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## Maninagar Campus

| Grade : XI | Subject : Physics Worksheet | Chapters : 1,2,3,4,5,6,7,8 |
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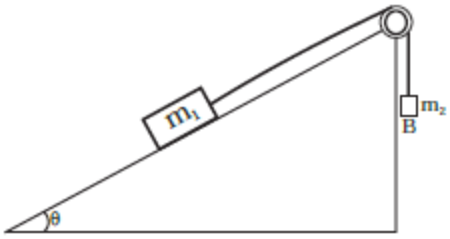
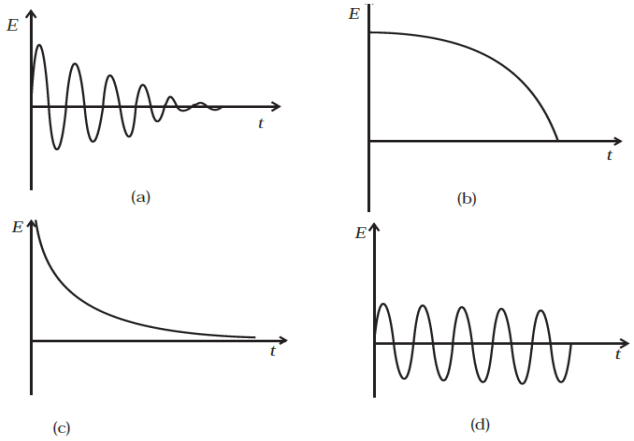
| Date : 28/08/2019 | Empower – 1 | |

### SECTION – A

1. A cricket ball of mass 150 g has an initial velocity **u** = (3 **i** +4 **j**) m/s and a final velocity **v** = - (3 **i** +4 **j**) after being hit. The change in momentum (final momentum-initial momentum) is (in kg m s1)
   (a) zero (b) – (0.45 **i** + 0.6 **j**) (c) – (0.9 **i** + 1.2 **j**) (d) –5 (**i** + **j**) .
2. Conservation of momentum in a collision between particles can be understood from
   (a) conservation of energy.
   (b) Newton's first law only.
   (c) Newton's second law only.
   (d) both Newton's second and third law.
3. A hockey player is moving northward and suddenly turns westward with the same speed to avoid an opponent. The force that acts on the player is
   (a) frictional force along westward.
   (b) muscle force along southward.
   (c) frictional force along south-west.
   (d) muscle force along south-west.
4. A body of mass 2 kg travels according to the law $x(t) = pt + qt^2 + rt^3$ where p = 3 m/s, q = 4m /$s^2$ and r = 5 m/$s^3$ . The force acting on the body at t = 2 seconds is
   (a) 136 N
   (b) 134 N
   (c) 158 N
   (d) 68 N
5. Mass m1 moves on a slope making an angle θ with the horizontal and is attached to mass m2 by a string passing over a frictionless pulley as shown in Fig. The co-efficient of friction between m1 and the sloping surface is μ. Which of the following statements are true?
   (a) If m2 > m1 sinθ , the body will move up the plane.
   (b) If m2 >m1 (sinθ + μ cosθ) , the body will move up the plane.
   (c) If m2 <m1 (sinθ + μ cosθ) , the body will move up the plane.
   (d) If m2 < m1 (sinθ − μ cosθ) , the body will move down the plane.



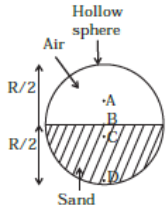

6. Which of the diagrams shown in Fig.represents variation of total mechanical energy of a pendulum oscillating in air as function of time?



**7.** A cricket ball of mass 150 g moving with a speed of 126 km/h hits at the middle of the bat, held firmly at its position by the batsman. The ball moves straight back to the bowler after hitting the bat. Assuming that collision between ball and bat is completely elastic and the two remain in contact for 0.001s, the force that the batsman had to apply to hold the bat firmly at its place would be
(a) 10.5 N
(b) 21 N
(c) $1.05 \times 10^4$ N
(d) $2.1 \times 10^4$ N

**8.** For which of the following does the centre of mass lie outside the body ?
(a) A pencil
(b) A shotput
(c) A dice
(d) A bangle

**9.** Which of the following points is the likely position of the centre of mass of the system shown in Fig.?
(a) A
(b) B
(c) C
(d) D




**10.** Different points in earth are at slightly different distances from the sun and hence experience different forces due to gravitation. For a rigid body, we know that if various forces act at various points in it, the resultant motion is as if a net force acts on the c.m. (centre of mass) causing translation and a net torque at the c.m. causing rotation around an axis through the c.m. For the earth-sun system (approximating the earth as a uniform density sphere)
(a) the torque is zero.
(b) the torque causes the earth to spin.
(c) the rigid body result is not applicable since the earth is not even approximately a rigid body.
(d) the torque causes the earth to move around the sun.

