Question			Answer	Marks	Guidance
1	**a**	**i**	Length from **A** to **B** = 8.0 (cm)	C1	**Allow** $\pm$ 0.1 cm
			displacement = 400 (km) or time = 1500 (s)		
			average velocity = $400 \times 10^3/1500$	C1	Possible ecf within the calculation for an incorrect value for length **AB**.
			average velocity = 270 (m s^{-1})	A1	**Note** no credit if distance is used.
		ii	(The average speed is different because) the <u>distance</u> (travelled) is different / not the same / greater than the <u>displacement</u>	B1	
	b	**i**	distance = $2 \times \pi \times 4.2 \times 10^8$ speed = $\dfrac{2 \times \pi \times 4.2 \times 10^8}{1.5 \times 10^5}$	C1	
			speed = 1.8×10^4 (m s^{-1})	A1	**Note**: Answer to 3 sf is 1.76×10^4 (m s^{-1}) **Not** 5600π (m s^{-1})
		ii	($0 = u^2 - 2as$) $(1.3 \times 10^3)^2 = 2 \times a \times 470 \times 10^3$ (Any subject)	C1	**Allow** full credit for '$mgh = \frac{1}{2} mu^2$' approach **Ignore** signs
			$a = \dfrac{(1.3 \times 10^3)^2}{2 \times 470 \times 10^3}$ (*a* must be the subject)	C1	
			acceleration = 1.8 (m s^{-2})	A1	**Allow**: 2 marks for 1.8×10^n; n $\neq$ 0
			Total	**9**	

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Question			Answer	Marks	Guidance
Z	(a)		Object moves into region <u>3</u>	M1	
			(net) force to left / 1 (N) to the left / 8 (N) > 7 (N) <u>and</u> (net) force down / 2 (N) down / 12 (N) > 10 (N)	A1	**Allow** use of labelled arrows, e.g ↓ 2 (N)
	(b)		(When an object is in equilibrium the) <u>sum</u> of clockwise moments (about a point) = <u>sum</u> of anticlockwise moments (about the same point)	B1	**Allow**: summation sign Σ
	(c)		$50 \times 46 = $ weight $\times 14$ weight = 164 (N) mass = 164/9.81 mass = 16.7 (kg) or 17 (kg)	C1 C1 A1	Possible ecf for weight calculated. **Note**: Using '$50 \times 46 = $ weight $\times 32$' gives an incorrect weight of 71.9 (N). However, 1 mark can be scored through ecf for a mass of 7.3 (kg) **Allow**: 3 marks for 'weight = 160 N, mass = 16.3 kg or 16 kg'
			Total	6	

Question			Expected Answers	Marks	Additional Guidance
3	(a)		A quantity that has (both) magnitude / size and direction	**B1**	**Not** 'A quantity that has direction'
	(b)		Circled /underlined quantities are: acceleration, displacement and weight	**B1**	**Note**: All three need to be identified for a mark
	(c)	(i)	Constant / <u>steady</u> / <u>uniform</u> acceleration (up to 4 s) Or Velocity increases at a <u>steady</u> / <u>constant</u> / <u>uniform</u> rate Or Has acceleration of 3.5 (m s^{-2})	**B1**	**Not** Accelerates up to 4 s / 'uniform motion' for the first B1 mark **Not** 'Accelerates at a constant rate'.
			Constant / <u>steady</u> / <u>uniform</u> velocity (after 4 s) Or Zero acceleration Or Travels at a velocity of 24 (m s^{-1})	**B1**	**Allow**: 'speed' instead of velocity **Allow**: 2 mark for 'Constant acceleration and then constant speed / velocity'
		(ii)	distance = area (under graph) distance = 68 (m)	**C1** **A1**	**Allow**: The C1 mark is for … distance $= \frac{1}{2}(10+24)\times 4.0$ **Allow**: Bald 68 (m) scores 2 marks Bald $\frac{1}{2}(4\times 14)$ or 28 (m) scores 1 mark for 'area of triangle'
		(iii) 1	Answer in the range: 1.1 to 1.2 (s)	**B1**	
		(iii) 2	Same areas under graphs $14t = 10t + (0.5\times 3.5\times t^2)$ $t = 2.28$ (s) ≈ 2.3 (s)	**C1** **A1**	**Note**: The C1 mark is for substitution **Allow**: Bald 2.3 (s) scores 2 marks **Allow:** Bald '$t = 2 \times$ **(iii)1**.' Scores 2 marks
			Total	**9**	

Question			Expected Answers	Marks	Additional Guidance
4	(a)		$F_H = 20\cos 38 = 15.76 \approx 15.8$ (N)	B1	**Allow**: 2 sf answers of 16 (N) and 12 (N)
			$F_V = 20\sin 38 = 12.31 \approx 12.3$ (N)	B1	**Allow**: 1 mark if vertical and horizontal components have been interchanged
	(b)	(i)	net force vertically = 0 / weight = upward forces	C1	
			weight = 12.3 + 12.3	C1	Possible ecf from F_V value from **(a)**
			weight = 24.6 (N) $\approx$ 25 (N)	A0	
			---------------------- Or ----------------------- correct triangle of forces diagram	C1	At least one label needed (e.g: 20, correct angle, etc) – arrows not needed
			correct determination of weight	C1	Weight in the range 22 – 27 (N)
			weight = 24.6 (N) $\approx$ 25 (N)	A0	
		(ii)	mass = $\dfrac{25}{9.81} = 2.55$ (kg)	C1	**Note**: 2.51 kg if 24.6 N is used
			density = $\dfrac{2.55}{2.9 \times 10^{-4}}$	C1	
			density = 8.8×10^3 (kg m^{-3})	A1	**Note**: 'weight/volume' scores zero **Note**: Answer is 8.7×10^3 if 2.51 kg is used **Allow**: 2 marks if g = 10 used and 25 N $\rightarrow$ 2.5 kg $\therefore \rho$ = 8620 (kg m^{-3}) **Note**: Bald 8.7×10^3 or 8.8×10^3 scores 3 marks **Allow**: 1 mark if 20 N is used instead of 25 N – this gives 7030 (kg m^{-3})
			Total	7	