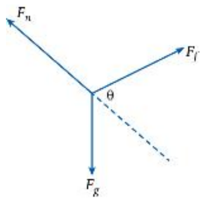
A Level OCR Physics

Chapter 4 Nature of quantities

Question	Answers	Extra information	Mark	AO	Spec reference
1(a)	The student has drawn arrows not lines/the diagram shows directions as well as distances		1	2	2.3.1
(b)	Evidence of use of scale e.g. Length of resultant line = 5.3 cm Length of 25 m line = 4.6 cm, so there are 5.43 m/cm Resultant = 5.3 × 5.43 = 29 m	 Calculation of scale Answer	 1 1	2	2.3.1
(c)	Resultant displacement = $\sqrt{25^2 + 15^2}$ $= \sqrt{850} = 29$ m		1 1	2	2.3.1
(d)	Angle = $\tan^{-1}(15/25)$ = 31°		1 1	2	2.3.1
2(a)	Momentum is the product of mass and velocity, and velocity is a vector	Accept magnitude and direction	1	1	2.3.1
(b)	Resolving in the x-direction: $m_1v_0 = m_1v_1 \cos\theta_1 + m_2v_2/\cos\theta_2$ Resolving in the y-direction: $m_1v_1 \sin\theta_1 = m_2v_2 \sin\theta_2$		 1 1	2	2.3.1
(c)	$m_2 = 1.67 \times 10^{-27}$ kg $m_1v_1 \sin\theta_1 = m_2v_2 \sin\theta_2$ $m_1 = \dfrac{m_2v_2 \sin\theta_2}{v_1 \sin\theta_1}$ $= \dfrac{1.67 \times 10^{-27}\ \text{kg} \times 2.4 \times 10^{8}\ \text{m s}^{-1} \times 0.616}{1.8 \times 10^{8}\ \text{m s}^{-1} \times 0.422}$ $= 3.25 \times 10^{-27}$ kg	 Correct substitution Answer	 1 1	2	2.3.1

Question	Answers	Extra information	Mark	AO	Spec reference
	$v_0 = \dfrac{m_1 v_1 \cos\theta_1 + m_2 v_2 \cos\theta_2}{m_1}$ = (3.25 × 10^{-27} kg × 1.8 × 10^8 m s^{-1} × 0.906) + (1.67 × 10^{-27} kg × 2.4 × 10^8 m s^{-1} × 0.788) ÷ 3.25 × 10^{-27} kg $= \dfrac{(5.30 \times 10^{-19}) + (3.16 \times 10^{-19})}{3.25 \times 10^{-27}\ \text{kg}}$ = 2.60 × 10^8 m s^{-1}	Correct substitution Answer	1 1		
(d)	Momentum would not be conserved in the x-direction		1	3	2.3.1
3(a)		Three arrows in correct directions, arrows attached to the dot, labelled weight/normal or reaction/friction Normal and frictional force at 90° by eye θ labelled correctly	1 1 1	2	2.3.1
(b)	$F_n = F_g \cos\theta$ $F_f = F_g \sin\theta$	Accept other symbols such as W, N, and F	1 1	2	2.3.1
(c)	$F_f = \mu F_n = \mu F_g/\cos\theta$ $F_f = F_g \sin\theta$ $\mu F_g \cos\theta = F_g \sin\theta$ $\mu = \tan\theta$		1 1 1	2	2.3.1
(d)	As the mass increases, the weight increases as $F_g = F_g \sin\theta = mg \sin\theta$, but so does the frictional force as $F_f = \mu F_n = \mu F_g$ – the mass cancels and does not affect the angle.	Dependence of F_g and F_n on mass Reasoned argument for independence of mass	1 1	3	2.3.1
4(a)	The person will be acted on by gravity that will, vertically, slow them to a stop and then accelerate them.	Method described accurately Correct vertical component	1 1	3	2.3.1

A Level OCR Physics

Chapter 4 Nature of quantities

Question	Answers	Extra information	Mark	AO	Spec reference
	Vertical component of velocity = v sin 30 = + v/2(upwards is positive) Acceleration = −9.81 m s^{-2} a = change in v/change in t $a = \frac{(0 - v/2)}{t}$ t = +v/19.62 This is the time to come to a halt, so total time = 2 × +v/19.62 = +v/9.81	Accept use of $v = u + at$ Answer	1		
(b)	Assume that the horizontal component of the velocity is constant during flight Distance travelled = horizontal component of velocity × time Horizontal component of velocity = v cos 30 = +0.866v (forward is positive) Distance travelled = +0.866v × +v//9.81 Distance = 8.83×10^{-2} v^2	Method described accurately Correct horizontal component Answer	1 1 1	3	2.3.1
(c)	Distance = 8.83×10^{-2} v^2 $v = \sqrt{\frac{d}{8.83 \times 10^{-2}}} = \sqrt{\frac{50}{8.83 \times 10^{-2}}} = 23.8\ \text{m s}^{-1}$		1	2	2.3.1
(d)	Conservation of energy; $mgh = 0.5\,mv^2$ $h = \frac{v^2}{2g} = \frac{23.8^2}{2 \times 9.81} = 28.9\ \text{m}$ This is the lowest height required as energy would also have been transferred to the thermal stores of the surrounds/drag forces would not be negligable	Calculation of height using conservation of energy Allow e.c.f from (c) Appropriate comment	1 1	2	2.3.1