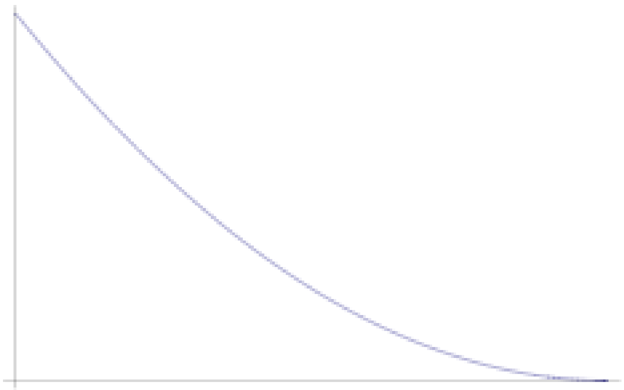
# Mark scheme for Extension Worksheet – Topic 2, Worksheet 3

**1** The speed is given by $v = u - gt$ and so $E_K = \frac{m}{2}(u-gt)^2$ ; hence the graph has to be:




[2]

**2** The work done in moving a distance $\Delta s$ is $W = F\Delta s$ and so the power developed is $W = \frac{F\Delta s}{\Delta t}$ ; but $\frac{\Delta s}{\Delta t}$ is the instantaneous speed *v* giving the result. [2]

**3** **a** The total energy at A is $mgH$ and the total energy at B is $\frac{1}{2}mv^2 + mg(2r)$ and so $\frac{1}{2}mv^2 + mg(2r) = mgH \Rightarrow v^2 = 2g(H-2r)$ ; hence

$v = \sqrt{2\times 9.8\times(1.20-2\times 0.30)} = 3.429 \approx 3.4\ \text{m s}^{-1}$ [2]

**b** The acceleration is directed towards the centre of the circle; and has magnitude

$\frac{v^2}{r} = \frac{3.429^2}{0.30} \approx 39\ \text{m s}^{-2}$ [2]

**c** Calling the reaction force *R*, we have that $R + mg = m\frac{v^2}{r} \Rightarrow R = m\frac{v^2}{r} - mg$ ;

hence $R = 0.25\times 39 - 0.25\times 9.8 = 7.3\ \text{N}$ [2]

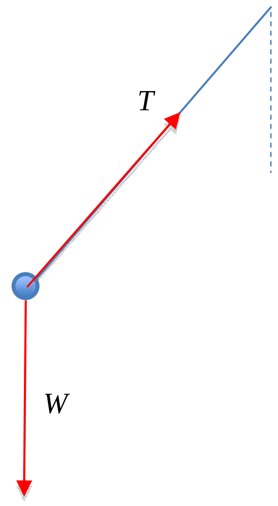
**d** Repeating the earlier steps: $R = m\frac{v^2}{r} - mg = \frac{m2g(H-2r)}{r} - mg = mg(\frac{2H}{r} - 5)$ ;

for the ball not to fall off the reaction force must never become zero, i.e. $R > 0$ ;

and this requires $\frac{2H}{r} - 5 > 0 \Rightarrow H > \frac{5R}{2}$ [3]

**4** **a** see diagram.




[2]

**b** $T\cos 28° = mg$ and $T\sin 28° = m\frac{v^2}{r}$, i.e.

$$T\sin 28^{\circ} = m\frac{v^2}{r}$$
$$T\cos 28^{\circ} = mg$$

dividing side by side gives $\tan 28° = \frac{v^2}{gr}$; and so

$$v = \sqrt{gr\tan 28^{\circ}} = \sqrt{9.8 \times 0.30 \times \tan 28^{\circ}} = 1.25\ \text{m s}^{-1}$$

[3]