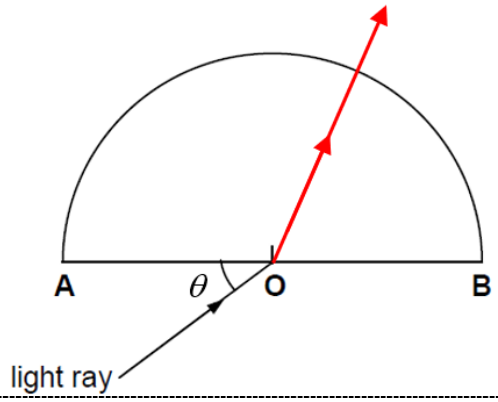
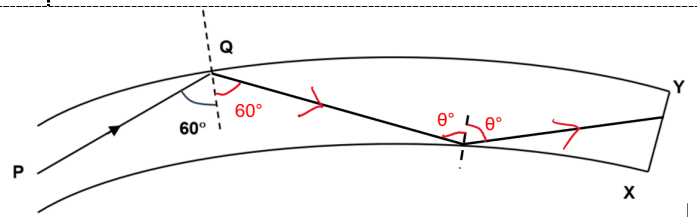
Section A (70 marks)

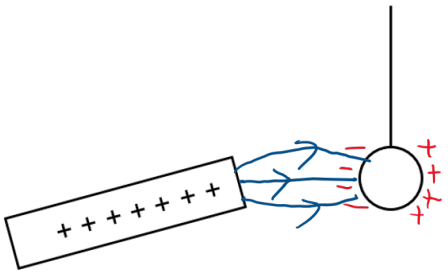
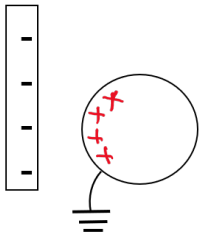
1	(a)		1 – suitable vector diagram 1 – Tensions labeled with correct arrows indicated. 1 – T_1 = **57 N to 63 N** 1 – T_2 = **38 N to 42 N**	
	(b)	(i)	precision is the smallest unit/division an instrument can measure	1
		(ii)	0.001 cm (or 0.01 mm)	1
	(c)	E = (2600 x 10^{12}) x 60 x 60 = **9.4 x 10^{18} J**		1 1

2	(a)	For an object in *equilibrium,* the sum of clockwise moments about *a pivot* is equal to the sum of anticlockwise moments about the *same pivot.*		1
	(b)	(i)	anti-clockwise moments = clockwise moments 0.60 x d = 0.16 X 0.40 d = **1.1 cm**	1 1
		(ii)	0.16 + 0.60 = W_R + W_S Since W_R = W_S (by inspection of symmetry), therefore W_R = W_S = ½ (0.16 + 0.60) = **0.38 N**	1 1
		(iii)	Rod 1 <u>rises</u> and at the same time <u>rotates clockwise</u> (both must be stated) due to the net clockwise moment. Rod 2 <u>rotates clockwise</u> as the sum of clockwise moments is now larger than the sum of anticlockwise moments. (or net clockwise moments)	1 1

3	(a)	(i)	difference in pressure = hρg = 0.10 x 13600 x 10 = **13 600 Pa**	 1 1
		(ii)	Pressure of gas A = (0.76 x 13600 x 10) + 13 600 Pressure of gas A = 116 960 = 117 000 Pa (3sf) or 120 000 Pa (2sf)	1 1
	(b)	Pressure difference more than 10 cm/ left hand side mercury level is higher. At higher altitude, atmospheric pressure decreases while gas A pressure remains constant, leading to a greater pressure difference between the two sides.		1 1

4	(a)	The angle of incidence of the light ray at C is zero (i = 0°)			1
	(b)	sin c = 1/1.8 c = 33.7° max angle θ = 90 – 33.7 = **56.3°**			1 1
	(c)	(i)		Light ray leaves without bending	1
		(ii)	Fig. 4.1. Light is going from an optically denser medium in the glass block to optically less dense medium air at boundary AB.		1
	(d)			1 – correct ray path with arrows 1 – first TIR angle labeled	

5	(a)	(i)	Period of a wave is the time taken for the wave to complete one oscillation.	1
		(ii)	Frequency = 1 / (2x20x60) = **4.2×10^{-4} Hz** (2sf)	1 1
	(b)	(i)	magnitude of X = 20/2 = **10 m** magnitude of Y = **150 km** {units important in physics}	1 1
		(ii)	v = fλ = $4.2 \times 10^{-4} \times 100\,000$ = **42 m/s** (correct f and λ needs to be substituted)	1
		(iii)	t = distance / speed = 200 000 / 42 = 1 hr 19 mins Time = 0800 + 1 hr 19 mins = **09 19 Hrs** (rounding off errors accepted)	1 1
	(c)	The ship will move up and down perpendicular to the direction of the wave.		1

