



## Daily Practice Problems Physics

### LAWS OF MOTION

1. (b)

$$\vec{a} = \frac{\vec{F}}{m}$$

2. (d)

$$\vec{a} = \frac{2\hat{i} + 3\hat{j}}{1}$$

$$F = \frac{dp}{dt} \quad P = mu$$

$$F = \frac{d}{dt}(mu)$$

$$F = m \frac{du}{dt} + u \frac{dm}{dt}$$

$$F = u \frac{dm}{dt}$$

$$\vec{a} = 2\hat{i} + 3\hat{j}$$

3. (c)

$$F = \frac{dP}{dt}$$

$$\int dP = \int F dt$$

$$\Delta P = \int F dt$$

$$\Delta P = \text{Area under } F - t$$

graph

7. (b)

$$u = 10 \text{ m/s}$$

$$v = 0$$

$$s = 5$$

$$a = ?$$

$$v^2 - u^2 = 2as$$

$$0^2 - 10^2 = 2 \times a \times 5$$

$$a = -10 \text{ m/s}^2$$

$$F = ma$$

$$F = 2000 \times (-10) = -2 \times 10^4 \text{ N}$$

4. (a)

$$\vec{F} = \frac{d\vec{p}}{dt} \quad (\vec{p} = m\vec{v})$$

8. (d)

$$\text{Area} = \Delta P$$

$$\text{Area} = mv - 0$$

$$0 = mv$$

$$v = 0$$

$$k_f = 0$$

5. (c)

$$(a) = \frac{F}{m} = \frac{5 \times 10^5}{2 \times 10^7} = 2.5 \times 10^{-2}$$

$$v^2 - u^2 = 2as$$

$$v = \sqrt{2as}$$

$$v = \sqrt{2 \times 2.5 \times 10^{-2} \times 2} = \sqrt{10^{-1}} =$$

$$\frac{1}{\sqrt{10}} = \frac{\sqrt{10}}{10} = \frac{3.16}{10} = 0.316$$

9. (c)

$$\frac{1}{2}mv_2^2 = \frac{1}{2} \left( \frac{1}{2}mv_1^2 \right)$$

$$v_2^2 = v_1^2/2$$

$$v_2 = 10/\sqrt{2}$$

6. (b)

$$F = -kv$$

$$m \frac{dv}{dt} = -kv$$

$$\int_{10}^{10/\sqrt{2}} \frac{dv}{v} = \int_0^{10} -k dt$$

$$|\ln v|_{10}^{10/\sqrt{2}} = -k|t|_0^{10}$$

$$\ln 10/\sqrt{2} - \ln 10 = -k(10 - 0)$$

$$\ln 1/\sqrt{2} = -10k$$

$$+ \ln \sqrt{2} = +10k$$

$$k = \frac{\ln \sqrt{2}}{10}$$

$$k = \frac{\ln 2}{20}$$

10. (b)  $I = \int F dt$

11. (a)

12. (e)

$$F_{\text{Gun}} = F_{\text{bullet per second}} \cdot$$

$$F_{\text{Gun}} = \frac{d}{dt}(P) = nmv$$

13. (a)

$$\Delta P = I$$

$$2mV = I$$

$$V = \frac{I}{2 \text{ m}} = \frac{0.54}{2 \times 10 \times 10^{-3}}$$

$$V = 27 \text{ m/s}$$

14. (e)

$$a = \frac{F}{1} = F$$

$$u = v$$

$$t = 1$$

$$s = ?$$

$$S = ut + \frac{1}{2}at^2$$

$$S = v \times 1 + \frac{1}{2}F \times 1^2$$

$$S = V + f/2$$

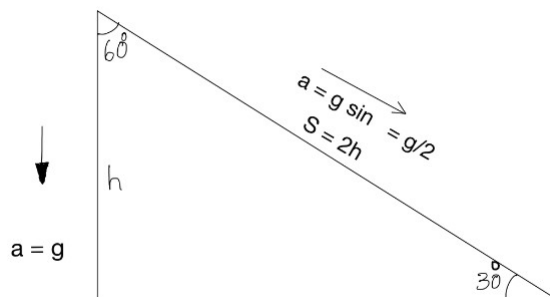
15. (e)