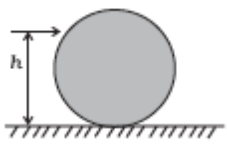
**11.** Satellites orbiting the earth have finite life and sometimes debris of satellites fall to the earth. This is because,
(a) the solar cells and batteries in satellites run out.
(b) the laws of gravitation predict a trajectory spiralling inwards.
(c) of viscous forces causing the speed of satellite and hence height to gradually decrease.
(d) of collisions with other satellites.

**12.** Both earth and moon are subject to the gravitational force of the sun. As observed from the sun, the orbit of the moon
(a) will be elliptical.
(b) will not be strictly elliptical because the total gravitational force on it is not central.
(c) is not elliptical but will necessarily be a closed curve.
(d) deviates considerably from being elliptical due to influence of planets other than earth.

**13.** In our solar system, the inter-planetary region has chunks of matter (much smaller in size compared to planets) called asteroids. They
(a) will not move around the sun since they have very small masse compared to sun.
(b) will move in an irregular way because of their small masses and will drift away into outer space.
(c) will move around the sun in closed orbits but not obey Kepler's laws.
(d) will move in orbits like planets and obey Kepler's laws.

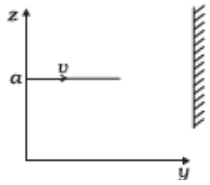
**14.** The earth is an approximate sphere. If the interior contained matter which is not of the same density everywhere, then on the surface of the earth, the acceleration due to gravity
(a) will be directed towards the centre but not the same everywhere.
(b) will have the same value everywhere but not directed towards the centre.
(c) will be same everywhere in magnitude directed towards the centre.
(d) cannot be zero at any point.

**15.** A uniform sphere of mass m and radius R is placed on a rough horizontal surface (Fig.). The sphere is struck horizontally at a height h from the floor. Match the following:



(a) h = R/2 (i) Sphere rolls without slipping with a constant velocity and no loss of energy.
(b) h = R (ii) Sphere spins clockwise, loses energy by friction.
(c) h = 3R/2 (iii) Sphere spins anti-clockwise, loses energy by friction.
(d) h = 7R/5 (iv) Sphere has only a translational motion, looses energy by friction.

**16.** A particle of mass m is moving in yz-plane with a uniform velocity v with its trajectory running parallel to +ve y-axis and intersecting z-axis at z = a (Fig. 7.2). The change in its angular momentum about the origin as it bounces elastically from a wall at y = constant is:




(a) mva $\hat{\mathbf{e}}_x$
(b) 2mva $\hat{\mathbf{e}}_x$
(c) ymv $\hat{\mathbf{e}}_x$
(d) 2ymv $\hat{\mathbf{e}}_x$

**17.** A Merry-go-round, made of a ring-like platform of radius R and mass M, is revolving with angular speed ω . A person of mass M is standing on it. At one instant, the person jumps off the round, radially away from the centre of the round (as seen from the round). The speed of the round afterwards is
(a) 2ω (b) ω (c) ω/2 (d) 0

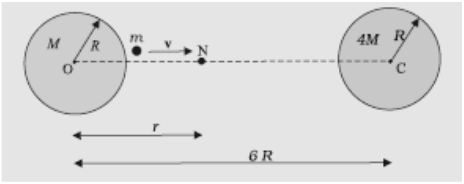
**18.** When a disc rotates with uniform angular velocity, which of the following is not true?
(a) The sense of rotation remains same.
(b) The orientation of the axis of rotation remains same.
(c) The speed of rotation is non-zero and remains same.
(d) The angular acceleration is non-zero and remains same.

