## AS and A-level MATHS

Forces 1
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Specification content coverage: R1, R2, R3

| Question | Solutions | Mark |
| :---: | :---: | :---: |
| 1 (a) | $\begin{aligned} & 0=8^{2}+2(-10) s \\ & s=3.2 \mathrm{~m} \end{aligned}$ | $\begin{aligned} & \hline 1 \\ & 1 \end{aligned}$ |
| 1 (b) | $\begin{aligned} & v=8-10 \times 0.3 \\ & v=5 \mathrm{~m} \mathrm{~s}^{-1} \\ & \text { upwards } \end{aligned}$ | $\begin{aligned} & \hline 1 \\ & 1 \\ & 1 \end{aligned}$ |
| 1 (c) | $s=8 t-5 t^{2}$ <br> Or find $t$ when $v=0$ and multiply by 2 $\begin{aligned} & 0=8 t-5 t^{2} \\ & t=\frac{8}{5}=1.6 \text { seconds } \end{aligned}$ | 1 <br> 1 <br> 1 |
| 2 (a) | $\begin{aligned} & -5 \mathbf{i}=4 \mathbf{a} \\ & \mathbf{a}=-\frac{5}{4} \mathrm{~m} \mathrm{~s}^{-2} \end{aligned}$ | $\begin{aligned} & 1 \\ & 1 \end{aligned}$ |
| 2 (b) | $\mathbf{F}=0.8\left(-\frac{5}{4}\right)=-1 \mathrm{~N}$ | $\begin{aligned} & \hline 1 \\ & 1 \end{aligned}$ |
| 3 (a) | Four term equation of motion for the combined body $\begin{aligned} & D-500-900=1.2(600+800) \\ & D=3080 \mathrm{~N} \end{aligned}$ | $\begin{aligned} & \hline 1 \\ & 1 \\ & 1 \\ & \hline \end{aligned}$ |
| 3 (b) | $\begin{aligned} & 3080-500-T=600 \times 1.2 \\ & \text { Or } T-900=800 \times 1.2 \\ & T=1860 \mathrm{~N} \end{aligned}$ | $\begin{aligned} & 1 \\ & 1 \end{aligned}$ |
| 4 | $\begin{aligned} & \text { N2L on } A: T=3 a \\ & \text { N2L on } B: 7-T=5 a \\ & a=0.875 \mathrm{~m} \mathrm{~s}^{-2} \\ & T=3 \times 0.875=2.625(2.63) \mathrm{N} \end{aligned}$ | $\begin{aligned} & \hline 1 \\ & 1 \\ & 1 \\ & 1 \end{aligned}$ |
| 5 | $\begin{aligned} & \text { First ball } s=12 t-9.8 t^{2} / 2 \\ & s=12 t-\frac{9.8 t^{2}}{2} \end{aligned}$ <br> Second ball $s=9(t-2)-9.8(t-2)^{2} / 2$ | $\begin{aligned} & \hline 1 \\ & 1 \\ & 1 \\ & 1 \end{aligned}$ |


|  | $s=9(t-2)-\frac{9.8(t-2)^{2}}{2}$ <br> (or 2nd ball $t, 1$ st $t+2)$ <br> $t=\frac{188}{83}(2.27) \quad\left(\right.$ or $\left.t=\frac{22}{83}, 0.27\right)$ <br> $s=2.04 \mathrm{~m}$ |  |
| :--- | :--- | :--- |
| 6 | When being pushed: $12-2=7 a, a=\frac{10}{7}$ |  |
| $v=x, s=s \quad x^{2}=2\left(\frac{10}{7}\right) s$ |  |  |
| When released: $-2=7 a, a=-\frac{2}{7}$ |  |  |
| $u=x, s=45-s$ |  |  |
| $0=x^{2}+2\left(-\frac{2}{7}\right)(45-s), x^{2}=\frac{4}{7}(45-s)$ |  |  |
| $\frac{20 s}{7}=\frac{180}{7}-\frac{4 s}{7}$ |  |  |
| $\frac{24 s}{7}=\frac{180}{7}, s=7.5$ |  |  |
| $7.5=\frac{1}{2}\left(\frac{10}{7}\right) t^{2}$ | 1 |  |
| $t=\sqrt{10.5}=3.24 \mathrm{~s}$ | 1 |  |