6	(a)	(i)		1 – charges drawn correctly in sphere. 1 – electric field drawn correctly with arrows.	
		(ii)	When the rod touches the sphere, some of the electrons in the sphere flows into the rod and neutralize some of the positive charges in the sphere. When the rod separates from the sphere, the rod has positive charges and the sphere also has net positive charges.		1 1
	(b)	(i)	providing a **conducting path** for charges to flow.		1
		(ii)			1

7	(a)	suitable working mass remaining = **5.0 mg**			1 1
	(b)	$^{234}_{90}\text{Th} \rightarrow {}^{234}_{91}\text{Pa} + {}^{0}_{-1}\beta$			1
	(c)	(i)	1.	22 cpm	1
			2.	49 – 22 = **27** c**pm**	1
			3.	Use of 27/2 = 13.5 13.5 + 22 = 35.5 85 or 90 days (evidence shown on graph)	 1 1

8	(a)	(i)	**6.0 J** of work is done by the source in driving a unit charge around a complete circuit.		1
		(ii)	$\frac{R_{LDR}}{(R_{LDR}+10\,000)}\times 6=0.23$		1
			R_{LDR} = **399 Ω** (3sf) or **400 Ω** (2sf)		1
		(iii)	When light falling on LDR decreases, resistance and p.d. across it increases. Voltmeter reading increases.		1 1
	(b)	(i)	10kΩ + 10kΩ = 20 000Ω 2.2 kΩ + 3.8 kΩ = 6000 Ω $\frac{1}{R}=\frac{1}{20\,000}+\frac{1}{6000}$ R = **4620 Ω** (3sf) or **4600 Ω** (2sf)		1 1
		(ii)	the source voltage is shared equally by the two equal resistors		1
		(iii)	(1)	p.d = $\frac{3.8\ k\Omega}{(3.8\ k\Omega\ 1+2.2\ k\Omega\ )}\times 6$ p.d. = **3.8 V**	1
			(2)	p.d. = 3.8 – 3.0 = **0.80 V**	1

9	(a)	(i)	acceleration is constant / the speed of the carriage increases throughout the motion / the speed of the carriage increase at a slower rate as compared to data 1.		1
		(ii)	distance = ½ x 2.00 x 2.50 distance = **2.5 m**		1 1
		(iii)	earth's gravitational force of attraction on carriage and carriage's gravitational force of attraction on the earth **or** Normal force of track pushing carriage and Normal force from carriage pushing track. Both forces equal in size but opposite in direction		1 1
		iv)	no difference in mass. by conservation of energy, k.e. = p.e the mass cancels out and does not play a part.		1 1
	(b)	(i)	a= (v – u)/t a = (2.7 - 2.6) / 0.20 a = - 0.50 m / s^2 deceleration = **0.50 m / s^2**		1
		(ii)	from t = 0.6 s to t = 1.20 s the speed is constant. Net Force is equal to zero and based on newtons' second law there is no friction acting.		1 1

Section B (10 marks)

10	(a)	Specific heat capacity c is defined as the amount of thermal energy required to raise the temperature of a unit mass (e.g. 1 kg) of a substance by 1 K (or 1˚C).	1
	(b)	There is a greater increase in the internal potential energy of a substance when vaporising than melting/ more thermal energy needed to break bonds during vaporising <u>there is also work done against the surrounding air pressure</u> in order for the molecules to escape into the atmosphere.	1 1
	(c)	(i) Thermal energy = 90 m^3 × 1.2 kg/m^3 × 1.0 kJ/(kg K) × 5 K = **540 kJ**	1 1
		(ii) Time taken = 540 kJ ÷ 270 J/s = 2000 s or **33.3 mins**	1 1
	(d)	Increase the surface area of the cooling pad for the air to pass through. Increase the rate of airflow through the cooling pad. Or Increase the rate of water flow down the cooling pad.	1
	(e)	Energy used = 0.050 x 3 = 0.15 kwh Cost = 0.15 x 0.30 = **$0.045**	1 1

11	(a)	As magnet rotates, the number of magnetic field lines cutting the coil changes / the magnetic flux linking the coil changes/ rate of change of magnetic field changes. By **Faraday's Law,** this causes an induced e.m.f., and hence an induced current in the complete circuit.	1 1,1
	(b)	The poles of the magnet will alternate in approaching and leaving the two ends of the soft iron. According to **Lenz's law**, the current induced will oppose the motion thus need to change direction of flow to repel and attract the magnet.	1 1
	(c)	Any two of: Increase the number of turns (per unit length) of the coil Increase the speed of rotation of the magnet Use a stronger magnet	1,1
	(d)	period: halves amplitude: doubles	1 1
	(e)	Less wear and tear energy loss as heat in the slip rings and carbon brushes reduced small **and** compact.	1

Answer for Preliminary Examination Physics P1

1	2	3	4	5	6	7	8	9	10
B	C	D	D	B	D	B	B	B	C

11	12	13	14	15	16	17	18	19	20
B	D	B	D	B	D	C	D	D	D

21	22	23	24	25	26	27	28	29	30
A	A	B	D	B	A	B	A	D	A

31	32	33	34	35	36	37	38	39	40
A	A	A	C	A	B	C	A	B	D