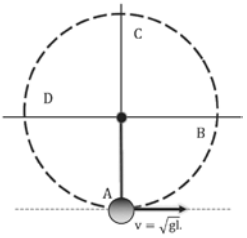
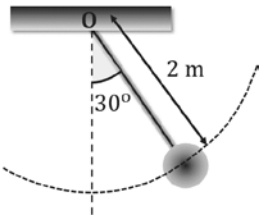
Pendulum

Q.1 The bob of the pendulum shown in figure is projected with a velocity $v = \sqrt{gl}$which of the following statement is correct?



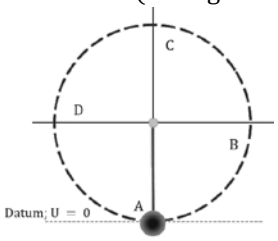
(A) The pendulum completes the circular path and returns to point
(B) The pendulum oscillates between B and D, always reaching to the B and D
(C) The pendulum oscillates between B and D but never reaches B or D
(D) The pendulum crosses point B and travels in parabolic path onwards

Q.2 The bob of the pendulum shown in figure describe an arc of a circle in a vertical plane. If the tension in the cord is 3 times of the weight of the bob for the position shown, the velocity of the bob at this position is.



(A)6.47 m/s **(B)**10 m/s **(C)**0 m/s **(D)**15 m/s

Q.3 A kg stone at the end of a 1 m long string is whirled in a vertical circle at a constant speed of 4 m/s. the tension in the string 6 N when the stone is (Take $g = 10\ m/s^2$)

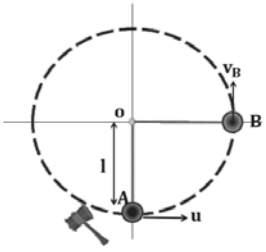


(A) At the top of the circle **(B)**At the bottom of the circle
(C) Halfway down **(D)**None of the above

Q.4 A stone of mass 1 kg tied to s light string of length $\frac{10}{3}$mis whirled in a vertical circle. If the ratio of the maximum tension to minimum tension is 4 and $g = 10\ m/s^2$then the speed of the stone at the highest point of the circle is.

(A)0 m/s **(B)**20 m/s **(C)**10 m/s **(D)**5 m/s

Q.5 The bob of a pendulum at rest is given a sharp hit to impart a horizontal velocity $u = \sqrt{10gl}$ where l is the length of the pendulum. Find the velocity of the bob when the string is horizontal.



(A) $\sqrt{2gl}$ **(B)** $\sqrt{4gl}$ **(C)** $\sqrt{6gl}$ **(D)** $\sqrt{8gl}$

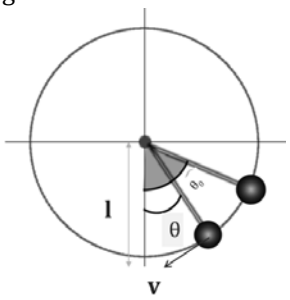
Q.6 The bob of a stationary pendulum is given a sharp hit to impart it a horizontal speed of $\sqrt{3gl}$Find the angle rotated by the string before it becomes slack.

(A) $\cos^{-1}(\frac{1}{3})$ **(B)** $\cos^{-1}(\frac{-1}{3})$ **(C)** $\cos^{-1}(\frac{2}{3})$ **(D)** $\cos^{-1}(\frac{-2}{3})$

Q.7 A particle is suspended from a fixed point by a string of length 3 m it is projected from equilibrium position with such a velocity that the string slackens after the particle has reached a height 5 m above the lowest point. Find the velocity of particle, just before the string slackens. Take g = 9.81 m/s²

(A) 10 m/s **(B)** 4.42 m/s **(C)** 0 m/s **(D)** 2 m/s

Q.8 A 40 kg mass at the end of a rope of length l oscillates in a vertical plane with angular amplitude θ_0What is the tension T in the rope when it makes an angle θwith the vertical? It the breaking strength of the rope is 80 kg f what the maximum angular amplitude isθ_{max} with which the mass can oscillate without the rope breaking?



