Ranker's Package

A meticulous collection of questions

for

NEET

Unit wise Questions with Solution

Physics

Topic : Unit, Dimension & Error, Vector, Motion in One Dimension, Projectile Motion, Circular motion, Laws of motion.

UNIT 1

Q.1 If energy (E), velocity (V) and time (T) are chosen as fundamental quantities, the dimensions of surface tension will be represented as –
(1) $EV^{-2}T^{-1}$ (2) $EV^{-1}T^{-2}$
(3) $EV^{-2}T^{-2}$ (4) $E^2V^{-1}T^{-3}$

Q.2 What is the % error in measurement of 'T' of a pendulum if maximum errors in measurements of length and 'g' are 2% and 4% respectively –
(1) 6% (2) 3% (3) 4% (4) 5%

Q.3 When a current of 5.0 ± 0.5 ampere flows through a wire, it develops a potential difference of 25 ± 1 volt. Then the resistance of wire is –
(1) (5.0 ± 1.5) ohm (2) (5.0 ± 0.7) ohm
(3) (5.0 ± 0.5) ohm (4) (5 ± 1) ohm

Q.4 The velocity of a moving particle depends upon time t as $V = at + \frac{b}{(t+c)}$. Then dimensional formula for b is –
(1) $M^0L^0T^0$ (2) $M^0L^1T^0$
(3) $M^0L^1T^{-1}$ (4) $M^0L^1T^{-2}$

Q.5 A physical quantity P is related to four observables (Physical quantities) a, b, c and d as follows $P = \frac{a^3b^2}{\sqrt{cd}}$. The percentage error of measurement in a, b, c and d are 1%, 3%, 4% and 2% respectively. What is the percentage error in P ?
(1) 10% (2) 13% (3) 1.3% (4) 17%

Q.6 Which of the following sets of forces can not have resultant force equal to zero ? (All forces are in Newton)
(1) 10, 10, 20 (2) 10, 10, 10
(2) 10, 20, 20 (4) 10, 20, 40

Q.7 A person is running on a horizontal road in vertically falling rain with a speed of 6 km/hr. He observes that the rain is falling on him at an angle of 30° with the vertical. The velocity of the rain will be –
(1) 6 km/hr (2) $6\sqrt{3}$ km/hr
(3) $2\sqrt{3}$ km/hr (4) 2 km/hr

Q.8 A bird is flying with a speed of 40 km/hour in the north direction. A train is moving with a speed of 40 km/hour in the east direction. A passenger sitting in the train will see the bird moving with velocity –
(1) 40 km/hour in the North-East direction,
(2) $40\sqrt{2}$ km/hour in the North-West direction.
(3) 40 km/hour in the North-West direction
(4) $40\sqrt{2}$ km/hour in the North-East direction.

Q.9 A man walks 30m towards North, then 20m towards East and in the last $30\sqrt{2}$ m towards South-West. The displacement from origin is-
(1) 10 m towards West
(2) 10 m towards East
(3) $10\sqrt{2}$ m towards North-West
(4) $10\sqrt{2}$ m towards North-East

Q.10 Drops of water fall from the roof of a building 9 m high at regular intervals of time, the first drop reaching the ground at the same instant fourth drop starts its fall. What are the distances of the second and third drops from the roof ?
(1) 6 m and 2 m (2) 6 m and 3 m
(3) 4 m and 1 m (4) 4 m and 2 m

Q.11 A bus starts moving with acceleration $2m/s^2$. A cyclist 96 m behind the bus starts simultaneously towards the bus at 20 m/s. After what time will he be able to overtake the bus ?
(1) 4 s (2) 8 s (3) 12 s (4) 16 s

Q.12 A particle starts from rest and travels a distance s with uniform acceleration, then it travels a distance 2s with uniform speed, finally it travels a distance 3s with uniform retardation and comes to rest. If the complete motion of the particle is a straight line then the ratio of its average velocity to maximum velocity is –

(1) 6/7 (2) 4/5 (3) 3/5 (4) 2/5

Q.13 The time is expressed as function of x where α and β are constants as $t = \alpha x^2 + \beta x$ and v is velocity. The retardation is –

(1) $2\alpha v^3$ (2) $2\beta v^3$ (3) $2\alpha\beta v^3$ (4) $2\beta^2 v^3$

Q.14 A particle moves with uniform acceleration and v_1, v_2 and v_3 denote the average velocities in three successive intervals of time t_1, t_2 and t_3. Which of the following relation is correct ?

(1) $(v_1 - v_2) : (v_2 - v_3) = (t_1 - t_2) : (t_2 + t_3)$

(2) $(v_1 - v_2) : (v_2 - v_3) = (t_1 + t_2) : (t_2 + t_3)$

(3) $(v_1 - v_2) : (v_2 - v_3) = (t_1 - t_2) : (t_1 - t_3)$

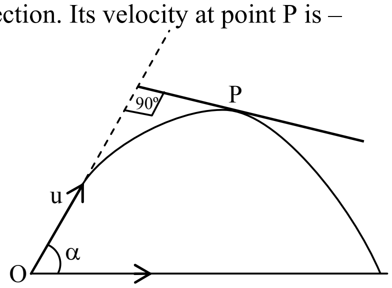
(4) $(v_1 - v_2) : (v_2 - v_3) = (t_1 - t_2) : (t_2 - t_3)$

Q.15 From the top of building 16 m high, water drops are falling at equal intervals of such that when the first reaches the ground, the fifth drop just starts. The distance between the successive drops, in metres, at that instant are –

(1) 7.5, 5, 2.5, 1 (2) 7, 5, 3, 1

(3) 8, 4, 2, 1 (4) none of these

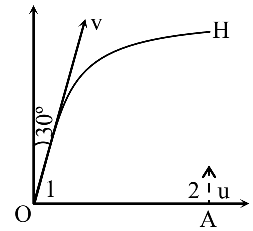
Q.16 A particle is projected from point O with velocity u in a direction making an angle α with the horizontal. At any instant its position is at point P at right angles to the initial direction of projection. Its velocity at point P is –



(1) u tan α (2) u cot α

(3) u cosec α (4) u sec α

Q.17 A particle 1 is projected with speed ' v' from a point O making an angle of 30° with the vertical at the same instant, a second particle 2 is thrown vertically upwards from a point A with speed u. The two particles reach H, the highest point on the parabolic path of particle 1 simultaneously. The ratio of $\frac{v}{u}$ is-



(1) $\frac{\sqrt{3}}{2}$ (2) $\frac{2}{\sqrt{3}}$ (3) $\sqrt{\frac{2}{3}}$ (4) $\sqrt{\frac{3}{2}}$