**19.** In a shotput event an athlete throws the shotput of mass 10 kg with an initial speed of 1 m/s at 45° from a height 1.5 m above ground. Assuming air resistance to be negligible and acceleration due to gravity to be 10 m/s $^2$ , the kinetic energy of the shotput when it just reaches the ground will be
(a) 2.5 J (b) 5.0 J (c) 52.5 J (d) 155.0 J

**20.** A body of mass 0.5 kg travels in a straight line with velocity v = a $x^{3/2}$ where a = 5 $m^{-1/2}s^{-1}$. The work done by the net force during its displacement from x = 0 to x = 2 m is
(a) 1.5 J (b) 50 J (c) 10 J (d) 100 J

## SECTION – B

**1.** Two uniform solid spheres of equal radii *R*, but masses *M* and *4M* have a center to centre separation of *6R* as shown in the fig. two spheres are held fixed and a projectile of mass *m* is projected from the surface of the sphere of mass *M* directly towards the centre of the second sphere. Kindly obtain an expression for the minimum speed of the projectile so that it reaches the surface of the second sphere.




**2.** Derive the equation for the acceleration due to gravity above and below the Earth's surface.

**3.** The angular speed of a motor wheel is increased from 1200 rpm to 3120 rpm in 16 seconds. Assuming uniform motion kindly compute:
(i) Angular Acceleration.
(ii) Number of revolutions that the wheel makes in this time.

**4.** If **A** = (3**i** + 4**j** + 6**k**) and **B** = (10**i** + 15**j** – 9**k**), compute the value of **A.B** and **A x B**.

**5.** If **A** = (1.5**i** + 4**j** + 25**k**) and **B** = (-4**i** + 22**j** – 3**k**), compute the value of **A.B** and **A x B**.

**6.** Derive equation for collision in one dimensions.

**7.** (a) State the Theorem of parallel axis.
(b) State the Theorem of perpendicular axis.
(c) Write a note on motion of Centre of Mass.

**8.** Using Work – Energy theorem for a variable force, kindly prove that the work done is equal to the change in K.E.

**9.** A girl riding a bicycle along a straight road with a speed of 5 m s–1 throws a stone of mass 0.5 kg which has a speed of 15 m/s with respect to the ground along her direction of motion. The mass of the girl and bicycle is 50 kg. Does the speed of the bicycle change after the stone is thrown? What is the change in speed, if so?

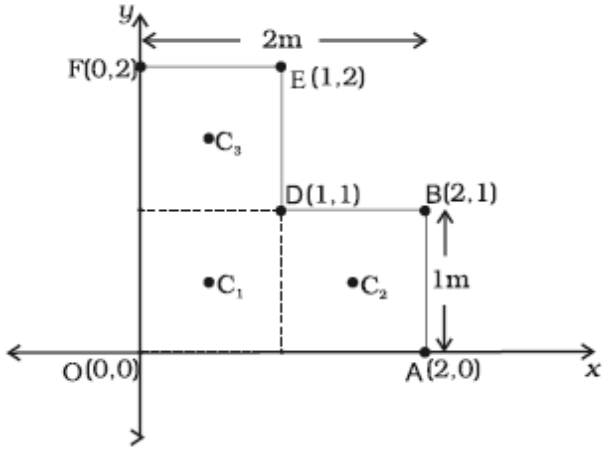
**10.** A person of mass 50 kg stands on a weighing scale on a lift. If the lift is descending with a downward acceleration of 9 m/s$^2$, what would be the reading of the weighing scale? (g = 10 m/s$^2$)

**11.** Prove that $\Delta V = F\Delta x$.

**12.** Find the potential energy of a system of four particles placed at the vertices of a square of side *l*. Also obtain the potential at the centre of the square.

**13.** Using $P = \frac{dW}{dt}$, prove that $\tau = I\alpha$.

**14.** Find the Centre of Mass of an L – shaped lamina with a mass of 3 kg from the following fig.




**15.** Write about the potential energy in a string and kindly derive the equations for the same.

**16.** Derive the equation for the periodic time of a satellite

**17.** Derive the equation for the gravitational potential energy.

**18.** Derive Newton's Second Law for a system of particles.

**19.** Using proper mathematical framework prove that Kinetic energy converts to potential energy when a body is dropped from a height H.

**20.** Bob of a pendulum is released from horizontal position. If the length of the pendulum is 1.5m, what is the speed with which the bob arrives at the lowermost point, given that it dissipated 5%of its initial energy against air resistance?

**21.** A trolley of 300 kg carrying a sandbag of 25 kg is moving uniformly with a speed of 27 km/hr on a frictionless track. After a while the sand starts leaking at 0.05 kg/s. What is the speed of the trolley when the sand bag is empty?

**22.** Write a note on geostationary satellites.

**23.** Derive Newton's Second Law.

**24.** Derive the equation for the motion of a body on a levelled and a banked road.

**25.** Write the steps to solve the problems of mechanics.

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