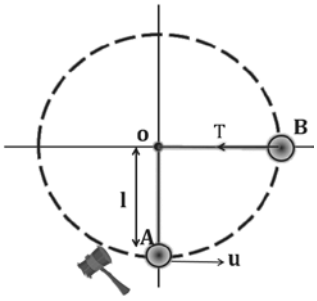
(A) $T = mg(2\cos\theta - 3\cos\theta_o), \theta_{max} = 60°$ **(B)** $T = mg(3\cos\theta - 2\cos\theta_o), \theta_{max} = 60°$

(C) $T = mg(2\cos\theta - 3\cos\theta_o), \theta_{max} = 60°$ **(D)** $T = mg(3\cos\theta - 2\cos\theta_o), \theta_{max} = 30°$

Q.9 A small stone of mass 200 g is tied to one end of a string of length 80 cm holding the other end in the hand, the stone is whirled in a vertical circle. What is the minimum speed that needs to be imparted at the lowest point such that the stone is just able to complete the vertical circle? (Take g = 10 m/s²)

(A) 4 m/s **(B)** 5.13 m/s **(C)** 6.32 m/s **(D)** 7 m/s

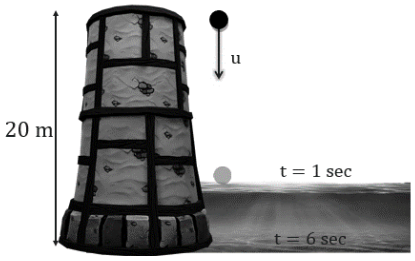
Q.10 The bob of a pendulum at rest is given a sharp hit to impart a horizontal velocity $u = \sqrt{10gl}$where l is the length of the pendulum. The tension in the string when it is horizontal is x = ___.



WORK SHEET

Throwing object

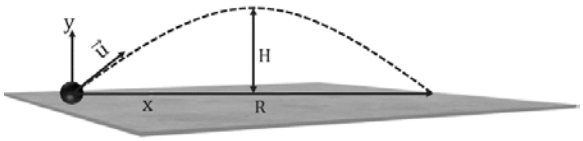
Q.11 A ball is thrown into a lake from a tower 20 m above the water surface. The ball hits the water after 1 sec with a velocity v and then sinks to the bottom of the lake. It comes to rest at the bottom of the lake 6 sec after it was thrown. Find the acceleration of the ball inside the lake and the depth of the lake.



(A) $5\ \text{m/s}^2, 62.5\ \text{m}$ **(B)** $-5\ \text{m/s}^2, 75\ \text{m}$ **(C)** $-5\ \text{m/s}^2, 62.5\ \text{m}$ **(D)** $5\ \text{m/s}^2\ 75\ \text{m}^{20\text{n}}$

Projectile Motion

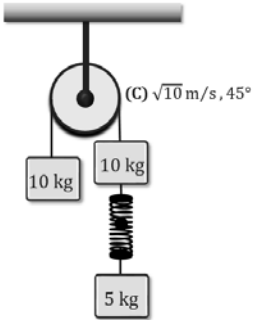
Q.12 The trajectory of a projectile is given by the equation $y = x - x^2$. What is the value of the initial velocity and the angle of projection?



(A) $\sqrt{10}\ \text{m/s}, 30°$ **(B)** $10\ \text{m/s}, 45°$ **(C)** $\sqrt{10}\ \text{m/s}, 45°$ **(D)** $10\ \text{m/s}, 30°$

Acceleration

Q.13 A pulley system is connected as shown in the figure. If the spring is elongated by a distance of 0.02 m, then what is the force constant of the spring? (Assume that the spring does not affect the overall acceleration of the bodies.)



(A) 200 N/m **(B)** 8000 N/m **(C)** 2000 N/m **(D)** 800 N/m

Tension

Q.14 Three blocks of mass 10 kg, 5 kg and 8 kg are connected to each other with a light string and placed on a wedge with angle of inclination 30°. A force F applied on the string causes all the three blocks to move with a common acceleration of 2 m/s^2. If the coefficient of friction between the blocks and the surface of the wedge is 0.2, then what is the tension at the three points A, B and C.

(A) $\text{TA} = 200.8\ \text{N},\ T_B = 69.85\ \text{N},\ T_C = 113.51\ \text{N}$

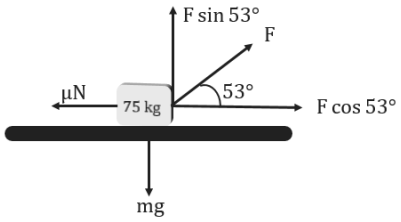
(B) $\text{TA} = 113.51\ \text{N},\ T_B = 69.85\ \text{N},\ T_C = 200.8\ \text{N}$

(C) $\text{TA} = 200.8\ \text{N},\ T_B = 113.51\ \text{N},\ T_C = 69.85\ \text{N}$

(D) $\text{TA} = 195\ \text{N},\ T_B = 60\ \text{N},\ T_C = 100\ \text{N}$

Force

Q.15 A force F is applied on a block of mass 75 kg at an angle of 53° with the horizontal. If the coefficient of friction between the floor and the block is 0.6, then what is the maximum value of force F that can be applied before the block starts moving?