Q.18 Two paper screens A and B are separated by a distance of 100 m. A bullet pierces A and then B. The hole in B is 10 cm below the hole in A. If the bullet is travelling horizontally at the time of hitting A, then the velocity of the bullet at A is-

(1) 100 m/s (2) 200 m/s

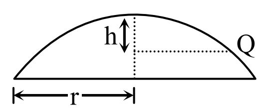
(3) 600 m/s (4) 700 m/s

Q.19 A wheel of radius R rolls forward half a revolution. Then the displacement of a point of the wheel initially in contact with the ground is-

(1) πR (2) 2R

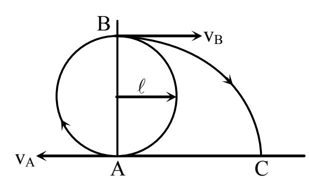
(3) $\pi(R + 2)$ (4) $R\sqrt{\pi^2 + 4}$

Q.20 A small body of mass m slides without frication from the top of a hemispherical cup of radius r as shown in the fallowing figure. If it leaves the surface of the cup at a vertical distance 'h' below the highest point, then –



(1) h = r (2) h = r/3 (3) h = r/2 (4) h = 2r/3

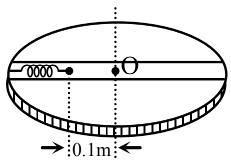
Q.21 An object is tied to a string of length ℓ and is revolved in a vertical circle at the minimum velocity. When the object reaches the upper most point, the string breaks and it describes a parabolic path as shown in the figure under the gravitational force. The horizontal range AC in the plane of A would be –



(1) $x = \ell$ (2) $x = 2\ell$

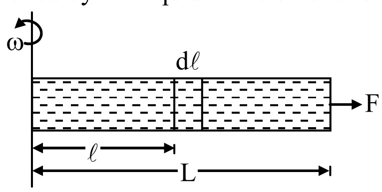
(3) $x = \sqrt{2\ell}$ (4) $x = 2\sqrt{2\ell}$

Q.22 A circular turn of radius 0.5 m has a smooth groove as shown in fig. A ball of mass 90 g is placed inside the groove along with a spring of spring constant 10^2N/cm. The ball is at a distance of 0.1 m from the centre when the turn table is at rest. On rotating the turn table with a constant angular frequency of 10^2 sec^{-1}, the ball moves away from the centre by a distance nearly equal to-



(1) 10^{-1} m (2) 10^{-2} m
(3) 10^{-3} m (4) 2×10^{-1} m

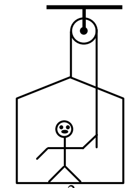
Q.23 A tube of length L is filled completely with an incompressible liquid of mass M and closed at both ends. The tube is then rotated in the horizontal plane about one of its ends with uniform angular velocity ω. (see in fig.)The force exerted by the liquid at the other end is



(1) $\frac{ML\omega^2}{2}$ (2) $\frac{ML^2\omega^2}{2}$
(3) $\frac{M\omega^2}{2L}$ (4) $\frac{M^2\omega}{2L}$

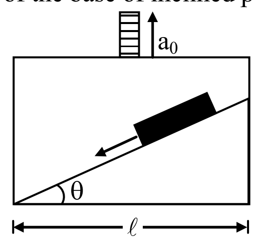
Q.24 A particle of mass m is moving in a circular path of constant radius r such that its centripetal acceleration a_c is varying with time t as $a_c = k^2rt^2$, where k is a constant. The power delivered to the particle by the forces acting on it is –
(1) $2\pi mk^2r^2t$ (2) mk^2r^2t
(3) $\frac{(mk^4r^2t^5)}{3}$ (4) zero

Q.25 The following figure shows a painter in a platform suspended along the building. When the painter pulls the rope the force exerted on the floor is 450N while the weight of the painter is 1000N. If the weight of the platform is 250N, the acceleration produced in the platform will be– (g = 10 m/s^2)



(1) 4 m/s^2 (2) 2 m/s^2 (3) 5 m/s^2 (4) 6 m/s^2

Q.26 A body slides down on a smooth inclined plane whose inclination with horizontal is θ. It is placed in a lift. If the lift is moving upwards with an acceleration a_0, then how much time will the body take in coming down the inclined plane? The length of the base of inclined plane is ℓ –



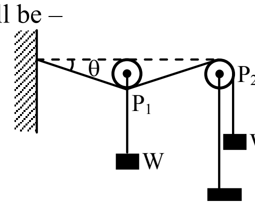
(1) $\left[\frac{2\ell}{(g+a_0)\sin\theta\cos\theta}\right]^{1/2}$

(2) $\left(\frac{2\ell}{g\sin\theta}\right)^{1/2}$

(3) $\left[\frac{\ell}{(g+a_0)\sin\theta}\right]^{1/2}$

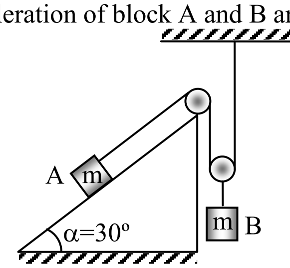
(4) $\left[\frac{2\ell}{(g-a_0)\sin\theta\cos\theta}\right]^{1/2}$

Q.27 In the arrangement shown in the figure the pulley P_1 is mobile but pulley P_2 is fixed. The angle θ will be –



(1) 15° (2) 30° (3) 45° (4) 60°

Q.28 In an arrangement shown in the figure, the acceleration of block A and B are given –



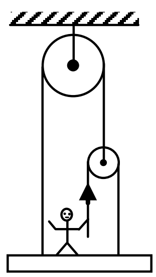
(1) g/3, g/6 (2) g/6, g/3
(3) g/2, g/2 (4) 0, 0

Q.29 The horizontal acceleration that should be given to a smooth inclined plane of angle $\sin^{-1}(1/\ell)$ to keep an object stationary on the plane relative to the inclined plane is:

(1) $g/\sqrt{\ell^2-1}$ (2) $g\sqrt{\ell^2-1}$

(3) $\sqrt{\ell^2-1/g}$ (4) $g/\sqrt{\ell^2+1}$

Q.30 In the given diagram, with what force must the man pull the rope to hold the plank in position ? Weight of the man is 60 kgf. Neglect the weights of plank, rope and pulley –



(1) 120 kgf (2) 60 kgf

(3) 30 kgf (4) 15 kgf

Q.31 In expression $F = at^{-1} + bt^2$; t represent time so dimension of a & b are –

(1) LT^{-2}, T^{-2} (2) T, T^{-2}

(3) LT^{-1}, T^{-2} (4) MLT^{-1}, MLT^{-4}

Q.32 Dimension of energy density will be –

(1) MLT^{-2} (2) $ML^{-1}T^{-2}$

(3) ML^2T^{-2} (4) $ML^{-2}T^{-2}$

Q.33 Number of particles, travelling per unit area per second along x-direction is expressed as $n = -D\left(\frac{n_2-n_1}{x_2-x_1}\right)$. Where n_1 & n_2 are no. of particles per unit volume and x_2 & x_1 are distances then dimension of D will be–

