

Question bank Set 2

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- 1) What is polar satellite?
- 2) What is Escape velocity? Derive the expression of escape velocity?
- 3) What is the relationship between Orbit Velocity of Satellite and Escape Velocity?
- 4) Derive Kepler's 3rd Law. Write down three laws of Kepler.
- 5) Express Newton's Law of Gravitation in Vector form.
- 6) Define Gravitational field. Write its expression.
- 7) Define Gravitational Field Intensity (Strength) and write its expression.
- 8) Define and derive expression for gravitational Potential Energy?
- 9) Define and derive expression for gravitational Potential?
- 10) Derive the expression for Orbit velocity of Satellite.
- 11) Derive the expression of centripetal acceleration and centripetal force for rotational motion.

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- 12) Why does a body fall towards the earth and not the reverse?
- 13) Derive the dimension of G (Gravitational constant). What is its value in SI?
- 14) The planet P is on an average 40 times as far from the sun as the earth is. What is P's orbital period in years?
(Hint: use 3rd law of Kepler)

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15) A man of 100 kg is to be put into a circular orbit at a distance of L above the surface of earth. What is its orbital speed? Radius of earth= R and mass of earth= M . What will be orbital speed if a man of 200 kg is selected for this?

16) Calculate the average rate at which the line joining the sun to the earth is sweeping out area. The average linear speed of the earth in the orbit is 29.5 km/s and the average radius of the earth is R km.

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Question bank Set 3

1) What is conservative force? Give 2 examples.

2) Work done in a cyclic process by spring force is zero - show this.

3) A machine that is made to shoot tennis balls consists of a tube, a spring ($k = 28$ N/m) and a catch for the spring that can be released to shoot the balls. When a ball is loaded into the tube, it compresses the spring by 50 cm. If you shoot a ping pong ball straight up out of this toy, how high will it go?

4) Derive the WE (Work Energy) Theorem.

5) A block of mass 3 kg is raised vertically upwards by means of mass-less string through a distance of $S=4$ m with a constant acceleration 2.5 m/second square. Find the work done by Tension and Gravity. Also find the net work done on the block.

6) Two billiards balls each of mass 0.05 kg moving in opposite directions with speed 9 m/s collide and rebound with the same speed. What is the impulse imparted to each ball due to the other?

Physics Question bank - set 4

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- 1) A body of mass 5 kg is acted upon by two perpendicular forces 8 N and 6 N. Give the magnitude and direction of the acceleration of the body.
- 2) Two masses 8 kg and 12 kg are connected at the two ends of light string that goes over a frictionless pulley. Find the acceleration of the masses and the tension in the string, when the masses are released.
- 3) A body of mass 6 kg is acted upon by a force which causes a displacement in it given by $x=t^2/4$ meter, where t =time in second. Calculate the work done by the force in 2 seconds.

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- 4) If a person can throw a stone to maximum height of H meter vertically, then find out the maximum distance through which it can be thrown horizontally by the same person.
- 5) The cricket ball of mass 0.25 kg with speed 10 m/s collides with a bat and returns with same speed within 0.01 second. Find out the force acted on the bat.
- 6) A particle is moving with a constant speed v in a circle. What is the magnitude of average velocity after half rotation?
- 7) A particle of mass 0.5 kg travels in a straight line with velocity $V=ax^{3/2}$, where $a=5 \text{ m}^{-1/2}\text{s}^{-1}$. What is the work done by the net force during displacement from $x=0$ to $x=2$ m.
- 8) An elastic spring of negligible mass has a force constant $k=4 \text{ N/m}$. One end of the spring is fixed to the wall and the other end touches a block of mass $m = 250 \text{ kg}$ placed on a horizontal surface. The spring is compressed by an amount $x=5 \text{ cm}$. The coefficient of friction between the block and **the**

horizontal surface is $(\mu) = 0.2$. If the system is released, then find the speed of the block when it leaves the spring. (hints: $PE=KE+ (-ive work by friction)$)

9) The weight of a body on surface of earth is 12.6 Newton. Calculate its weight when it's raised to a height half the radius of earth. (ans: 5.6 N)

10) A rocket of mass 100 kg burns 0.1 kg of fuel per second. If velocity of exhaust gas is 1 km/sec, then what is the acceleration of the rocket?

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Physics Question bank - set 5

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Solving these problems will help you strengthen your base and understanding.

1) Define the following:

a) Gravitational Field (b) Intensity of this field (c) Gravitational Potential Energy (PE), (d) Gravitational Potential

2) Superposition theorem holds good for Gravitational force and Gravitational PE. Explain this.

3) Find out the expression of orbit velocity of Satellite.

4) Escape velocity is root 2 times orbit velocity. Show this.

5) Derive the total energy of orbiting satellite. Why is this negative.

6) Explain the weightlessness in an orbiting satellite.

7) Prove the last law of Kepler.

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8) State 3 laws of Kepler.

Physics Question bank - set 6

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Solving these problems will help you strengthen your base and understanding.

- 1) A body at rest explodes in three fragments. Is it possible that two equal parts move in mutually perpendicular directions with the same velocity and third mass moves midway between the two?
- 2) If the speed of a moving vehicle is increased by 200% then how much should be the change in the retarding force to stop the vehicle over half the previous distance?
- 3) If 20 Joules of work is done in compressing a spring from 0 cm to 6 cm then find the work done in compressing the same from 3cm to 6 cm.
- 4) Does the work done on a body by a force depend upon the path followed by it?
- 5) A ball is dropped from rest at a height of 20m. If it loses 30% of its kinetic energy on striking the ground, what is the height to which it bounces? How do you account for this loss in kinetic energy?
- 6) Why is no energy being consumed in planetary motion?
- 7) A truck and a car are moving with the same K.E. on a straight line road. If

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their engines are made off at the same time, which one of them will stop at a lesser distance?

