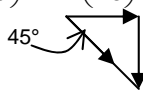


Q 1	mark	sub
<p>either</p> <p>70V obtained So $70V = 1400$</p> <p>and $V = 20$</p> <p>or</p> <p>$V = 20$</p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p>	<p>Attempt at area. If not trapezium method at least one part area correct. Accept equivalent.</p> <p>Or equivalent – need not be evaluated.</p> <p>Equate their 70V to 1400. Must have attempt at complete areas or equations.</p> <p>cao</p> <p>Attempt to find areas in terms of ratios (at least one correct)</p> <p>Correct total ratio – need not be evaluated. (Evidence may be 800 or 400 or 200 seen).</p> <p>Complete method. (Evidence may be 800/40 or 400/20 or 200/10 seen).</p> <p>cao</p> <p>[Award 3/4 for 20 seen WWW]</p>
		4

Q 2	mark	sub
<p>$(v =) 12 - 3t^2$</p> <p>$v = 0 \Rightarrow 12 - 3t^2 = 0$</p> <p>so $t^2 = 4$ and $t = \pm 2$</p> <p>$x = \pm 16$</p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>A1</p> <p>A1</p>	<p>Differentiating</p> <p>Allow confusion of notation, including $x =$</p> <p>Dep on 1st M1. Equating to zero.</p> <p>Accept one answer only but no extra answers. FT only if quadratic or higher degree.</p> <p>cao. Must have both and no extra answers.</p>
		5

Q 3	mark	sub
(i)	B1	1
<p>$R = mg$ so 49 N</p>		
(ii)	B1	2
	B1	
(iii)	M1	4
<p>$\uparrow R + 10\cos 40 - 49 = 0$</p> <p>$R = 41.339\dots$ so 41.3 N (3 s. f.)</p> <p>$F = 10\sin 40 = 6.4278\dots$ so 6.43 N (3 s. f.)</p>	<p>B1</p> <p>A1</p> <p>B1</p>	
		7

Q 4	mark	sub
(i) ↓ $20 + 16\cos 60 = 28$	B1	1
(ii) either → $16\sin 60$ Mag $\sqrt{28^2 + 192} = 31.2409...$ so 31.2 N (3 s.f.) or Cos rule $\text{mag}^2 = 16^2 + 20^2 - 2 \times 16 \times 20 \times \cos 120$ 31.2 N (3 s. f.)	B1 M1 F1 M1 A1 A1	3
(iii) Magnitude of accn is $15.620... \text{ m s}^{-2}$ so 15.6 m s^{-2} (3 s. f.) angle with 20 N force is $\arctan\left(\frac{16\sin 60}{28}\right)$ so $26.3295... \text{ so } 26.3^\circ$ (3 s. f.)	B1 M1 A1	3
		7
Q 5	mark	sub
(i) sphere $19.6 - T = 2a$ block $T - 14.8 = 4a$	M1 A1 A1	3
(ii) Solving $T = 18 \quad a = 0.8$	M1 A1 F1	3
		6

Q 6	mark	sub
(i) $t = 2.5 \Rightarrow \mathbf{v} = \begin{pmatrix} -5 \\ 10 \end{pmatrix} + 2.5 \begin{pmatrix} 6 \\ -8 \end{pmatrix} = \begin{pmatrix} 10 \\ -10 \end{pmatrix}$  <p>speed is $\sqrt{10^2 + 10^2} = 14.14\dots$ so 14.1 m s^{-1} (3 s. f.)</p>	B1 Need not be in vector form E1 Accept diag and/or correct derivation of just $\pm 45^\circ$ F1 FT their v	3
(ii) $\mathbf{s} = 2.5 \begin{pmatrix} -5 \\ 10 \end{pmatrix} + \frac{1}{2} \times 2.5^2 \times \begin{pmatrix} 6 \\ -8 \end{pmatrix}$ $= \begin{pmatrix} 6.25 \\ 0 \end{pmatrix}$ <p>so 090°</p>	M1 Consideration of s (const accn or integration) A1 Correct sub into <i>uvast</i> with u and a . (If integration used it must be correct but allow no arb constant) A1 A1 cao. CWO.	4
		7