(1) LT^{-2} (2) L^2T^4 (3) LT^{-3} (4) L^2T^{-1}

Q.34 Suppose a physical quantity is measured and the result is expressed as nu where n is a numerical value and u is the unit used. If the result is expressed in various units, then –

(1) $n \propto$ size of u (2) $n \propto (\text{size of u})^2$

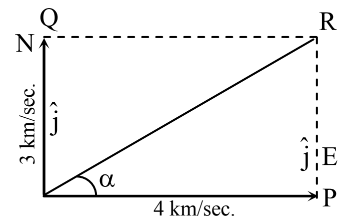
(3) $n \propto \sqrt{\text{size of u}}$ (4) $n \propto \frac{1}{\text{size of u}}$

Q.35 If C and R represent capacitance and resistance respectively, then the dimensions of RC are –

(1) $M^0L^0T^2$ (2) M^0L^0T

(3) ML^{-1} (4) None of these

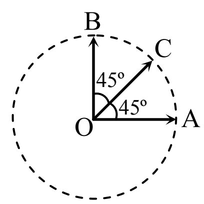
Q.36 The velocity of a particle P due east is 4 km/sec. and that of Q is 3 km/sec due south. The velocity of P with respect to Q will be –



(1) $(4\hat{i}+3\hat{j})_{E-N}$ (2) $(3\hat{i}+4\hat{j})_{N-E}$

(3) $(4\hat{i}-3\hat{j})_{N-S}$ (4) $(3\hat{i}-4\hat{j})_{S-N}$

Q.37 The three vector $\vec{OA}$, $\vec{OB}$ and $\vec{OC}$ have the same magnitude R. Then the sum of these vectors have magnitude –



(1) R (2) $\sqrt{2}$ R

(3) 3 R (4) $(1+\sqrt{2})$ R

Q.38 If $\vec{A}=\hat{i}+\hat{j}$ and $\vec{B}=\hat{i}-\hat{j}$, then a vector $\vec{C}$ perpendicular to both $\vec{A}$ and $\vec{B}$, and having a magnitude equal to 3 is –

(1) $3\hat{k}$ (2) $\sqrt{3}\,(\hat{i}+\hat{j})$

(3) $\sqrt{3}\,(\hat{i}+\hat{k})$ (4) $\sqrt{3}\,(\hat{j}+\hat{k})$

Q.39 The resultant of two vectors $(\vec{P}+\vec{Q})$ and $(\vec{P}-\vec{Q})$ is the vector $\sqrt{3P^2+Q^2}$. The angle between given two vectors is –

(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{4}$

(3) $\frac{\pi}{3}$ (4) π

Q.40 The velocity of a swimmer with respect to the direction of river flow is ' v ' and the velocity of river flow is 'u'. In what direction should the swimmer swim in order to reach a point just in front of the starting point –

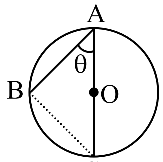
(1) $\sin^{-1}\frac{v}{u}$ (2) $\sin^{-1}\frac{u}{v}$

(3) $\sin^{-1}\left(\frac{u}{\sqrt{u^2+v^2}}\right)$ (4) $\sin^{-1}\left(\frac{v}{\sqrt{u^2+v^2}}\right)$

Q.41 A boat moving at 5km/hr, crosses a 1km wide river in 15 min, taking the minimum distance route. The velocity of river water will be in km/hr.

(1) $\sqrt{41}$ (2) 1 (3) 4 (4) 3

Q.42 A frictionless wire AB fixed on a sphere of radius R. A very small spherical ball slips on this wire. The time taken by this ball to slip from A to B is –



(1) $\frac{2\sqrt{gR}}{g\cos\theta}$ (2) $2\sqrt{gR}\ \frac{\cos\theta}{g}$

(3) $2\sqrt{\frac{R}{g}}$ (4) $\frac{gR}{\sqrt{g\cos\theta}}$

Q.43 A train of length 200 m travelling at 30 m/sec overtakes another train of length 300 m travelling at 20 m/sec. The time taken by the first train to pass the second is –

(1) 30 sec (2) 10 sec (3) 50 sec (4) 40 sec

Q.44 A rocket is fired vertically upwards and moves with net vertical acceleration of 20 m/s^2. After 1 minute, the fuel is exhausted. The time taken by it to reach the highest point after the fuel is exhausted will be nearly

(1) 4 min. (2) 2 min. (3) 1 min. (4) 0.5 min.

Q.45 Two points move in the same straight line starting at the same moment from the same point in it. The first moves with constant velocity u and the second with constant acceleration f. During the time that elapses before the second catches the first the greatest distance between the particles, is –

(1) $\frac{u}{f}$ (2) $\frac{u^2}{2f}$ (3) $\frac{f}{2u^2}$ (4) $\frac{f}{u^2}$

Q.46 A jeep has to reach one peak at 89.6 m high to another 70 m high. The horizontal distance of separation is 20 m. The minimum velocity with which it has to jump is –

(1) 5 ms^{-1} (2) 10 ms^{-1}

(3) 15 ms^{-1} (4) 20 ms^{-1}

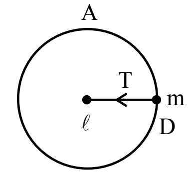
Q.47 A stone is dropped from a height h. Simultaneously, another stone is thrown up from the ground which reaches a height 4h. The two stones cross each other after time–

(1) $\sqrt{\frac{h}{8g}}$ (2) $\sqrt{8gh}$ (3) $\sqrt{2gh}$ (4) $\sqrt{\frac{h}{2g}}$

Q.48 From the top of a tower at height h, a particle is projected horizontally with velocity u and another particle is thrown down with same velocity u. If the time taken by these be t_1 and t_2 then –

(1) $t_1 > t_2$ (2) $t_1 < t_2$ (3) $t_1 = t_2$ (4) $t_1 = 2t_2$

Q.49 A particle of mass m, attached with a string of length ℓ is moving in a vertical circle. If the particle is just looping the loop without slackening of the string and v_A, v_B, v_D are speeds at positions A, B, D shown in figure then-



(1) $v_B > v_D > v_A$

(2) tension in the string at D is 3 mg

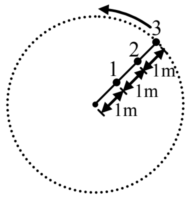
(3) $v_D = \sqrt{3g\ell}$

(4) all of the above

Q.50 For two projection angles θ_1 and θ_2, the range of a projectile is the same and time of flights are t_1 and t_2. If the range is r, then the product t_1t_2 is proportional to –

