Uniform Circular Motion

41. (d) Radial force $= \frac{mv^2}{r} = \frac{m}{r}\left(\frac{p}{m}\right)^2 = \frac{p^2}{mr}$ [As $p = mv$]

42. (b) $\frac{mv^2}{r} \propto \frac{K}{r} \Rightarrow v \propto r^\circ$

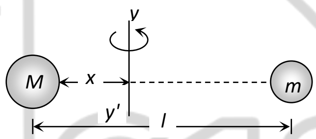
i.e. speed of the particle is independent of *r*.

43. (b) If the both mass are revolving about the axis *yy'* and tension in both the threads are equal then

$M\omega^2 x = m\omega^2(l - x)$

$\Rightarrow Mx = m(l - x)$

$\Rightarrow x = \frac{ml}{M+m}$



44. (b) $tan\,\theta = \frac{v^2}{rg} = \frac{400}{20\times 9.8} \Rightarrow \theta = 63.9^\circ$

45. (d) In complete revolution change in velocity becomes zero so average acceleration will be zero.

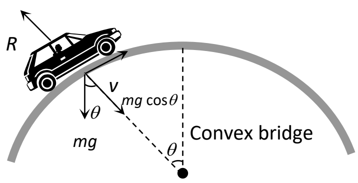
46. (a) We know that $tan\,\theta = \frac{v^2}{Rg}$ and $tan\,\theta = \frac{h}{b}$

Hence $\frac{h}{b} = \frac{v^2}{Rg} \Rightarrow h = \frac{v^2 b}{Rg}$

47. (b)

48. (a) $R = mg\cos\theta - \frac{mv^2}{r}$

when θ decreases cosθ increases *i.e.*, *R* increases.



49. (d) Tension in the string $T = m\omega^2 r = 4\pi^2 n^2 mr$

$$\therefore T \propto n^2 \Rightarrow \frac{n_2}{n_1} = \sqrt{\frac{T_2}{T_1}} \Rightarrow n_2 = 5\sqrt{\frac{2T}{T}} = 7rpm$$

50. (b)

51. (a) $T = m\omega^2 r \Rightarrow 10 = 0.25 \times \omega^2 \times 0.1 \Rightarrow \omega = 20rad/s$

52. (c) $v = 36\frac{km\rightleftarrows}{h} = 10\frac{m}{s} \therefore F = \frac{mv^2}{r} \rightleftarrows = \frac{500\times100}{50} = 1000N.$

53. (a) $T = \frac{mv^2}{r} \Rightarrow 25 = \frac{0.25\times v^2}{1.96} \Rightarrow v = 14m/s$

54. (b) Centripetal force= $mr\omega^2 = 5 \times 1 \times (2)^2 = 20N$

55. (a) $\frac{mv^2}{r} = \frac{k}{r^2} \Rightarrow mv^2 = \frac{k}{r} \therefore$ K.E.= $\frac{1}{2}mv^2 = \frac{k}{2r}$

P.E.= $\int F dr = \int \frac{k}{r^2} dr = -\frac{k}{r}$

$\therefore$ Total energy = K.E. + P.E. = $\frac{k}{2r} - \frac{k}{r} = -\frac{k}{2r}$

56. (d) Maximum tension = $\frac{mv^2}{r} = 16N$

$\Rightarrow \frac{16\times v^2}{144} = 16 \Rightarrow$ *v* = 12 *m/s*

57. (a) The maximum velocity for a banked road with friction,

$$v^2 = gr\left(\frac{\mu + \tan\theta}{1 - \mu\tan\theta}\right)$$

$$\Rightarrow v^2 = 9.8 \times 1000 \times \left(\frac{0.5+1}{1-0.5\times1}\right) \Rightarrow v = 172m/s$$

58. (d) $v = r\omega = \frac{r \times 2\pi}{T} = \frac{0.06 \times 2\pi}{60} = 6.28 mm/s$

Magnitude of change in velocity $= |\vec{v_2} - \vec{v_1}|$
$= \sqrt{v_1^2 + v_2^2} = 8.88 mm/s (\text{As } v_1 = v_2 = 6.28 mm/s)$

59. (a) Work done by centripetal force in uniform circular motion is always equal to zero.

60. (b) $v = r\omega = 20 \times 10 cm/s = 2 m/s$