(A)450 N **(B)**750 N **(C)**416.66 N **(D)**500 N

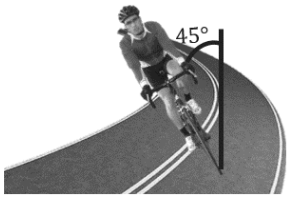
Acceleration

Q.16 A point moves along a circle of radius 4 m. The distance x is related to time by $x = ct^3$. What should be the value of c, so that the tangential acceleration is equal to the normal acceleration when its linear velocity is 4 m/s?

(A)0.288 m/s^3 **(B)**0.288 m/s^2 **(C)**0.333 m/s^2 **(D)**0.333 m/s^3

Angle of banking

Q.17 The maximum speed of a cyclist on a race track is $20\ m/s$ and he can bend to a maximum angle of 45°. The race track has a curve of radius $20\ m$.Is this race track safe for the racer? If not, what should be the angle of banking of the curve?

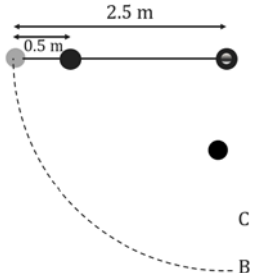


(A) The track is safe **(B)**The track is not safe, 19°

(C) The track is not safe, 10° **(D)**The track is not safe, 15°

Velocity

Q.18 The string of a pendulum is attached to a bob and is released from its initial rest position. A fixed peg is present in the path of motion of the pendulum. What are the velocities of the bob at positions B and C respectively? The distances are as shown in the figure.

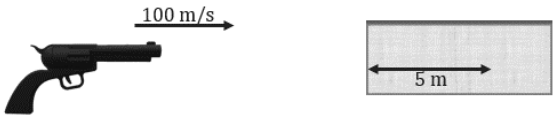


(A)3.6 m/s and7.07 m/s **(B)**7.07 m/s and 3.16 m/s

(C)5.34 m/sand10.78 m/s **(D)**7.07 m/s and 6.32 m/s

Deceleration

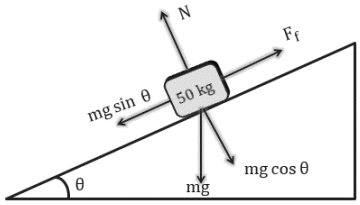
Q.19 A bullet of mass $50\ g$ is fired horizontally into a wooden block of mass $10\ kg$. The bullet penetrates the wooden block and moves through a distance of $5\ m$ before coming to a stop within the block. If the initial speed of the bullet is $100\ m/s$, then what is the deceleration of the bullet? (Assume retarding force is uniform)



(A) 250 m/s^2 **(B)** 100 m/s^2 **(C)** 500 m/s^2 **(D)** 1000 m/s^2

Work Done

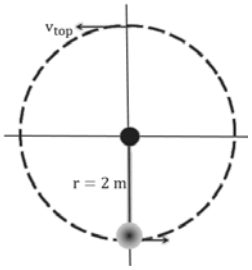
Q.20 A 50 kg block slides down an incline with an angle of incline 45°. The coefficient of friction between the block and the incline is 0.3. A worker applies a force on the block, so that it slides down the incline of length 2 m with a constant velocity. What is the work done by the worker on the block?



(A) 495.2 J **(B)** −495.2 J **(C)** −525.7 J **(D)** 525.7 J

Speed

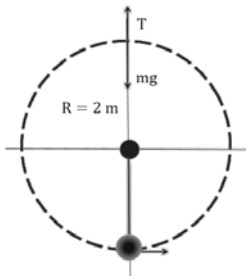
Q.21 A small stone of man 0.2 kg tied to a massless inextensible string is rotated in a vertical circle of radius of 2 m.If the particle is just able to complete a vertical circle, what is the speed at highest point of the circular path. Also calculate speed if mass of stone is increased by 50% (Takeg = 10 m/s^2)



(A) 4.47 m/s, 6.70 m/s **(B)** 4.47 m/s, 10.05 m/s
(C) 10.05 m/s, 4.47 m/s **(D)** 4.47 m/s, 4.47 m/s