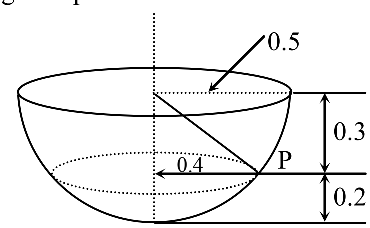
(1) r (2) r^2 (3) $\frac{1}{r}$ (4) $\frac{1}{r^2}$

Q.51 A boy revolves three balls each of mass 100 g and tied with strings of 1 meter length each as shown. If the speed of the outermost ball is 6 m/s. If the boy, goes on increasing the speed of revolution, then which of the strings would break first –



(1) Inner – most (2) Outer most
(3) Middle (4) All at same time

Q.52 A particle P will be in equilibrium inside a hemispherical bowl of radius 0.5m at a height 0.2m from the bottom when the bowl is rotated at an angular speed –



(1) $10/\sqrt{3}$ rad /s (2) $10\sqrt{3}$ rad /s
(3) 10 rad /s (4) $\sqrt{20}$ rad /s

Q.53 A motor car is moving along a circular path of radius 500 m with a speed of 30 m/s. If its speed is increasing at the rate of $2 m/s^2$, then its resultant acceleration would be –
(1) $2 m/s^2$ (2) $2.5 m/s^2$
(3) $2.7 m/s^2$ (4) $4 m/s^2$

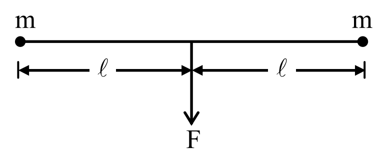
Q.54 The minimum radius of a circular path on which a cyclist can safely move with a speed of 7 m/s, is (static coefficient of friction between cycle tyre and road is 0.25) –
(1) 10 m (2) 20 m (3) 25 m (4) 30 m

Q.55 A particle is moving along a circular path of radius 3 meter in such a way that the distance travelled measured along the circumference given by $S = \frac{t^2}{2} + \frac{t^3}{3}$. The acceleration of particle when t = 2 sec. is –
(1) $1.3 m/s^2$ (2) $13 m/s^2$
(3) $3 m/s^2$ (4) $10 m/s^2$

Q.56 A sphere is suspended by a thread of length ℓ. The minimum horizontal velocity which has to be imparted to the sphere for it to reach the height of suspension is –
(1) $\sqrt{g\ell}$ (2) $\sqrt{2g\ell}$ (3) $2 g \ell$ (4) $g \ell$

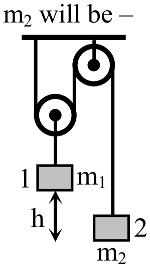
Q.57 A man of 60kg wt. is being lifted with a rope tied to a helicopter. If the helicopter is ascending with an acceleration of $4 m/sec^2$, the tension in the string will be –
(1) 828 N (2) 588N (3) 348N (4) Zero

Q.58 Two particles each of mass m are connected by a light string of length 2ℓ. A constant force F is applied continuously at the middle point and perpendicular to the initial position of the string. When the distance between the particles is 2x, then the acceleration along the line joining the particles will be –



(1) $\frac{F}{2m}\frac{x}{\ell}$ (2) $\frac{F}{2m}\frac{\ell}{x}$
(3) $\frac{F}{2m}\frac{\sqrt{\ell^2 - x^2}}{x}$ (4) $\frac{x}{(\ell^2 - x^2)^{1/2}}\frac{F}{2m}$

Q.59 In the arrangement shown in the figure the mass of body m_1 is four times the mass of the body m_2. Height h = 20cm. The masses of pulleys and thread and the friction in the system are assumed negligible. At any instant body m_2 is released so that the body m_1 moves downwards and the body m_2 moves upwards. The maximum height of the body m_2 will be –



(1) 0.25m (2) 0.33m (3) 0.45m (4) 0.60m

Q.60 A machine-gun of mass M fires n bullets per second. The mass of each bullet is m and speed is v. Force acting on the machine-gun is–
(1) zero (2) Mvn (3) mvn (4) mv/n

ANSWER KEY

1. (3)	**2.** (2)	**3.** (2)	**4.** (2)	**5.** (2)	**6.** (4)	**7.** (2)	**8.** (2)	**9.** (1)
10.(3)	**11.** (2)	**12.**(3)	**13.**(1)	**14.**(2)	**15.**(2)	**16.**(2)	**17.**(2)	**18.**(4)
19.(4)	**20.**(2)	**21.**(2)	**22.**(2)	**23.**(1)	**24.**(2)	**25.**(2)	**26.**(1)	**27.**(2)
28.(4)	**29.**(1)	**30.**(4)	**31.**(4)	**32.**(2)	**33.**(4)	**34.**(4)	**35.**(2)	**36.**(1)
37.(4)	**38.**(1)	**39.**(3)	**40.**(1)	**41.**(4)	**42.**(3)	**43.**(3)	**44.**(2)	**45.**(2)
46.(2)	**47.**(1)	**48.**(1)	**49.**(4)	**50.**(1)	**51.**(1)	**52.**(1)	**53.**(3)	**54.**(2)
55.(2)	**56.**(2)	**57.**(1)	**58.**(4)	**59.**(4)	**60.**(3)	**61.**(3)	**62.**(4)	**63.**(4)
64.(1)	**65.**(3)	**66.**(4)	**67.**(2)	**68.**(3)	**69.**(3)	**70.**(3)	**71.**(3)	**72.**(2)
73.(3)	**74.**(4)	**75.**(2)	**76.**(2)	**77.**(2)	**78.**(2)	**79.**(1)	**80.**(3)	**81.**(1)
82.(1)	**83.**(2)	**84.**(2)	**85.**(4)	**86.**(2)	**87.**(4)	**88.**(2)	**89.**(4)	**90.**(3)
91.(3)	**92.**(3)	**93.**(3)	**94.**(2)	**95.**(4)	**96.**(4)	**97.**(3)	**98.**(3)	**99.**(1)
100.(4)	**101.**(2)	**102.**(1)	**103.**(3)	**104.**(1)	**105.**(1)	**106.**(2)	**107.**(1)	**108.**(2)
109.(2)	**110.**(2)	**111.**(2)	**112.**(4)	**113.**(3)	**114.**(3)	**115.**(2)	**116.**(2)	**117.**(3)
118.(2)	**119.**(1)	**120.**(4)	**121.**(2)	**122.**(4)	**123.**(3)	**124.**(4)	**125.**(2)	**126.**(3)
127.(3)	**128.**(3)	**129.**(3)	**130.**(2)	**131.**(3)	**132.**(2)	**133.**(2)	**134.**(4)	**135.**(3)
136.(2)	**137.**(2)	**138.**(2)	**139.**(1)	**140.**(2)	**141.**(1)	**142.**(3)	**143.**(3)	**144.**(3)
145.(2)	**146.**(1)	**147.**(2)	**148.**(4)	**149.**(1)	**150.**(4)	**151.**(4)	**152.**(3)	**153.**(3)
154.(4)	**155.**(3)	**156.**(3)	**157.**(2)	**158.**(2)	**159.**(2)	**160.**(3)	**161.**(4)	**162.**(1)
163.(4)	**164.**(4)	**165.**(1)	**166.**(1)	**167.**(2)	**168.**(2)	**169.**(2)	**170.**(2)	**171.**(4)
172.(4)	**173.**(3)	**174.**(3)	**175.**(3)	**176.**(4)	**177.**(2)	**178.**(3)	**179.**(2)	**180.**(2)
181.(4)	**182.**(4)	**183.**(2)	**184.**(3)	**185.**(2)	**186.**(3)	**187.**(3)	**188.**(3)	**189.**(2)
190.(4)	**191.**(3)	**192.**(1)	**193.**(4)	**194.**(1)	**195.**(2)	**196.**(2)	**197.**(4)	**198.**(1)
199.(4)	**200.**(4)	**201.**(2)	**202.**(1)	**203.**(1)	**204.**(3)	**205.**(3)	**206.**(1)	**207.**(1)
208.(3)	**209.**(3)	**210.**(4)	**211.**(4)	**212.**(4)	**213.**(3)	**214.**(1)	**215.**(1)	**216.**(4)
217.(3)	**218.**(2)	**219.**(2)	**220.**(3)	**221.**(4)	**222.**(4)	**223.**(1)	**224.**(1)	**225.**(3)
226.(4)	**227.**(1)	**228.**(3)	**229.**(1)	**230.**(4)	**231.**(1)	**232.**(2)	**233.**(1)	**234.**(2)