$$F = v \frac{dm}{dt} = 10 \times 2 = 20 \text{ N}$$

$$a = \frac{F}{m} = \frac{20}{4}$$

$$a = 5 \text{ ms}^{-2}$$

16. (b)



$$S = 1/2at^2$$

$$2h = \frac{1}{2}(g/2)t_1^2$$

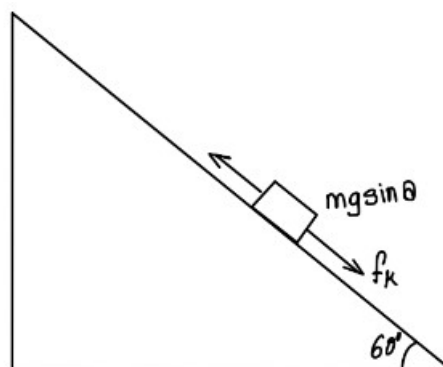
$$h = \frac{1}{2}gt_2^2$$

$$4 = \left(\frac{t_1}{t_2}\right)^2 \Rightarrow \frac{t_1}{t_2} = 2 : 1$$

17. (e)

18. (e)

19. (b)



$$f_k = mg \sin 60 = \frac{\sqrt{3}mg}{2}$$

$$F = mg \sin 60 + f_k$$

$$F = 2mg \sin 60$$

$$F = 2 \times 1 \times 10 \times \frac{\sqrt{3}}{2} = 17.32 \text{ N}$$

20. (b)

$$\frac{1}{2}m_1v_1^2 = \frac{1}{2}m_2v_2^2$$

$$m_1v_1^2 = m_2v_2^2$$

$$m_1(a_1t_1)^2 = m_2(a_2t_2)^2$$

$$m_1\left(\frac{F}{m_1}t_1\right)^2 = m_2\left(\frac{F}{m_2}t_2\right)^2$$

$$\frac{t_1^2}{m_1} = \frac{t_2^2}{m_2}$$

$$\frac{t_1}{t_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{20}{5}} = 2$$

21. (c)

$$m = 0.05 \text{ m}$$

$$u = 80 \text{ m/s}$$

$$v = 0 \text{ m/s}$$

$$s = 0.40 \text{ m}$$

$$v^2 - u^2 = 2as$$

$$0^2 - 80^2 = 2 \times a \times 0.4$$

$$a = -\frac{80 \times 80}{2 \times 0.4} = -8000 \text{ m/s}^2$$

$$F = ma = 0.05 \times (-8000)$$

$$= -400 \text{ N}$$

22. (e)

$$\int F dt = \Delta p$$

$$\text{Area} = mv - 0$$

$$100 = 2 \times v$$

$$v = 50 \text{ m/s}$$

$$\text{Area} = \left(\frac{1}{2} \times 2 \times 10\right) + (2 \times 10) +$$

$$\left(\frac{10+20}{2} \times 2\right)$$

$$+ \frac{1}{2} \times 4 \times 20$$

$$= 10 + 20 + 30 + 40 = 100$$

23. (c)

$$K = \frac{p^2}{2m} \quad \frac{K'}{K} - 1 = 0.56$$

$$K' = \frac{(1.25p)^2}{2m} \quad \frac{K' - K}{K} = 0.56$$

$$\frac{K'}{K} = (1.25)^2 \quad \frac{\Delta K}{K} = 0.56$$

$$K'/K = 1.56 \quad \frac{\Delta K}{K} \times 100 = 56\%$$

24. (b)

$$W_1 = m(g + a) = m(g + g/4) = \frac{5mg}{4}$$

$$W_2 = m(g - a) = m(g - g/4) = \frac{3mg}{4}$$

$$\frac{W_2}{W_1} = 3/4 \times 4/5 = 3/5$$

$$W_2 = 3/5 W_1 = \frac{3}{5} \times 50 = 30 \text{ kg} \cdot wt$$

25. (e)

