CHAROTAR UNIVERSITY OF SCIENCE & TECHNOLOGY

I Semester of BSc Physic Examination March 2018

PD102 Mechanics

Date: 27-03-2018 Day: Tuesday Time:10.00 AM To10:30AM Maximum Marks: 20

MCQ

Important Instructions:

- Tick the correct answer and it should be written in question paper itself.
- Use of non-programmable calculator is allowed.

Q - I Choose the correct answer for the following questions. **20**

1. An object experiences a net force and exhibits an acceleration in response. Which of the following statements is always true?
(a) The object moves in the direction of the force.
(b) The acceleration is in the same direction as the velocity.
(c) The acceleration is in the same direction as the force.
(d) The velocity of the object increases.

2. A baseball of mass m is thrown upward with some initial speed. A gravitational force is exerted on the ball:
(a) at all points in its motion
(b) at all points in its motion except at the highest point
(c) at no points in its motion
(d) only when it falls on the surface of the earth

3. If a fly collides with the windshield of a fast-moving bus, which object experiences an impact force with a larger magnitude?
(a) the fly
(b) the bus
(c) the same force is experienced by both
(d) both will not experience any force

4. Which of the following is the reaction force to the gravitational force acting on your body as you sit in your desk chair?
(a) The normal force exerted by the chair
(b) The force you exert downward on the seat of the chair

(c) both (a) and (b)
(d) Upward gravitational force on the Earth due to you

5. An older model car accelerates from rest to speed v in 10 seconds. A newer, more powerful sports car accelerates from rest to 2v in the same time period. What is the ratio of the power of the newer car to that of the older car?
(a) 0.25
(b) 0.5
(c) 1
(d) 4

6. An object falls off a table to the floor. We wish to analyze the situation in terms of kinetic and potential energy. In discussing the kinetic energy of the system, we:
(a) must include the kinetic energy of both the object and the Earth
(b) can ignore the kinetic energy of the Earth because it is not part of the system
(c) can ignore the kinetic energy of the Earth because the Earth is so massive compared to the object
(d) can ignore the kinetic energy of the object as the object size is small compared to earth

7. In an isolated system, which of the following is a correct statement of the quantity that is conserved?
(a) kinetic energy
(b) potential energy
(c) kinetic energy plus potential energy
(d) both kinetic energy and potential energy

8. A rock of mass m is dropped to the ground from a height h. A second rock, with mass 2m, is dropped from the same height. When the second rock strikes the ground, its kinetic energy is:
(a) twice that of the first rock
(b) four times that of the first rock
(c) the same as that of the first rock
(d) half as much as that of the first rock

9. A ball is connected to a light spring suspended vertically. When displaced downward from its equilibrium position and released, the ball oscillates up and down. In the system of the ball and the spring, what forms of energy are there during the motion?
(a) kinetic and elastic potential
(b) kinetic and gravitational potential
(c) kinetic, elastic potential, and gravitational potential
(d) elastic potential and gravitational potential

10. A competitive diver leaves the diving board and falls toward the water with her body straight and rotating slowly. She pulls her arms and legs into a tight tuck position. Her angular speed:
(a) increases
(b) decreases
(c) stays thesame
(d) keep on changing

11. Two spheres roll down an incline, starting from rest. Sphere A has the same mass and radius as sphere B, but sphere A is solid while sphere B is hollow. Which arrives at the bottom first?
(a) sphere A
(b) sphere B
(c) Both arrive at the same time
(d) Impossible to determine

12. What is the gravitational acceleration close to the surface of a planet with twice the mass and twice the radius of Earth? Answer as a multiple of g, the gravitational acceleration near Earth's surface.

(a) 0.25g
(b) 0.5g
(c) g
(d) 2g

13. The gravitational force exerted on an astronaut on Earth's surface is 650 N down. When she is in the International Space Station, is the gravitational force on her.
(a) larger
(b) exactly the same
(c) smaller
(d) nearly but not exactly zero

14. A merry-go-round rotates with constant angular speed. As a rider moves from the rim of the merry-go-round toward the center, what happens to the magnitude of total centripetal force that must be exerted on him?
(a) It increases
(b) It is not zero, but remains the same
(c) It decreases
(d) It's always zero

15. A constant net nonzero torque is exerted on an object. Which of the following quantities cannot be constant for this object?
(a) angular acceleration
(b) angular velocity
(c) moment of inertia
(d) center of mass

16. If two particles have equal kinetic energies, are their momenta equal?
(a) yes, always
(b) no, never
(c) yes, as long as their masses are equal
(d) yes, if both their masses and directions of motion are the same

17. Two particles of different mass start from rest. The same net force acts on both of them as they move over equal distances. How do their final kinetic energies compare?
(a) The particle of larger mass has more kinetic energy
(b) The particle of smaller mass has more kinetic energy
(c) The particles have equal kinetic energies
(d) Either particle might have more kinetic energy.

18. The distance between the crest of a water wave and the next trough is 2 m. If the frequency of a particular wave is 2 Hz, what is the speed of the wave?
(a) 4 m/s
(b) 1 m/s
(c) 8 m/s
(d) 2 m/s

19. A block-spring system vibrating on a frictionless, horizontal surface with an amplitude of 6.0 cm has a total energy of 12 J. If the block is replaced by one having twice the mass of the original block and the amplitude of the motion is again 6.0 cm, what is the energy of the more massive system?
(a) 12 J
(b) 24 J
(c) 6 J
(d) 48 J

20. A simple pendulum has a period of 2.5 s. What is its period if its length is made four times as large?
(a) 0.625 s
(b) 5 s
(c) 2.5 s
(d) 3.54 s

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I Semester of BSc Physic Examination March 2018

PD102 Mechanics

Date: 27-03-2018 Day: Tuesday Time: 10.30 AM To 01:00PM Maximum Marks: 50

Instructions:

1. **Section I and II must be attempted in TWO ANSWER SHEET.**
2. Make suitable assumptions and draw neat figures wherever required.
3. Use of non-programmable calculator is allowed.
4. Show necessary calculations.