235.(1)	**236.**(4)	**237.**(1)	**238.**(1)	**239.**(2)	**240.**(3)	**241.**(3)	**242.**(3)	**243.**(2)
244.(3)	**245.**(1)	**246.**(2)	**247.**(1)	**248.**(4)	**249.**(1)	**250.**(2)	**251.**(1)	**252.**(2)
253.(3)	**254.**(1)	**255.**(4)	**256.**(4)	**257.**(1)	**258.**(3)	**259.**(1)	**260.**(3)	**261.**(2)
262.(2)	**263.**(2)	**264.**(4)	**265.**(4)	**266.**(2)	**267.**(2)	**268.**(2)	**269.**(1)	**270.**(1)
271.(2)	**272.**(2)	**273.**(4)	**274.**(1)	**275.**(4)	**276.**(4)	**277.**(3)	**278.**(1)	**279.**(2)
280.(4)	**281.**(4)	**282.**(2)	**283.**(3)	**284.**(2)	**285.**(3)	**286.**(3)	**287.**(1)	**288.**(1)

HINTS & SOLUTIONS

UNIT 1

Topic : Unit, Dimension & Error, Vector, Motion in One Dimension, Projectile Motion, Circular motion, Laws of motion.

1.[3] $\sigma = kE^a V^b T^c$

$[M^1 L^0 T^{-2}] = (ML^2T^{-2})^a (LT^{-1})^b T^c$

$= M^a L^{2a+b} T^{-2a-b+c}$

$\therefore$ a =1; 2a + b = 0, b = – 2a = – 2 ;

– 2a – b + c = – 2

or c = 2a + b – 2 = 2 – 2 – 2 = – 2

$\therefore$ $\sigma = E^1 V^{-2} T^{-2}$ (if k = 1)

2.[2] $T = 2\pi\sqrt{\frac{\ell}{g}}$

$\therefore \frac{\Delta T}{T}\times 100 = \frac{1}{2}\left(\frac{\Delta \ell}{\ell}+\frac{\Delta g}{g}\right)\times 100$

$= \frac{1}{2}(2\% + 4\%) = 3\%$

3.[2] (5.0 ± 0.7) ohm

4.[2] $V = at + \frac{b}{t+c}$

Here $\frac{b}{t+c}$

Dimension = Dimension of velocity = LT^{-1}

Also C's dimension = T

$\therefore \frac{b}{t} = LT^{-1}$

$\Rightarrow$ b = L i.e. $M^0 L^1 T^0$

5.[2] $\because$ $P = \frac{a^3b^2}{\sqrt{cd}}$

$\Rightarrow \therefore \frac{\Delta P}{P} = \frac{3\Delta a}{a} + \frac{2\Delta b}{b} + \frac{1}{2}\frac{\Delta c}{c} + \frac{\Delta d}{d}$

$\therefore \frac{\Delta P}{P}\times 100 = 3\times 1 + 2\times 3 + \frac{1}{2}\times 4 + 1\times 2 = 13\ \%$

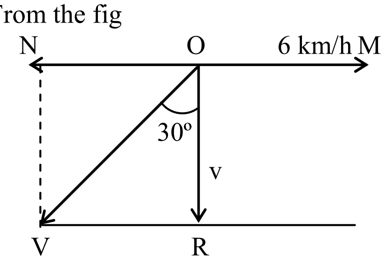
6.[4] Resultant force (F_r)

$(F_1 - F_2) < F_r < (F_1 + F_2)$

7.[2] $\because$ Relative velocity of rain

= velocity of rain – velocity of person

From the fig



$\tan 30° = \frac{VR}{OR} = \frac{ON}{OR}$,

$\Rightarrow \therefore \frac{1}{\sqrt{3}} = \frac{6}{OR}$

$\Rightarrow$ $OR = 6\sqrt{3}$

$\therefore$ $V_{OR} = 6\sqrt{3}$ km/h

8.[2] The velocity of the bird relative to earth is $\vec{v} = v\hat{j} = 40\hat{j}$ and the velocity of the train relative to earth is $\vec{u} = u\hat{i} = 40\hat{i}$

$\therefore$ Velocity of bird relative to train

$\vec{v}' = \vec{v} - \vec{u} = 40\hat{j} - 40\hat{i} = 40(\hat{j} - \hat{i})$

$\therefore |\vec{v}'| = \sqrt{40^2 + 40^2} = 40\sqrt{2}$ km/hour

If the θ is angle between $\vec{v}'$ and $\vec{u}$, then

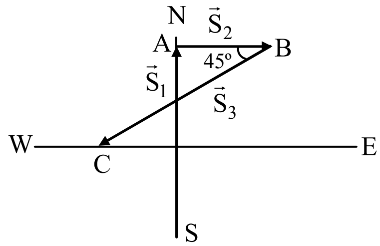
$\cos\theta = \frac{\vec{v}'.\vec{u}}{|\vec{v}'||\vec{u}|} = \frac{40(\hat{j}-\hat{i}).(40\hat{i})}{(40\sqrt{2})(40)} = -\frac{1}{\sqrt{2}}$,

$\therefore$ θ = 135º or north-west direction.