26. (d)

$$T = m_1g + m_2g$$

$$T = (m_1 + m_2)g$$

27. (c)

$$W = m(g - a)$$

$$W = 60(10 - 4)$$

$$W = 360 \text{ N}$$

28. (d)

$$2T = mg$$

$$T = Mg/2$$

$$T = \frac{2 \times 10}{2} = 10 \text{ N}$$

29. (d)

$$F - (m_1g + m_2g) = (m_1 + m_2)a$$

$$120 - (20 + 40) = 6a$$

$$a = 10 \text{ m/s}^2$$

$$T - 2g = 2a$$

$$T - 2 \times 10 = 2 \times 10$$

$$T = 40 \text{ N}$$

30. (c)

31. (d)

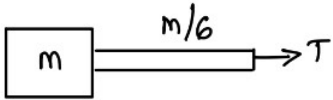
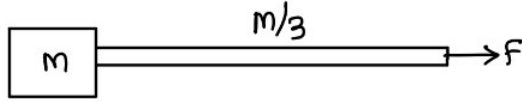
$$T_1 - (10g + 6g) = (10 + 6)a$$

$$T_1 - 160 = 16 \times 2$$

$$T = 160 + 32$$

$$= 192 \text{ N}$$

32. (e)



$$F = (m + m/3)a \Rightarrow a = \frac{3F}{4m}$$

$$T = (m + m/6)a$$

$$T = \frac{7M}{6} \times \frac{3F}{4m} = \frac{7F}{8}$$

33. (a)

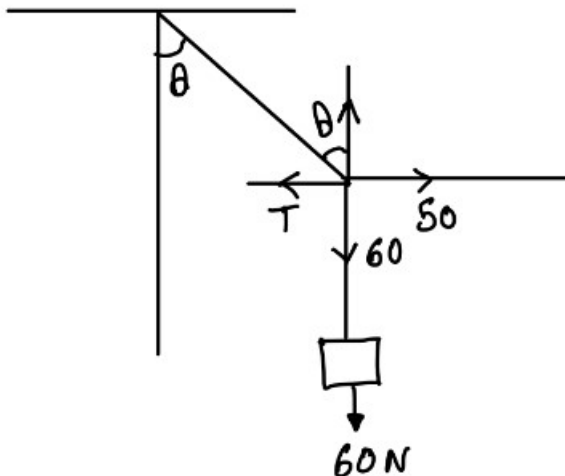
$$T - mg = ma$$

$$T = m(g + a)$$

$$T = 5(10 + 0.25)$$

$$= 50 + 1.25 = 51.25$$

34. (d)



$$T \sin \theta = 50$$

$$T \cos \theta = 60$$

$$\tan \theta = 5/6$$

35. (d)

$$a = \frac{T_3}{m_1 + m_2 + m_3} = \frac{40}{20} = 2 \text{ m/s}^2$$

$$T_2 = (m_1 + m_2)a = 16 \times 2 = 32 \text{ N}$$

36. (a)

$$T - 2mg = 2ma$$

$$3mg - T = 3ma$$

$$mg = 5ma$$

$$a = g/5$$

37. (b)

$$100 \times 10^4 = (10 \times 0) + (90 \times V_2)$$

$$V_2 = \frac{10}{9} \times 10^4$$

$$= 1.1111 \times 10^4 = 11.11 \times 10^3$$

38. (d)

$$(2 \times 8)\hat{i} + (1 \times 12)\hat{j} + 0.5\vec{V}_3 = 0$$

$$0.5\vec{v}_3 = -(16\hat{i} + 12\hat{j})$$

$$\vec{V}_3 = -(32\hat{i} + 24\hat{j})$$

$$|\vec{V}_3| = \sqrt{32^2 + 24^2} = 40$$

39. (d)

$$\vec{F}_{av} = \frac{\vec{\Delta p}}{\Delta t}$$

$$\vec{F}_{av} = \frac{\vec{p}_3}{\Delta t}$$

$$\vec{F}_{av} = -\frac{(3\hat{i} + 4\hat{j})}{10^{-4}}$$

$$= -(3\hat{i} + 4\hat{j}) \times 10^4$$

$$(1 \times 3\hat{i}) + (1 \times 4\hat{j}) + \vec{P}_3 = 0$$

$$\vec{P}_3 = -(3\hat{i} + 4\hat{j})$$

40. (b)

