Mark scheme for Support Worksheet – Topic 2, Worksheet 3

1 Applying total energy conservation: $mgh = \frac{1}{2}mv^2$ hence $h = \frac{v^2}{2g} \approx \frac{4.9^2}{2 \times 9.8} \approx 1.2$ m [1]

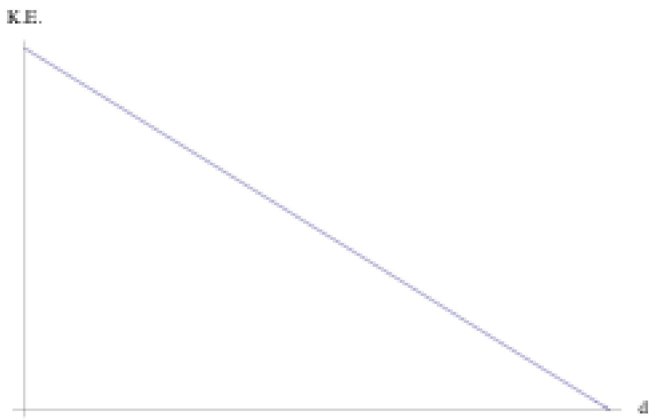
2 The mass cancels out so doubling it would make no difference (in the absence of friction). [1]

3 At the rebound height the energy of the body would be 80% of its original and since the energy at the top is just potential energy *mgh*; the rebound height will be $0.8 \times 1.2 = 0.96$ m [2]

4 Momentum is conserved but energy is not, choice **B**. [1]

5 The useful power developed by the motor is $\frac{mgh}{t} = \frac{6.0 \times 10 \times 3.0}{5.0} = 36$ W; hence the input power is $\frac{36}{0.30} = 120$ W [2]

6 You must realise that $E_K = \frac{1}{2}mv^2$ and $v^2 = u^2 - 2gd$; so the graph will be a straight line with a negative slope.



[2]

7 The potential energy keeps decreasing and gets transformed to thermal energy in the body and the surroundings; no potential energy goes into kinetic energy. [2]

8 The gravitational force between the Earth and the Sun. [1]

9 Acceleration has to do with changes in the velocity vector; and here the direction of the velocity vector is changing. [2]

10 a The ball is not in equilibrium because it is moving on a circle/equilibrium requires motion on a straight line. [1]

b The speed of the ball as it moves past the vertical position is $v = \sqrt{2gh} = \sqrt{2 \times 10 \times 0.80} = 4.0\ \text{m s}^{-1}$; hence

$$T - W = m\frac{v^2}{r} \Rightarrow T = 2.4 + \frac{0.24 \times 4.0^2}{0.80} = 7.2\ \text{N}$$

[2]

11 $N - mg = \dfrac{mv^2}{R} = \dfrac{m(2\pi Rf)^2}{R} = m4\pi^2 Rf^2$

since we want $N = 0$ we must have

$$g = 4\pi^2 Rf^2 \Rightarrow f = \sqrt{\frac{g}{4\pi^2 R}} = \frac{1}{2\pi}\sqrt{\frac{3.0 \times 10^{11}}{30 \times 10^3}} \approx 503 \text{ revolutions per second}$$

[2]