9.[1] $\vec{S}_1 = 30\hat{j}$, $\vec{S}_2 = 20\hat{i}$,

$\vec{S}_3 = -30\sqrt{2}\ (\hat{i}\cos 45^o + \hat{j}\sin 45^o)$

$= -30\sqrt{2}\left(\hat{i}\frac{1}{\sqrt{2}} + \hat{j}\frac{1}{\sqrt{2}}\right) = -30(\hat{i}+\hat{j})$,



$\therefore$ Displacement $\vec{S} = \vec{S}_1 + \vec{S}_2 + \vec{S}_3$

$= 30\hat{j} + 20\hat{i} - 30\hat{i} - 30\hat{j}$

$= -10\hat{i}$ = 10 m towards west.

10.[3] Time taken by first drop to reach the ground

$$t = \sqrt{\frac{2s}{g}} = \sqrt{\frac{2\times 9}{10}} = \sqrt{1.8} = 1.36 \text{ s}$$

Time interval between successive drops

= 1.36 / 3 sec

From, $s = ut + \frac{1}{2}at^2$

Distance of 2nd drop

$$s_2 = 0 + \frac{1}{2} \times 10\left(\frac{2}{3} \times 1.36\right)^2 = 4 \text{ m}$$

Distance of 3rd drop

$$s_3 = 0 + \frac{1}{2} \times 10\left(\frac{1}{3} \times 1.36\right)^2 = 1\text{m.}$$

11.[2] Let the cyclist overtake the bus after time t.

Then $20 \times t = 96 + \frac{1}{2} \times 2 \times t^2$

or $t^2 - 20t + 96 = 0$

or $(t - 12)(t - 8) = 0$

or t = 8 sec. and 12 sec.

Thus the cyclist will overtake after 8 second.

12.[3] When particle is moving with uniform acceleration, let v be the velocity of particle at a distance s, then average velocity

$$= \frac{0+v}{2} = v/2$$

time taken, $t_1 = \frac{2}{(v/2)} = \frac{2s}{v}$

When particle moves with uniform velocity,

time taken, $t_2 = \frac{2s}{v}$

When particle moves with uniform retardation,

time taken, $t_3 = \frac{3s}{(0+v)/2} = \frac{6s}{v}$

Total time $= t_1 + t_2 + t_3$

$$= \frac{2s}{v} + \frac{2s}{v} + \frac{6s}{v} = \frac{10s}{v}$$

$\therefore$ $v_{av} = \frac{s + 2s + 3s}{10s/v} = \frac{6v}{10}$

or $\frac{v_{av}}{v} = \frac{6}{10} = \frac{3}{5}$

13.[1] Check by dimensions

14.[2] $v_1 = \frac{at_1}{2}$, $v_2 = at_1 + \frac{at_2}{2}$,

$v_3 = a(t_1 + t_2) + \frac{at_3}{2}$. Solving

$$\frac{v_1 - v_2}{v_2 - v_3} = \frac{t_1 + t_2}{t_2 + t_3}$$

15.[2] For the first drop

$$S_1 = \frac{1}{2}gt_1^2 = 16$$

$\therefore$ $t_1 = \sqrt{\frac{32}{g}} = 4\sqrt{\frac{2}{g}}$

since the drops are falling at equal intervals

$\therefore$ $t_2 = 3\sqrt{\frac{2}{g}}$, $t_3 = 2\sqrt{\frac{2}{g}}$, $t_4 = \sqrt{\frac{2}{g}}$

$\therefore$ $S_2 = \frac{1}{2}gt_2^2 = \frac{1}{2}g \times 9 \times \frac{2}{g} = 9\text{m}$

$$S_3 = \frac{1}{2}gt_3^2 = \frac{1}{2}g \times 4 \times \frac{2}{g} = 4\text{m}$$

$$S_4 = \frac{1}{2}gt_4^2 = \frac{1}{2}g \times \frac{2}{g} = 1\text{m}$$

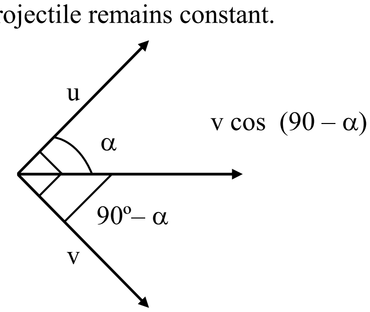
$\therefore$ $(S_1 - S_2) = 16 - 9 = 7\text{m}$

$\therefore$ $(S_2 - S_3) = 9 - 4 = 5\text{m}$

$\therefore$ $(S_3 - S_4) = (4 - 1) = 3\text{m}$

$\therefore$ $(S_4 - S_5) = 1 - 0 = 1\text{m}$

16.[2] The horizontal component of velocity of the projectile remains constant.



$\therefore$ $v\cos(90 - \alpha) = u\cos\alpha$

$\therefore$ $v\sin\alpha = u\cos\alpha \Rightarrow v = u\cot\alpha$

17.[2] $\because$ time taken by particle 1 to reach point H is given by

$$t = \frac{v \sin 60}{g} = \frac{\sqrt{3}v}{2g}$$

Time taken by particle 2 to reach H is given by

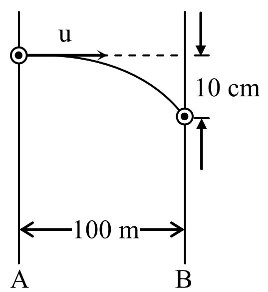
$$t' = \frac{u}{g}$$

Now $\quad t = t'$

$$\therefore \quad \frac{\sqrt{3}v}{2g} = \frac{u}{g}$$

$$\Rightarrow \quad \frac{v}{u} = \frac{2}{\sqrt{3}}$$

18.[4] See fig.



Here $\quad 100 = ut$ or $t = \frac{100}{u}$

Also $\left(\frac{10}{100}\right) = \frac{1}{2} \times (9.8) \times \left(\frac{100}{u}\right)^2$

Solving we get u = 700 m/s

19.[4] When wheel rolls through half revolution, the horizontal displacement = πR and vertical displacement = 2R.