$$(1 \times 5)\hat{i} + (2 \times 6)\hat{j} + m\vec{v}_3 = 0$$

$$m\vec{v}_3 = -(5\hat{i} + 12\hat{j})$$

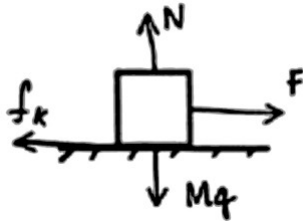
$$m|\vec{v}_3| = \sqrt{5^2 + 12^2} = 13$$

$$m = \frac{13}{6.5} = 2 \text{ kg}$$

$$M = 1 + 2 + 2$$

$$= 5 \text{ kg}$$

41. (d)



$$f_k = \mu N$$

$$f_k = \mu mg$$

$$F - f_k = ma$$

$$F = \mu mg + ma$$

$$F = (0.3 \times 10 \times 10) + (10 \times 3)$$

$$= 60 \text{ N}$$

42. (c)

$$S = \frac{h}{\sin 30} = 2h = 10$$

$$a = g \sin 30 - \mu g \cos 30$$

$$a = 10 \times \frac{1}{2} - \frac{1}{2\sqrt{3}} \times 10 \times \frac{\sqrt{3}}{2}$$

$$= 5 - 5/2$$

$$= 2.5 \text{ m/s}^2$$

$$v^2 - u^2 = 2as$$

$$v^2 - 0^2 = 2 \times 2.5 \times 10$$

$$v = \sqrt{50}$$

$$v = 7$$

43. (d)

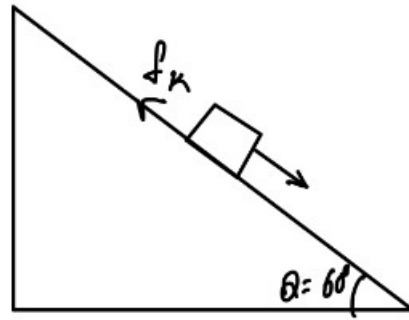
$$\tan \theta = \frac{v^2}{Rg}$$

$$\tan \theta = \frac{20 \times 20}{40\sqrt{3} \times 10} = \frac{1}{\sqrt{3}}$$

$$\theta = 30^\circ$$

44. (b)

45. (b)



from 1st statement  $f_k = mg \sin 60$  When it moves up the plane,

$$F = mg \sin 60 + f_k$$

$$F = 2mg \sin 60$$

$$= 2 \times 1 \times 10 \times \sqrt{3}/2 = 10\sqrt{3} = 17.32$$

46. (a)

$$V_{\max} = \sqrt{\mu rg}$$

$$V_{\max} = \sqrt{0.8 \times 84.5 \times 10}$$

$$= 26 \text{ m/s}$$

47. (b)

$$V_{\max} = \sqrt{\mu rg}$$

$$= \sqrt{0.64 \times 20 \times 10}$$

$$= 8\sqrt{2}$$

$$= 8 \times 1.4 = 11.2$$

48. (b) Impulse,  $I = \text{change in momentum, } \Delta P$

$$F_{\text{avg}} = \frac{\Delta P}{\Delta t} \because \Delta P_1 = \Delta P_2 \therefore I_1 = I_2$$

Given  $\Delta t_1 = 3 \text{ s}$  and  $\Delta t_2 = 5 \text{ s}$  Hence,  $F_{\text{avg}}$  in case (i), when  $\Delta t_2 = 3 \text{ s}$  is more than (ii) when  $\Delta t_2 = 5 \text{ s}$

