YEAR 12 PHYSICS ANSWERS TO ASSIGNMENT #2

Q1. a) $v = \frac{2\pi r}{T}$ i/ $\therefore v = \frac{2\pi \times (12\times10^{-3})}{12\times3600} = 1.75\times10^{-6}$ m s^{-1}

ii/ $T = \frac{60}{1500} = 4.0\times10^{-2}$ s $\therefore v = \frac{2\pi\times 2.75}{4.0\times10^{-2}} = 432$ m s^{-1}

iii/ $\therefore v = \frac{2\pi\times (4.2\times10^{4}\times10^{3})}{24\times3600} = 3054$ m s^{-1}

iv/ $T = \frac{60}{33.33} = 1.800$ s $\therefore v = \frac{2\pi\times(15\times10^{-2})}{1.800} = 0.524$ m s^{-1}

b) $a_c = \frac{v^2}{r}$ i/ $\therefore a_C = 2.55\times10^{-10}$ m s^{-2}.

ii/ $\therefore a_C = 6.71\times10^{5}$ m s^{-2}.

iii/ $\therefore a_C = 0.222$ m s^{-2}.

iv/ $\therefore a_C = 1.83$ m s^{-2}.

Q2. a) $F_C = m a_C$ $\therefore F_C$ (max'm) $= 12.1 = 0.40\, a_C$ $\therefore a_C = 30.25$ m s^{-2}.

b) $a_c = \frac{v^2}{r}$ $\therefore v^2 = a_C r = 30.25\times0.16 = 4.84$. $\therefore v = 2.2$ m s^{-1}.

c) $T = \frac{2\pi r}{v}$ $\therefore T = \frac{2\pi\times0.16}{2.2} = 0.457$ s

Q3. a) $F_G = \frac{G m_1 m_2}{r^2} = \frac{(6.668\times10^{-11})(6.0\times10^{24})\times5000}{[(6380+420)\times10^{3}]^2} = 43261$ N

b) $a_C \equiv a_G$ $\therefore m a_C = F_C = F_G$ $\therefore a_C = \frac{43261}{5000} = 8.65$ m s^{-2}

c) $a_c = \frac{v^2}{r}$ $\therefore v^2 = r a_C = [6800\times10^{3}]\times8.65$ $\therefore v = 7.67\times10^{3}$ m s^{-1}

d) $T = \frac{2\pi r}{v}$ $\therefore T = \frac{2\pi\times(6800\times10^{3})}{(7.67\times10^{3})} = 5570$ s - a little over 1.5 hours.

Q4. a) $v = \frac{2\pi r}{T}$ $\therefore v = \frac{2\pi\times(1.50\times10^{11})}{3.156\times10^{7}} = 29863$ m s^{-1}

b) $a_c = \frac{v^2}{r}$ $\therefore a_c = \frac{29863^2}{(1.50\times10^{11})} = 5.945\times10^{-3}$ m s^{-2}

c) $F_C = m a_C$ $F_G = m a_G$ But $F_C \equiv F_G$ $\therefore$ ~~m~~ $a_C =$ ~~m~~ a_G $\therefore 5.945\times10^{-3} = \frac{G m_1}{r^2}$

$\therefore m_{SUN} = \frac{r^2 a_C}{G} = \frac{(1.50\times10^{11})^2\times5.945\times10^{-3}}{6.668\times10^{-11}} = 2.00\times10^{30}$ kg

d) $F_G = \frac{G m_1 m_S}{r^2} = m_S a_c = \frac{v^2}{r}$ $\therefore \frac{G m_1}{r^2} = a_c = \frac{v^2}{r}$ But $v = \frac{2\pi r}{T}$ $\therefore v^2 = \frac{4\pi^2 r^2}{T^2}$

$\frac{G m_1}{r^2} = \frac{4\pi^2 r^2}{r T^2}$ $\therefore r^3 = \frac{G m_1 T^2}{4\pi^2} = \frac{(6.67\times10^{-11})(2.00\times10^{30})(3.76\times10^{8})^2}{4\pi^2}$ $\therefore r = 7.82\times10^{11}$ m

e) $v = \frac{2\pi r}{T}$ $\therefore v = \frac{2\pi\times(7.82\times10^{11})}{3.755\times10^{8}} = 13000$ m s^{-1} [to 2 signif. figures]