Question 10 (5 marks)

a. $\frac{1}{2}k(\Delta x)^2 = mgh$

$\frac{1}{2} \times k \times (0.49)^2 = 1 \times 9.8 \times 0.49$ 1 mark

$k = \frac{2 \times 9.8}{0.49}$

$= 40 \text{ N m}^{-1}$ 1 mark

b. The net force acting on the mass is given by the difference of the weight and the upward tension in the spring.

net force $= mg - k(\Delta x)$

net acceleration $= \frac{mg - k(\Delta x)}{m}$

$= g - \frac{k(\Delta x)}{m}$ 1 mark

The greatest acceleration occurs when the mass has been released and the spring has not extended at all. 1 mark

The value of the greatest acceleration of the mass is 9.8 m s^{-2}. 1 mark

Question 11 (5 marks)

a. $g = \frac{GM_{\text{Earth}}}{r^2}$

$= \frac{6.67 \times 10^{-11} \times 5.98 \times 10^{24}}{(2.66 \times 10^7)^2}$ 1 mark

$= 0.564 \text{ N kg}^{-1}$ 1 mark

b. $\frac{r^3}{T^2} = \frac{GM_{\text{Earth}}}{4\pi}$

$T = 2\pi\sqrt{\frac{r^3}{GM_{\text{Earth}}}}$

$= 2\pi\sqrt{\left(\frac{(2.66 \times 10^7)^3}{6.67 \times 10^{-11} \times 5.98 \times 10^{24}}\right)}$ 1 mark

$= 43\,161 \text{ s}$ 1 mark

$= \frac{43\,161}{3\,600}$

$= 11.98$

$= 12.0 \text{ h}$

1 mark

Note: Deduct 1 mark if answer is not given to three significant figures.