49. (b) Force,  $F = \frac{dm}{dt} v = \frac{10}{5} \times 4.5 = 9 \text{ dyne}$

50. (b) Initial momentum  $\vec{P}_i = 0.15 \times 12(\hat{i})$

Final momentum  $\vec{P}_f = 0.15 \times 12(-\hat{i})$

$$|\Delta \vec{P}| = 3.6 \text{ kg m/s or, } 3.6 = F \Delta t$$

$$3.6 = 100 \Delta t \therefore \Delta t = 0.036 \text{ sec}$$

51. (c)

$$(F = \frac{dp}{dt} = v \frac{dm}{dt} = 10 \times 1 = 10 \text{ N})$$

$$a = \frac{F}{m} = \frac{10}{2} = 5 \text{ m/s}^2$$

52. (b)

By law of conservation of linear momentum

$$\vec{P}_i = \vec{P}_f$$

$$\Rightarrow 60 \times V = (120 + 60) \times 2$$

$$\Rightarrow 60 V = 360$$

$$\Rightarrow V = 6 \text{ m/s}$$

53. (a) Impulse = change in momentum

$$= m[v - (-v)] = 2mv$$

$$= 2 \times 0.4 \times 15 = 12 \text{Ns}$$

54. (c)

Acceleration,  $\vec{a} = \frac{\vec{F}}{m} = \frac{40\hat{i} + 10\hat{j}}{5} = 8\hat{i} + 2\hat{j}$

Using,

$$\Rightarrow \vec{s} = \vec{u}t + \frac{1}{2}\vec{a}t^2 \Rightarrow \vec{s} = \frac{1}{2}(8\hat{i} + 2\hat{j}) \times 100$$

$$\Rightarrow \vec{s} = 400\hat{i} + 100\hat{j}$$

55. (d)

$$\vec{a} = \frac{\vec{F}}{m} = 10\hat{i} + 5\hat{j}$$

Displacement of the box along x-axis,

$$x = \frac{1}{2}a_x t^2 = \frac{1}{2} \times 10 \times 100 = 500 \text{ m}$$

56. (b)

From Newton's second law

$$\frac{dp}{dt} = F = kt$$

Integrating both sides we get,

$$\int_p^{3p} dp = \int_0^T kt dt \Rightarrow [p]_p^{3p} = k \left[ \frac{t^2}{2} \right]_0^T$$

$$\Rightarrow 2p = \frac{kT^2}{2} \Rightarrow T = 2\sqrt{\frac{p}{k}}$$

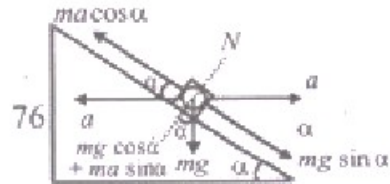
57. (a)

From question, Mass of body,  $m = 5 \text{ kg}$   
Velocity at  $t = 0$ ,  $u = (6\hat{i} - 2\hat{j}) \text{ m/s}$   
Velocity at  $t = 10 \text{ s}$ ,  $v = +6\hat{j} \text{ m/s}$   
Force,  $F = ?$   
Acceleration,  $a = \frac{v-u}{t} = \frac{6\hat{j} - (6\hat{i} - 2\hat{j})}{10} = \frac{-3\hat{i} + 4\hat{j}}{5} \text{ m/s}^2$   
Force,  $F = ma$

$$= 5 \times \frac{(-3\hat{i} + 4\hat{j})}{5} = (-3\hat{i} + 4\hat{j}) \text{ N}$$

58. (c)

When the incline is given an acceleration  $a$  towards the right, the block experiences a pseudo force  $ma$  towards left.



For block to remain stationary, Net force along the incline should be zero.  
 $mg \sin \alpha = ma \cos \alpha \Rightarrow a = g \tan \alpha$

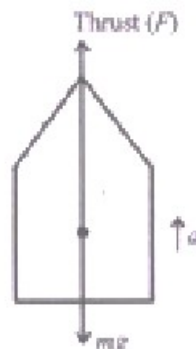
59. (b)

(b) In the absence of air resistance, if the rocket moves up with an acceleration  $a$ , then thrust

$$F = mg + ma$$

$$\therefore F = m(g + a) = 3.5 \times 10^4 (10 + 10)$$

$$= 7 \times 10^5 \text{ N}$$



Angle with x-axis:  $\tan \theta = \frac{y \text{ component}}{x \text{ component}} = \frac{1}{1}$   
 So,  $\theta = \tan^{-1}(1) = 45^\circ$

60. (d)

Resultant force is zero, as three forces are represented by the sides of a triangle taken in the same order. From Newton's second law,  $\vec{F}_{\text{net}} = m\vec{a}$ . Therefore, acceleration is also zero i.e., velocity remains unchanged.