Q 7	mark	sub
(i) acceleration is $\frac{24}{12}$ so 2 m s^{-2}	B1	1
(ii) $24 - 15 = 12a$ $a = 0.75 \text{ m s}^{-2}$ 1 st distance is $0.5 \times 2 \times 16 = 16$ 2 nd distance is $0.5 \times 0.75 \times 16 = 6$ Difference is 10 m	M1 A1 M1 A1 A1	5
(iii) $12g \sin 5 - 15 = 12a$ $a = -0.39587...$ so -0.396 m s^{-2} (3 s. f.)	M1 M1 A1 A1	4
(iv) time $0 = 1.5 + at \Rightarrow t = 3.789...$ so 3.79 s (3 s. f.) distance $s = 0.5 \times (1.5 + 0) \times 3.789...$ (or...) giving $s = 2.8418...$ so 2.84 m (3 s. f.)	M1 A1 M1 A1	4
(v) accn is given by $0 = 1.5 + 3.5a \Rightarrow a = -\frac{3}{7} = -0.42857...$ $12g \sin 5 - R = 12 \times -0.42857...$ so $R = 15.39...$ so 15.4 N (3 s. f.)	M1 A1 M1 A1	4
		18

Q 8	mark	sub	
(i) Using $s = ut + 0.5at^2$ with $u = 10$ and $a = -10$	E1	Must be clear evidence of derivation of -5 . Accept one calculation and no statement about the other.	1
(ii) either $s = 0$ gives $10t - 5t^2 = 0$ so $5t(2 - t) = 0$ so $t = 0$ or 2 . Clearly need $t = 2$ or Time to highest point is given by $0 = 10 - 10t$ Time of flight is $2 \times 1 = 2$ s horizontal range is 40 m as $40 < 70$, hits the ground	B1 M1 A1 M1 M1 A1 B1 E1	Factorising Award 3 marks for $t = 2$ seen WWW Dep on 1 st M1. Doubling their t . Properly obtained FT $20 \times$ their t Must be clear. FT their range.	5
(iii) need $10t - 5t^2 = -15$ Solving $t^2 - 2t - 3 = 0$ so $(t - 3)(t + 1) = 0$ and $t = 3$ range is 60 m	M1 M1 A1 M1 A1	[May divide flight into two parts] Equate $s = -15$ or equivalent. Allow use of ± 15 . Method leading to solution of a quadratic. Equivalent form will do. Obtaining $t = 3$. Allow no reference to the other root. [Award SC3 if $t = 3$ seen WWW] Range is $20 \times$ their t (provided $t > 0$) cao. CWO.	5
(iv) Using (ii) & (iii), since $40 + 60 > 70$, paths cross (For $0 < t \leq 2$) both have same vertical motion so B is always 15 m above A	E1 E1	Must be convincing. Accept sketches. Do not accept evaluation at one or more points alone. That B is <i>always</i> above A must be clear.	2
(v) Need x components summing to 70 $20 \times 0.75 + 20 \times 2.75 = 15 + 55 = 70$ so true Need y components the same $10 \times 2.75 - 5 \times 2.75^2 + 15 = 4.6875$ $10 \times 0.75 - 5 \times 0.75^2 = 4.6875$	M1 E1 M1 B1 E1	May be implied. Or correct derivation of 0.75 s or 2.75 s Attempt to use 0.75 and 2.75 in two vertical height equations (accept same one or wrong one) 0.75 and 2.75 each substituted in the appropriate equ Both values correct. [Using cartesian equation: B1, B1 each equation: M1 solving: A1 correct point of intersection: E1 Verify times]	5
			18