SECTION – I

Q – II Answer the following questions as directed **20**

1. i. If a fly collides with the windshield of a fast-moving bus, the bus experiences the greater acceleration: State True or False 2

ii. An object experiences a net force and exhibits an acceleration in response. Which of the following statements is always true?

(a)The object moves in the direction of the force. (b) The acceleration is in the same direction as the velocity. (c) The acceleration is in the same direction as the force. (d) The velocity of the object increases.

2. i. Why does mud fly off a rapidly turning automobile tire? 2

ii. A pail of water can be whirled in a vertical path such that none is spilled. Why does the water stay in the pail, even when the pail is above your head?

3. When a particle rotates in a circle, a force acts on it directed toward the center of rotation. Why is it that this force does no work on the particle? 2

4. Discuss whether any work is being done by each of the following agents and, if so, whether the work is positive or negative: (a) a chicken scratching the ground, (b) a person studying, 2

5. Explain why the total energy of a system can be either positive or negative, whereas the kinetic energy is always positive. 2

6. What would the curve of U versus x look like if a particle were in a region of neutral equilibrium? 2

7. Why can't you put your heels firmly against a wall and then bend over without falling? 2

8. Does a larger net force exerted on an object always produce a larger change in the momentum of the object, compared to a smaller net force? Explain. 2

9. A pendulum bob is made from a sphere filled with water. What would happen to the frequency of vibration of this pendulum if the sphere had a hole in it that allowed the water to leak out slowly? 2

10. Explain why the kinetic and potential energies of an object–spring system can never be negative. 2

SECTION – II

Q-III Answer the following questions as directed **30**

1. The upward normal force exerted by the floor is 620 N on an elevator passenger who weighs 650 N. What are the reaction forces to these two forces? Is the passenger accelerating? If so, what are the magnitude and direction of the acceleration? 3

OR

A small car (mass 380 kg) is pushing a large truck (mass 900 kg) due east on a level road. The car exerts a horizontal force of 1200 N on the truck. What is the magnitude of the force that the truck exerts on the car?

2. A loaded grocery cart is rolling across a parking lot in a strong wind. You apply a constant force $\vec{F} = (30N)\hat{\imath} - (40N)\hat{\jmath}$ to the cart as it undergoes a displacement $\vec{s} = (-9m)\hat{\imath} - (3m)\hat{\jmath}$. How much work does the force you apply do on the grocery cart? 3

3. Adult cheetahs, the fastest of the great cats, have a mass of about 70 kg and have been clocked running at up to 32m/s. (a) How many joules of kinetic energy does such a swift cheetah have? (b) By what factor would its kinetic energy change if its speed were doubled? 3

4. Using a small pendulum of length 0.171 m, a geophysicist counts 72.0 complete swings in a time of 60.0 s. What is the value of g in this location? 3

5. You throw a 20N rock vertically into the air from ground level. You observe that when it is 15.0 m above the ground, it is traveling at 25m/s upward. Use the work–energy theorem to find (a) the rock's speed just as it left the ground and (b) its maximum height. 3

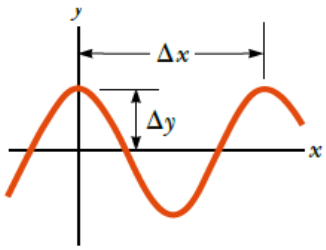
OR

A soccer ball with mass 0.420 kg is initially moving with speed 2m/s. A soccer player kicks the ball, exerting a constant force of magnitude 40 N in the same direction as the ball's motion. Over what distance must the player's foot be in contact with the ball to increase the ball's speed to 6m/s.

6. A wave has a wavelength of 3 m. Calculate the frequency of the wave if it is (a) a sound wave and (b) a light wave. Take the speed of sound as 343 m/s and the speed of light as 3 x 10^8 m/s. 3

7. A student with mass 45 kg jumps off a high diving board. Using 6x10^{24}kg for the mass of the earth, what is the acceleration of 9.8m/s^2 the earth toward her as she accelerates toward the earth with an acceleration of Assume that the net force on the earth is the force of gravity she exerts on it. Expalin your result. 4

8. A wave traveling in the positive x-direction is pictured in figure. Find the amplitude, wavelength, speed, and period of the wave if it has a frequency of 8 Hz. In Figure, Δx = 40cm and Δy = 15.0 cm. 4



9. (a) Find the amplitude, frequency, and period of motion for an object vibrating at the end of a horizontal spring if the equation for its position as a function of time is x= $(0.25m)\cos\left(\frac{\pi}{8}\right)t$ 4

(b) Find the maximum magnitude of the velocity and acceleration.

(c) What are the position, velocity, and acceleration of the object after 1.00 s has elapsed?

OR

A 0.5kg object connected to a light spring with a spring constant of 20.0 N/m oscillates on a frictionless horizontal surface.

(a) Calculate the total energy of the system and the maximum speed of the object if the amplitude of the motion is 3 cm.

(b) What is the velocity of the object when the displacement is 2 cm?

(c) Compute the kinetic and potential energies of the system when the displacement is 2 cm.