

1.

<p>(a) '$v = u + at$': $74 = 2 + a \times 20 \Rightarrow a = \underline{3.6 \text{ m s}^{-2}}$</p>	<p>M1 A1 (2)</p>
<p>(b) '$v^2 = u^2 + 2as$': $74^2 = 2^2 + 2 \times 3.6 \times AC$</p> <p>or '$s = ut + \frac{1}{2}at^2$': $AC = 2 \times 20 + \frac{1}{2} \times 3.6 \times 20^2$</p> <p style="margin-left: 40px;">$\Rightarrow AC = 760 \text{ m}$</p> <p style="margin-left: 40px;">Hence $BC = 1200 - 760 = \underline{440 \text{ m}}$</p>	<p>M1 A1√ A1 B1√ (4)</p>

2.

<p>(a) Distance after 4 s = $16 \times 4 - \frac{1}{2} \times 9.8 \times 4^2$</p> <p style="margin-left: 40px;">$= -14.4 \Rightarrow h = (+) \underline{14.4 \text{ m}}$</p>	<p>M1 A1 A1 (3)</p>
<p>(b) $v = 16 - 9.8 \times 4$</p> <p style="margin-left: 40px;">$= -23.2 \Rightarrow \text{speed} = (+) \underline{23.2 \text{ m s}^{-1}}$</p>	<p>M1 A1 A1 (3) 6</p>

3.

<p>(a) $v^2 = u^2 + 2as \Rightarrow 0^2 = 21^2 - 2 \times 9.8 \times h$</p> <p style="margin-left: 40px;">$h = 22.5 \text{ (m)}$</p>	<p>M1 A1 A1 <u>3</u></p>
<p>(b) $v^2 = u^2 + 2as \Rightarrow v^2 = 0^2 + 2 \times 9.8 \times 24$</p> <p style="margin-left: 40px;">$(= 470.4)$</p> <p style="margin-left: 40px;">$v \approx 22 \text{ (ms}^{-1}\text{)}$</p>	<p>or equivalent M1 A1</p> <p>accept 21.7 A1 <u>3</u></p>
<p>(c) $v = u + at \Rightarrow -\sqrt{470.4} = 21 - 9.8t$</p> <p style="margin-left: 40px;">$t \approx 4.4 \text{ (s)}$</p>	<p>or equivalent M1 A2 (1, 0)</p> <p>- 1 each error</p> <p>accept 4.36 A1 <u>4</u> 10</p>

4.

(a)

$$27 = 0 + \frac{1}{2}a \cdot 3^2 \Rightarrow a = \underline{6}$$

M1 A1 (2)

(b)

$$v = 6 \times 3 = \underline{18 \text{ m s}^{-1}}$$

M1 A1 f.t.
(2)

(c)

$$\text{From } t = 3 \text{ to } t = 5, s = 18 \times 2 - \frac{1}{2} \times 9.8 \times 2^2$$

M1 A1 f.t.

$$\text{Total ht.} = s + 27 = \underline{43.4 \text{ m. } 43 \text{ m}}$$

M1 A1 (4)

5.

$$(a) v^2 = u^2 + 2as \Rightarrow 17.5^2 = u^2 + 2 \times 9.8 \times 10$$

$$\text{Leading to } u = 10.5$$

M1 A1
A1 (3)

$$(b) v = u + at \Rightarrow 17.5 = -10.5 + 9.8T$$

$$T = 2\frac{6}{7} \text{ (s)}$$

M1 A1 f.t.
DM1 A1 (4)

Alternatives for (b)

$$s = \left(\frac{u+v}{2}\right)T \Rightarrow 10 = \left(\frac{17.5 + -10.5}{2}\right)T$$

$$\frac{20}{7} = T$$

[7]

M1A1 f.t.
DM1A1 (4)

$$\text{OR } s = ut + \frac{1}{2}at^2 \Rightarrow -10 = 10.5t - 4.9t^2$$

M1 A1 f.t.

$$\text{Leading to } T = 2\frac{6}{7}, \left(-\frac{5}{7}\right)$$

Rejecting negative DM1 A1 (4)

(b) can be done independently of (a)

$$s = vt - \frac{1}{2}at^2 \Rightarrow -10 = -17.5t + 4.9t^2$$

M1 A1

$$\text{Leading to } T = 2\frac{6}{7}, \frac{5}{7}$$

DM1

For final A1, second solution has to be rejected. $\frac{5}{7}$ leads to a negative u .