61. (b)

$$a = \frac{M_2 g - M_1 g}{M_1 + M_2} \text{ When, } M_2 = 2m_1$$

$$\Rightarrow a_1 = \frac{2M_1 g - M_1 g}{3M_1} = \frac{g}{3}$$

$$\text{When } M_2 = 3M_1 \Rightarrow a_2 = \frac{3M_1 g - M_1 g}{4M_1} = \frac{g}{2}$$

$$\text{The ratio } \frac{a_1}{a_2} = \frac{\frac{g}{3}}{\frac{g}{2}} = \frac{2}{3}$$

62. (c)

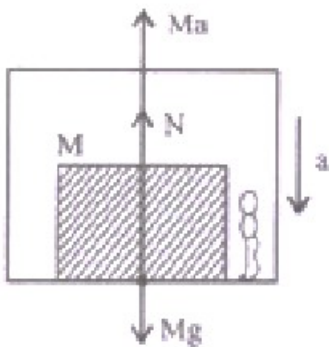
For observer in box

$$N + Ma = Mg$$

$$\Rightarrow N = M(g - a)$$

$$\Rightarrow \frac{Mg}{4} = M(g - a)$$

$$\Rightarrow a = \frac{3g}{4}$$



63. (a)

Let addition force required be  $\vec{F}$

$$\vec{F} + 5\hat{i} - 6\hat{i} + 7\hat{j} - 8\hat{j} = 0$$

$$\Rightarrow \vec{F} = \hat{i} + \hat{j}, |\vec{F}| = \sqrt{1^2 + 1^2} = \sqrt{2}$$

64. (b)

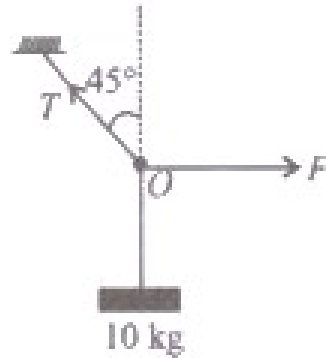
When elevator does downward, then a pseudo force acts on object in upward direction, due to which effective weight of object decreases.

65. (a)

The free body diagram is By Lami's theorem

$$\Rightarrow \frac{mg}{135^\circ} = \frac{F}{135}$$

$$\Rightarrow F = mg = 100 \text{ N}$$



66. (e)

We have, acceleration of system as

$$a = \frac{6mg}{10m} = \frac{3g}{5}$$

taking 8, 9, 10 together

$$T = 3ma = 3m \times \frac{3g}{5} = \frac{3 \times 2 \times 3 \times 10}{5} = 36 \text{ N}$$

67. (d)

Total weight acting downward,  $W = (20 \times 3 + 10)g = 70g$  Now from FBD,  $N - mg = ma$

$$\Rightarrow N - 70g = 70 \times 0.2$$

$$\Rightarrow N = 70(g + 0.2)$$

$$\Rightarrow N = 684 \text{ N}$$

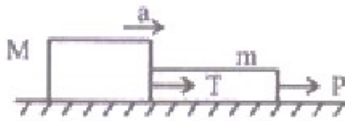
68. (d)

Taking the rope and the block as a system we get  $P = (m + M)a$   $\therefore$  Acceleration produced,

$$a = \frac{P}{m + M}$$

Taking the block as a system, Force on the block,  $F = Ma$

$$\therefore F = \frac{MP}{m + M}$$



69. (d)

