Uniform Circular Motion

101. (c) $L = I\omega$. In U.C.M. ω=constant $\therefore$ L = constant.

102. (c) $\because W = FS\cos\theta$ $\therefore$ θ = 90°

103. (b)

104. (c) In uniform circular motion tangential acceleration remains zero but magnitude of radial acceleration remains constant.

105. (d) The inclination of person from vertical is given by,

$$\tan\theta = \frac{v^2}{rg} = \frac{(10)^2}{50\times 10} = \frac{1}{5} \therefore \theta = \tan^{-1}(1/5)$$

106. (d) The centripetal force, $F = \frac{mv^2}{r} \Rightarrow r = \frac{mv^2}{F}$

$\therefore r \propto v^2$ or $v \propto \sqrt{r}$ (If m and F are constant),

$$\Rightarrow \frac{v_1}{v_2} = \sqrt{\frac{r_1}{r_2}} = \sqrt{\frac{1}{2}}$$

107. (b) As the speed is constant throughout the circular motion therefore its average speed is equal to instantaneous speed.

108. (a) Linear velocity,

$v = \omega r = 2\pi n r = 2 \times 3.14 \times 3 \times 0.1 = 1.88 m/s$

Acceleration, $a = \omega^2 r = (6\pi)^2 \times 0.1 = 35.5 m/s^2$

Tension in string, $T = m\omega^2 r = 1 \times (6\pi)^2 \times 0.1 = 35.5N$

109. (a) $a = \frac{v^2}{r} = \frac{(400)^2}{160} = 10^3 m/s^2 = 1 km/s^2$

110. (b) $v\sqrt{\mu r g}_{max.} = \sqrt{0.5 \times 40 \times 9.8} = 14 m/s$

111. (b) $F = \frac{mv^2}{r} = \frac{500 \times 100}{50} = 10^3 N$

112. (b) $F = m\left(\frac{4\pi^2}{T^2}\right)R$. If masses and time periods are same then $F \propto R \therefore F_1/F_2 = R_1/R_2$

113. (b) It is a vector quantity.

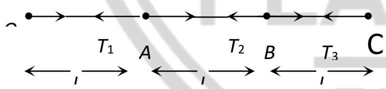
114. (a) $a = \frac{v^2}{r} = v\omega \Rightarrow a' = (2v)\left(\frac{\omega}{2}\right) = a$ *i.e.* remains constant.

115. (d) Tension in the string $T_0 = mR\omega_0^2$

In the second case $T = m(2R)(4\omega_0^2) = 8mR\omega_0^2 = 8T_0$

116. (b) Average velocity= $\frac{\text{Total displacement}}{\text{time}} = \frac{2m}{1s} = 2ms^{-1}$

117. (d) Let ω is the angular speed of revolution



$T_3 = m\omega^2 3l$

$T_2 - T_3 = m\omega^2 2l \Rightarrow T_2 = m\omega^2 5l$

$T_1 - T_2 = m\omega^2 l \Rightarrow T_1 = m\omega^2 6l$

$T_3 : T_2 : T_1 = 3 : 5 : 6$

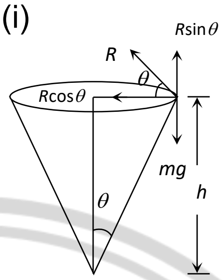
118. (b) $F = \frac{mv^2}{r}$. For same mass and same speed if radius is doubled then force should be halved.

119. (c) $a = \frac{v^2}{r} = \omega^2 r = 4\pi^2 n^2 r = 4\pi^2 \left(\frac{22}{44}\right)^2 \times 1 = \pi^2 m/s^2$ and its direction is always along the radius and towards the centre.

120. (d) The particle is moving in circular path

From the figure, $mg = R\sin\theta$ ...(i)

$\frac{mv^2}{r} = R\cos\theta$ ...(ii)



From equation (i) and (ii) we get

$\tan\theta = \frac{rg}{v^2}$ but $\tan\theta = \frac{r}{h}$

$\therefore h = \frac{v^2}{g} = \frac{(0.5)^2}{10} = 0.025m = 2.5cm$

121. (a) Angular velocity $= \frac{2\pi}{T} = \frac{2\pi}{24} rad/hr = \frac{2\pi}{86400} rad/s$

122. (d) $\omega = \frac{2\pi}{T} = \frac{2\pi}{60} = 0.1047\ rad/s$

and $v = \omega r = 0.1047 \times 3 \times 10^{-2} = 0.00314\ m/s$