A1 (4)

6.

$$45 = 2u + \frac{1}{2}a2^2 \Rightarrow 45 = 2u + 2a$$

$$165 = 6u + \frac{1}{2}a6^2 \Rightarrow 165 = 6u + 18a$$

eliminating either u or a

$$u = 20 \text{ and } a = 2.5$$

M1 A1

M1 A1

M1

A1 A1

[7]

7.

(a)	$-6.45 = u - 9.8 \times 0.75$ $0.9 = u \quad **$	M1 A1 A1	(3)
(b)	$0 = 0.81 - 2 \times 9.8 \times s$ $s = 0.041 \text{ or } 0.0413$	M1 A1	(2)
(c)	$h = -0.9 \times 0.75 + 4.9 \times 0.75^2$ $h = 2.1 \text{ or } 2.08$	M1 A1 A1	(3)

8.

(a)	$0^2 = u^2 - 2 \times 9.8 \times 40$ $u = 28 \text{ m s}^{-1} \quad ** \text{ GIVEN ANSWER}$	M1 A1 A1	(3)
(b)	$33.6 = 28t - \frac{1}{2}9.8t^2$ $4.9t^2 - 28t + 33.6 = 0$ $t = \frac{28 \pm \sqrt{28^2 - 4 \times 4.9 \times 33.6}}{9.8}$ $= 4 \text{ s or } (1.7 \text{ s or } 1.71 \text{ s})$	M1 A1 M1 A1 A1	(5)

9.

(i)	Height reached by first particle is given by $0 = 21^2 - 2 \times 9.8 \times s$ so $s = 22.5$ so 22.5 m	M1 A1	Other methods must be complete. Allow $g = \pm 9.8, \pm 10$ Accept with consistent signs	2
(ii)	Sol (1) t seconds after second particle projected its height is $15t - 4.9t^2$ and the first particle has height $22.5 - 4.9t^2$ (or $21t - 4.9t^2$) either Sub $t = 1.5$ to show both have same value State height as 11.475 m or $15t - 4.9t^2 = 22.5 - 4.9t^2$ giving $t = 1.5$ and height as 11.475 m	M1 A1 M1 A1 E1 A1 M1 A1	Allow $g = \pm 9.8, \pm 10$ Allow $g = \pm 9.8, \pm 10$ Award only if used correctly (or sub $t = 3.64$ into $21t - 4.9t^2$ for 1 st & $t = 1.5$ for 2 nd) cao. Accept any reasonable accuracy. Don't award if only one correctly used equation obtained.	6
	Sol (2) t seconds after second particle projected its height is $15t - 4.9t^2$ and the first particle has fallen $4.9t^2$ Collide when $15T - 4.9T^2 + 4.9T^2 = 22.5$ so $T = 1.5$ $H = 22.5 - 4.9 \times 1.5^2 = 11.475$ m	M1 A1 B1 M1 E1 A1	Allow $g = \pm 9.8, \pm 10$ Or other correct method cao. Accept any reasonable accuracy. Don't award if only one correctly used equation obtained.	

10.

(i)	$14 = 2u + 0.5a \times 4$ $19 = u + 5a$ Solving gives $u = 4$ and $a = 3$	M1 A1 A1 M1 F1	Use of appropriate <i>uvast</i> for either equ Any form Any form Attempt at solution of 2 eqns in 2 unknowns. At least one value found . Must have complete correct solution to their eqns. .	5
(ii)	$19^2 = 4^2 + 2 \times 3 \times s$ or $s = 4 \times 5 + 0.5 \times 3 \times 25$ $s = 57.5$ so 57.5 m	M1 A1	Use of appropriate <i>uvast</i> and their u, a & $t = 5$. cao [Accept 50 if $t = 7$ instead of $t = 5$ in (i) for 2/2]	2