Angular speed

Q.22 A 2 kg ball is swinging in a vertical circle at the end of an inextensible string 2 m long. The angular speed of the ball if the string can sustain a maximum tension of 119.6 N is (Take g = 9.8 m/s^2)

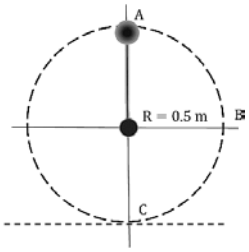


(A) $5\sqrt{2}$ rad/s **(B)** 5 rad/s **(C)** $2\sqrt{2}$ rad/s **(D)** 2 rad/s

Sol. **(B)** 5 rad/s

Velocity

Q.23 A stone weighing 1 kg is whirled in a vertical circle at the end of a rope of length 0.5 m. Stone completes the vertical circle with minimum possible speed. The velocity of the stone midway, when the string is horizontal is (Take g = 10 m/s^2)



(A) $\sqrt{20}$ m/s **(B)** 5 m/s **(C)** $\sqrt{15}$ m/s **(D)** 3 m/s

Circular Motion

Q.24 A particle is suspended from a fixed point by a string of length l.It is projected from the equilibrium position with a velocity $v = 2\sqrt{gl}$ as shown in the figure below, which of the following statements is true?

(A) The particle reaches point C and undergoes free fall along the diameter CA

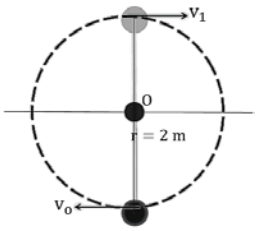
(B) The particle reaches a point between B and C where tension and velocity are both zero and free falls.

(C) The particle reaches a point between B and C, where tension is zero but velocity is not zero, and follows a parabolic path

(D) The particle never reaches point B and it oscillates between B and C

Kinetic Energy

Q.25 A stone of mass 1 kg is connected to a light inextensible string of length 2 m and the other end of the string is fixed. If the stone is moving in a vertical circular path, having ratio of maximum velocity to the minimum velocity as 3. The value of kinetic energy at the bottommost point on the vertical circle is [Takeg $= 10$ m/s^2]



(A) 90 J **(B)** 180 J **(C)** 45 J **(D)** 360 J

Pendulum

Q.26 In a simple pendulum, the breaking strength of the string is double the weight of the bob. The bob is released from rest when the string is horizontal. The string breaks when it makes an angle θ with the vertical. Then

(A) $\theta = \cos^{-1}\left(\frac{1}{3}\right)$ **(B)** $\theta = 60^\circ$ **(C)** $\theta = \cos^{-1}\left(\frac{2}{3}\right)$ **(D)** $\theta = 0^0$

Tension

Q.27 A particle of mass m just completes the vertical circular motion. What will be the difference in tension at the lowest and highest point?

(A) 2 mg **(B)** 4mg **(C)** 8 mg **(D)** 6 mg

Pendulum

Q.28 A metallic bob of mass 'm' attached to a string, is raised through a height of 50 cm and released. At what distance along the vertical from the point of suspension should a nail be placed so that the bob just completes a circle with the nail as the center?

(A) 0.2 m **(B)** 2 m **(C)** 1 m **(D)** 1.8 m

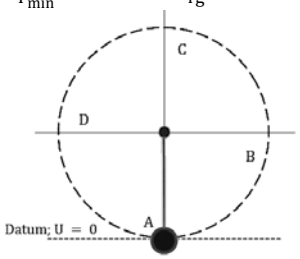
Tension

Q.29 A particle tied to a string describes a vertical circular motion of radius R continuously. If it has velocity $\sqrt{3gR}$ at the highest point, then the ratio of respective tensions in the string at the highest and lowest point is

(A) 4:3 **(B)** 5:4 **(C)** 1:4 **(D)** 3:2

Circular Motion

Q.30 An object is tied to a string and rotated in a vertical circle of radius r. Constant speed (v) is maintained along the trajectory. If $\frac{T_{max}}{T_{min}} = 2$, then $\frac{v^2}{rg} =$



ANSWER KEY

Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(C)	(A)	(A)	(C)	(D)	(B)	(B)	(B)	(C)	8.8.0.8.00
WORK SHEET										
Q.	11	12	13	14	15	16	17	18	19	20
Sol.	(C)	(C)	(C)	(C)	(C)	(D)	(B)	(D)	(D)	(B)
Q.	21	22	23	24	25	26	27	28	29	30
Sol.	(D)	(B)	(C)	(C)	(C)	(C)	(D)	(D)	(C)	3,3.0,3.00