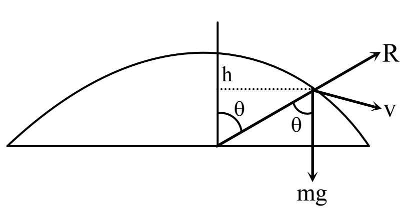
Resultant displacement

$$= \sqrt{(\pi R)^2 + (2R)^2}$$

$$= R\sqrt{\pi^2 + 4}$$

20.[2] $\quad mg \cos \theta - R = \frac{mv^2}{r}$

contact loss when R = 0



$$mgh = \frac{1}{2}mv^2$$

$$\frac{v^2}{r} = g \cos \theta \ ; \ v^2 = 2gh$$

$$\Rightarrow \quad \frac{2gh}{r} = g \times \frac{r-h}{r} \Rightarrow h = \frac{r}{3}$$

$$\left(\because \ \cos \theta = \frac{r-h}{r}\right)$$

21.[2] Minimum speed at B = $\sqrt{g\ell}$

$$2\ell = \frac{1}{2} g t^2 \Rightarrow t = \sqrt{\frac{4\ell}{g}}$$

$$\therefore \quad x = AC = \sqrt{g\ell} \times \sqrt{\frac{4\ell}{g}} = 2\ell$$

22.[2] When the turn table rotates with angular speed ω, the particle of mass m describes a circle of radius r. The centrifugal force experienced is

$m r\omega^2 = (9 \times 10^{-2})\,(10^{-1})\,(10^2)^2 = 9 \times 10$N

As a result of this force, the spring is compressed by a distance x.

The restoring force of the spring

$$= kx = 10^4\,x$$

In equilibrium, $9 \times 10 = 10^4\,x$

or $\quad x = 10^{-2}$ m

23.[1] Consider a small element $d\ell$ at a distance ℓ from the axis. The mass of this element is given by

$$m = \frac{Md\ell}{L}$$

centrifugal force on this element = $m\omega^2\ell$

$$= \left(\frac{Md\ell}{L}\right)\omega^2\ell$$

$$\therefore \quad \text{Total force} = \frac{M}{L}\,\omega^2 \int_0^L \ell\, d\ell$$

$$= \frac{M}{L}\,\omega^2 \left(\frac{L^2}{2}\right) = \frac{ML\omega^2}{2}$$

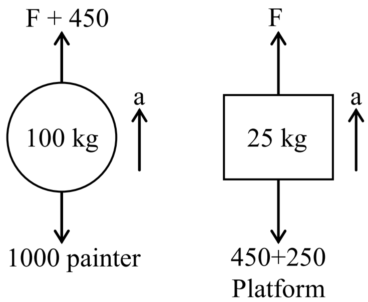
24.[2] $\quad a_C = \frac{v^2}{r} = k^2 r t^2$

or $\quad v^2 = k^2 r^2 t^2$

$$\therefore \quad E = \frac{1}{2}mv^2 = \frac{mk^2r^2t^2}{2}$$

$$\therefore \quad P = \frac{dE}{dt} = m\,k^2 r^2 t$$

25.[2] Let the acceleration be a and mass of the painter $= \frac{1000}{10} = 100$kg. If the pull applied to the rope by the painter is F, then the rope will also apply same amount of force. From Newton's law



$F + 450 - 1000 = 100a$

or $\quad F - 550 = 100a \quad$ ....(1)

Mass of platform

$$= \frac{250}{10} = 25\text{kg}$$

$\therefore F - 450 - 250 = 25a$

or $\quad F - 700 = 25a \quad$ ...(2)

From equations (1) and (2)

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

26.[1] As the lift is moving up with an acceleration a_0, the resultant acceleration in the frame of reference of lift will be $(g + a_0)$ vertically downwards. The component of acceleration along the plane $f = (g + a_0)\sin\theta$

Length of the inclined plane $s = \frac{\ell}{\cos\theta}$

$\therefore$ Time taken in coming down

$$t = \left(\frac{2s}{f}\right)^{1/2} = \left[\frac{2\ell/\cos\theta}{(g+a_0)\sin\theta}\right]^{1/2}$$

$$= \left[\frac{2\ell}{(g+a_0)\sin\theta\cos\theta}\right]^{1/2}$$

27.[2] If the tension in the string is T then T = W For the equilibrium of weight suspended from P_1

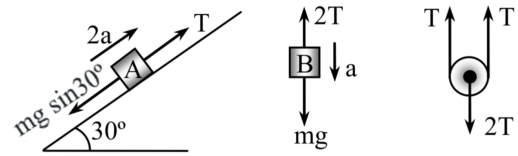
$2T\cos(90° - \theta) = W$

or $\quad 2W\sin\theta = W$

$$\sin\theta = \frac{1}{2}$$

$\therefore \quad \theta = 30°$

28.[4]



$T - mg\sin 30° = m(2a)$

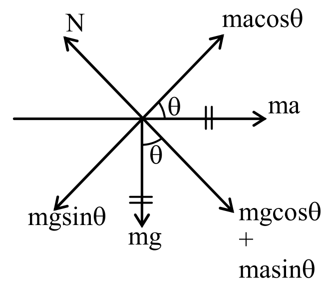
or $\quad T - \frac{mg}{2} = 2ma \quad$ ...(1)

and $\quad mg - 2T = ma \quad$ ...(2)

Solving equation (1) and (2) we get

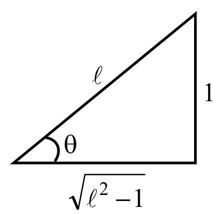
$$a = 0$$

29.[1]



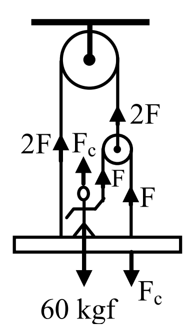
$$mg\sin\theta = ma\cos\theta$$

$$a = g\tan\theta$$



$$a = \frac{g}{\sqrt{\ell^2 - 1}}$$

30.[4] Let the required force is F and contact force is F_c Equation of equilibrium of force



For the man

$$F + F_c = 60\text{ kgf}$$

For the plank

$$3F = F_c$$

$\therefore \quad 4F = 60$ kgf

or $\quad F = 15$ kgf

31.[4] For given expression to be correct it is necessary that dimensions of at^{-1} & bt^2 should be dimension that of force.

$\therefore \quad [at^{-1}] = [F] = MLT^{-2}$

$aT^{-1} = MLT^{-2}$

$\therefore \quad a = MLT^{-1}$ similarly $b = MLT^{-4}$

32.[2]

33.[4]

34.[4] $n \propto 1/u$

35.[2] RC = T.

36.[1] The velocity of P with respect to Q is

$V_{PQ} = V_P - V_Q$

$\therefore \quad V_P = 4\hat{i}$

$V_Q = -3\hat{j}$

$\therefore \quad |V_{PQ}| = \sqrt{16+9} = 5$ m/s.

Let the resultant makes an angle α with the direction of P.