8) The power of a pump motor is 4KW. How much water in kg/minute can it raise a height of 20m? ($g = 10 \text{ m/s}^2$)

9) Is it possible for work to be positive negative or zero? "Explain with example.

10) The bob of a simple pendulum is released from a horizontal position. If the length of the pendulum is 2m, what is the speed with which the bob arrives at the lowermost point? Given that it dissipates 10% of its initial energy against air resistance?

Physics Question bank – set 7

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1) A particle of mass 0.5 kg travels in a straight line with velocity $v=ax^{3/2}$, where a $5 \text{ m}^{-1/2} \text{ s}^{-1}$. What is the work done by the net force during its displacement from $x=0$ to $x=2$ meter?

2) A body of mass 6 kg is acted upon by a force which causes a displacement in it given by $x=t^2/4$ meter, where t =time in second. The work done by the force in 2 sec is : _____.

3) If a person can throw a stone to maximum height of h meter vertically, then the maximum distance through which it can be thrown horizontally by the same person is: _____.

4) A particle is moving with a constant speed V in a circle. What is the magnitude of avg velocity after half rotation?

5) A ball with MOI of 1.6, mass of 4 kg and radius of 1 m rolls without slipping down an incline which is 10 meter high. What is the speed of the ball when it reaches the bottom of the incline?

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- 6) Three bodies a ring, a solid cylinder and a solid sphere roll down the same inclined plane without slipping. They start from rest. The radii of the bodies are same. Which of the bodies reaches the ground with maximum velocity?
- 7) The time period of a satellite of earth is 5 hours, if the separation between the earth and the satellite is increased to 4 times the previous value, the new time period would be _____.
- 8) A ball is thrown from a point with a speed V_0 at an angle of projection θ . From the same point and at the same instant, a person starts running with a constant speed $V_0/2$ to catch the ball. Will the person be able to catch the ball? If yes, what should be the angle of projection?

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- 9) A particle is projected at 60° to the horizontal with a KE with a value K. The KE at the highest point is _____.
- 10)
The blocks A and B have equal masses and they are on the floor. The surface of A is smooth but that of B has a friction coefficient of 0.1 with the floor. Block A is moving at a speed of 10 m/s towards B which is kept at rest. Find the distance travelled by B if (a) the collision is perfectly elastic and (b) the collision is perfectly inelastic. $g=10 \text{ m/s}^2$.
- 11) A particle moves along the x axis from $x=0$ to $x=5$ m under the influence of a force F (in N) given by $F=3x^2-2x+7$. Calculate the work done.
- 12) A uniform chain of length L and mass M is lying on a smooth table and one third of its length is hanging vertically down over the edge of the table. What is the work required to pull the hanging part on to the table?
- 13) Calculate the distance below and above the surface of the earth, at which the value of acceleration due to gravity becomes $\frac{1}{4}$ th that at earth's surface?
- 14) The planet Pluto is on average 40 times as far from the sun as the earth is. What is Pluto's orbital period in years?

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Appendix

Question bank Set 1

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- 1) A stone is falling freely from rest and the total distance covered by it in the last second of its motion equals the distance covered by it in the first 3 seconds of its motion. How long does the stone remain in air?
- 2) A circular track of radius 100 m is banked at an angle of 30° . If the coefficient of friction between the wheels of a car and the road is 0.5, then what is the (i) optimum speed of the car to avoid wear and tear on its tires, and (ii) maximum permissible speed to avoid slipping?
- 3) Velocity of an object is $\mathbf{V1}=8$ m/s towards N and velocity of a different object is $\mathbf{V2}= 6$ m/s towards West. Determine $\mathbf{V1-V2}$.
- 4) A 20 kg iron block is kept on a horizontal table. It is pulled with a rope which is at 30 degree with the horizontal floor. If coefficient of friction is 0.4 then what is the minimum force required along the rope to pull the block?
- 5) What is the value of coefficient of static friction of an inclined plain where a mass of 50 kg is tending to slip downwards when the angle of inclination is made 15 degree?
- 6) What is mechanical advantage?
- 7) A force of 200 N makes an angle of theta with the X axis and has a scalar Y component of 30 N. Find both the scalar X component of the force and angle theta.
- 8) Write and derive the work energy theorem.

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- 9) A 50 kg bucket is being lifted by a rope. The rope will not break if the tension is 525 N or less. The bucket started at rest and after being lifted 3 meter , its moving at 5 m/s. If the acceleration is constant, is the rope in danger of breaking?
- 10) Two blocks of 4 kg and 5 kg are in contact on a frictionless table. If a force of 3 N is applied on 2 kg block, then what will be the force of contact between the 2 blocks?
- 11) Can we have the value of coefficient of friction more than one?
- 12) Define equilibrium of a system?
- 13) An object of mass M kg moving with a velocity of 20 m/s is stopped in 2 secs by applying a force against its motion. What is the magnitude of the force?
- 14) Can you deduce the first law of Newtonian motion from the 2nd law?
- 15) 'Pulling' a box or 'pushing' it on the horizontal floor. Which one is easier and why (show with FBD / Vector)