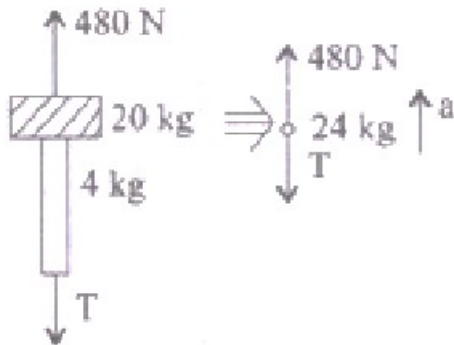
$$a = \frac{480}{20+12+8} = 12 \text{ m/s}^2$$

$$480 - T = 24a$$

$$480 - T = 24 \times 12$$

$$480 - T = 288$$

$$T = 192 \text{ N}$$



70. (e)

Mass of the person,  $M = 60 \text{ kg}$  Tension in the rope of the lift when it moves downward with acceleration  $a$ ,

$$T = M(g - a) = 60(10 - 1.8) = 492 \text{ N}$$

71. (a)

From the free diagram shown

$$N = Mg \cos \theta$$

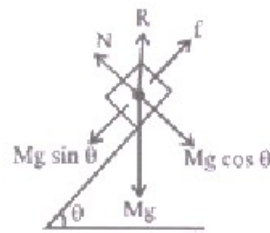
$$f = Mg \sin \theta$$

Contact force,  $R = \sqrt{N^2 + f^2}$

$$\Rightarrow R = \sqrt{(Mg \cos \theta)^2 + (Mg \sin \theta)^2}$$

$$= \sqrt{(Mg)^2 (\cos^2 \theta + \sin^2 \theta)}$$

$$\Rightarrow R = Mg$$



72. (b)

For beaker to move with disc

$$f_s = m\omega^2 R$$

We know that  $f_s \leq f_{s \text{ max}}$

$$m\omega^2 R \leq \mu mg$$

$$R \leq \mu g / \omega^2$$

73. (d)

Suppose length of plane is  $L$ . When block descends the plane, rise in kinetic energy = fall in potential energy =  $mgL \sin \phi$   
Work done by friction =  $\mu \times (\text{reaction}) \times \text{distance}$   
 $0 + \mu(mg \cos \phi) \times (L/2) = \mu(mg \cos \phi) \times (L/2)$

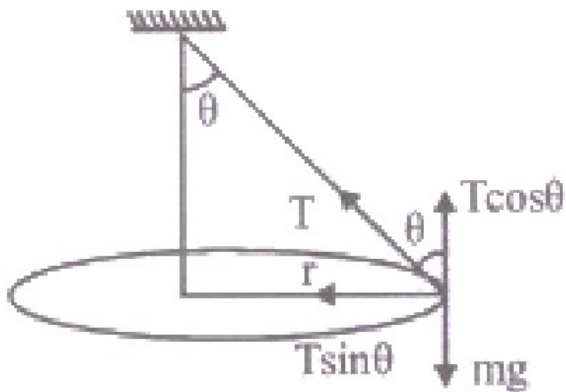
Now, work done = change in KE  
 $mgL \sin \phi = \mu(mg \cos \phi) \times (L/2) \Rightarrow \tan \phi = \mu/2 \therefore \mu = 2 \tan \phi$

74. (a) From figure

$$\sin' \theta = \frac{r}{L} = \frac{L}{L\sqrt{2}} = \frac{1}{\sqrt{2}} \Rightarrow \theta = 45^\circ$$

$$T \sin \theta = \frac{mv^2}{r} \quad T \cos \theta = mg \quad \text{From (i) and (ii)}$$

$$\tan \theta = \frac{v^2}{rg} \Rightarrow v = \sqrt{rg}$$



75. (d)

Given.  $\theta = 45^\circ$ ,  $r = 0.4$  m,  $g = 10$  m/s<sup>2</sup>

$T \sin \theta = \frac{mv^2}{r}$   $T \cos \theta = mg$  From equation (i) & (ii) we have,

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

$$v^2 = rg \quad \because \theta = 45^\circ$$

Hence, speed of the pendulum in its circular path,

$$v = \sqrt{rg} = \sqrt{0.4 \times 10} = 2 \text{ m/s}$$