Where $\tan\alpha = \frac{RP}{OP} = \frac{3}{4}$ (E – N) direction.

$\tan\alpha = \frac{RP}{OP} = \frac{3}{4}$ (E – N)

37.[4] $(1 + \sqrt{2})R$

38.[1] $3\hat{k}$

39.[3] $[P^2 + Q^2 + 2(P+Q)(P-Q)\cos\theta] = 3P^2 + Q^2$

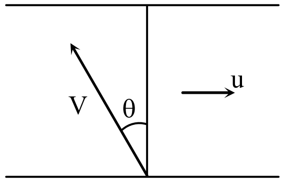
or $P^2 + Q^2 + 2PQ + P^2Q^2 + 2(P^2 - Q^2)\cos\theta = 3P^2 + Q^2$

or $2(P^2 - Q^2)\cos\theta = P^2 - Q^2$

$\therefore \quad \cos\theta = \frac{1}{2}$ or $\theta = \frac{\pi}{3}$

40.[2] $\because \quad \sin\theta = \frac{u}{v}$,

$\theta = \sin^{-1}\frac{u}{v}$



41.[4] $t = \frac{d}{\sqrt{v^2 - u^2}}$

$\Rightarrow \quad \frac{1}{4} = \frac{1}{\sqrt{5^2 - u^2}}$

$\Rightarrow \quad u = 3$ km / hr

42.[3] Acceleration of the body down the plane

$= g\cos\theta$

Distance travelled by ball in time t second

$= AB = \frac{1}{2}(g\cos\theta)t^2$

From ΔABC, AB = 2 R cos θ ;

So, $2R\cos\theta = \frac{1}{2}g\cos\theta\, t^2$

or $t^2 = \frac{4R}{g}$

or $t = 2\sqrt{\frac{R}{g}}$

43.[3] Total distance travelled

= 300 + 200 = 500 m

Relative velocity = 30 – 20 = 10 m/s.

Time taken $= \frac{500}{10} = 50$ s.

44.[2] Velocity when fuel is exhausted,

$v = u + at = 0 + 20 \times 60 = 1200$ m/s

Now, $a = -g = -10\ m/s^2$

Again, from $v = u + at$

$0 = 1200 - 10t$

$t = \frac{1200}{10} = 120$ sec = 2 min.

45.[2] Let x be the distance between the points after t sec. Now,

$x = ut - \frac{1}{2}ft^2$

Further $x = u\left[t - \frac{u}{f}\right] - \frac{1}{2}f\left[t - \frac{u}{f}\right]$

x is greatest, when $t - \frac{u}{f} = 0$

or $t = \frac{u}{f}$

Now, from eq.(1)

$x_{max} = u\left(\frac{u}{f}\right) - \frac{1}{2}f\left(\frac{u}{f}\right)^2 = \left(\frac{u}{f}\right)^2$

46.[2] $h = \frac{1}{2}gt^2$

$\therefore \quad 19.6 = \frac{1}{2} \times 9.8 \times t^2$

$\therefore \quad t = 2s,$

Horizontal velocity

$= \frac{20}{2} = 10 ms^{-1}$

47.[1] Let the two stones cross each other at height x from the ground level

$v^2 = u^2 - 2gs$

$\Rightarrow \quad 0 = u^2 - 2g\,(4h)$

$\therefore \quad u = \sqrt{8gh}, \quad x = \sqrt{8gh}\ t - \frac{1}{2}gt^2$

$(h - x) = \frac{1}{2}gt^2$

$\therefore \quad h = \sqrt{8gh}\ t$

$\therefore \quad t = \sqrt{\frac{h}{8g}}$

48.[1] Displacement in vertical direction are same for both the particles. But initial velocity in downward direction is different.
Velocity of particle 1 in downward direction is zero but velocity of particle 2 in downward direction is u so particle 2 will take less time so $t_2 < t_1$

49.[4]

50.[1] r
(Hint : if $\theta_1 = \theta$, then $\theta_2 = 90 - \theta$)

51.[1] Suppose the mass of each ball is m and angular velocity is ω, the tensions of the strings tied to the balls 1, 2, 3 are T_1, T_2, T_3 respectively. If the distances of the balls 1, 2, 3 from the centre are r_1, r_2, r_3 then $T_3 = m\, r_3\, \omega^2$, $T_2 - T_3 = m\, r_2\, \omega^2$, $T_1 - T_2 = m\, r_1\, \omega^2$. Let speed of the outermost ball is 6m/s.

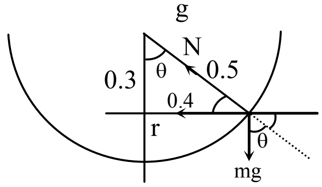
$T_1 = 2.4$ N, $T_2 = 2.0$ N, $T_3 = 1.2$ N.

The inner - most string will break first.

52.[1] $N \sin\theta = m\omega^2 r$

$N \cos\theta = mg$

$\tan\theta = \frac{\omega^2 r}{g}$



$\omega = \sqrt{\frac{g\tan\theta}{r}} = \sqrt{\frac{10 \times \frac{4}{3}}{0.4}}$

$\omega = \frac{10}{\sqrt{3}}$

53.[3] Radial acceleration a_R and tangential acceleration a_T are mutually perpendicular in a circular motion. Therefore, their resultant acceleration is

$a = \sqrt{a_R^2 + a_T^2} = \left[\left(\frac{v^2}{r}\right)^2 + a_T^2\right]^{1/2}$

$= \sqrt{\left(\frac{30 \times 30}{500}\right)^2 + 2^2}$

$= \sqrt{(1.8)^2 + 2^2} = 2.7\ m/s^2$

54.[2] The necessary centripetal force is provided by maximum frictional force.

$\mu mg = \frac{mv^2}{r}$

$\therefore \quad r = \frac{v^2}{\mu g} = \frac{7 \times 7}{0.25 \times 9.8} = 20m.$

55.[2] $S = \frac{t^2}{2} + \frac{t^3}{3}$

diff. w.r.t. t,

so we get. $\frac{ds}{dt} = v = \frac{2t}{2} + \frac{3t^2}{3} = t + t^2$

$= 2 + 2^2 = 6$

Linear acceleration :-

$\Rightarrow \quad \frac{dv}{dt} = a = 1 + 2t = 5$

Angular acceleration :-

$\frac{V^2}{r} = \frac{36}{3} = 12$

so Net acceleration

$= \sqrt{(12)^2 + 5^2} = 13$

56.[2] To reach the height of suspension, $h = \ell$

$v = \sqrt{2gh} = \sqrt{2g\ell}$.

57.[1] $m_0 = 60kg$

$a = 4m/s^2$

$T = m_0\,(a + g)$

$= 60 \times (4 + 9.8)$

$T = 828$ N