2020

PHYSICS

Total marks : 70   Time : 3 hours

General instructions:
i)   *Approximately 15 minutes is allotted to read the question paper and revise the answers.*
ii) *The question paper consists of 30 questions. All questions are compulsory.*
iii) *Marks are indicated against each question.*
iv) *Internal choice has been provided in some questions.*

N.B: Check that all pages of the question paper is complete as indicated on the top left side.

1. Which of the following length measurements is most accurate?   **1**
    (a) 500.0 cm   (b) 0.0005 cm
    (c) 5.00 cm   (d) 5000 cm

2. A body is initially at rest. It undergoes one-dimensional motion with constant acceleration. The power delivered to it at time 't' is proportional to   **1**
    (a) $t^{1/2}$ (b) $t^{3/2}$
    (c) t   (d) t^2

3. For which of the following, does the centre of mass lie outside the body?   **1**
    (a) A pencil   (b) A shot put
    (c) A dice   (d) A bangle

4. If longitudinal strain for a wire is 0.03 and its Poisson's ratio is 0.5, then its lateral strain is   **1**
    (a) 0.003   (b) 0.0075
    (c) 0.015   (d) 0.4

5. The relation PV=RT can describe behaviour of a real gas at   **1**
    (a) high temperature and high density
    (b) high temperature and low density
    (c) low temperature and low density
    (d) low temperature and high density

6. State the law of inertia.   **1**

7. If $(\vec{A}+\vec{B})\cdot(\vec{A}-\vec{B})=0$, show that the magnitude of both the vectors are equal.   **1**

8. Define elastic collision.   **1**

9.   Why is it that a liquid set in rotation comes to rest after sometime?   **1**

10.   What is meant by degree of freedom of a gas molecule?   **1**

11.   Prove that the displacement of an object at any instant is numerically
      equal to the area under velocity – time graph.   **2**

12.   **a.** A shell of mass 0.02 kg is fired by a gun of mass 100 kg. If the muzzle
              speed of the shell is 80 m/s, what is the recoil speed of the gun?
                                      Or   **2**
      b. A batsman hits back a ball straight in the direction of the bowler without
              changing its initial speed of 12m/s. If the mass of the ball is 0.15 kg,
              determine the impulse imparted to the ball. (Assume linear motion of
              the ball).

13.   Derive the equation of motion F= ma.   **2**

14.   Show that the area of the triangle contained between the vectors $\vec{a}$
      and $\vec{b}$ is one half of the magnitude of $\vec{a} \times \vec{b}$.   **2**

15.   **a.** Draw the schematic diagram of a heat engine. Write the formula for
              efficiency of a heat engine.
                                      Or   **2**
      b. What are reversible and irreversible process?

16.   **a.** What is Doppler shift? Give two applications of Doppler effect.
                                      Or   **2**
      b. Write the expressions for potential and kinetic energy of a body
              executing simple harmonic motion.

17   Two uniform solid spheres of equal radii R, but mass M and 4M have a
       centre to centre separation 6R. The two spheres are held fixed. A projectile
      of mass 'm' is projected from the surface of the sphere of mass 'M' directly
      towards the centre of the second sphere. Obtain an expression for the
      minimum speed 'v' of the projectile so that it reaches the surface of the
   second sphere.   **3**
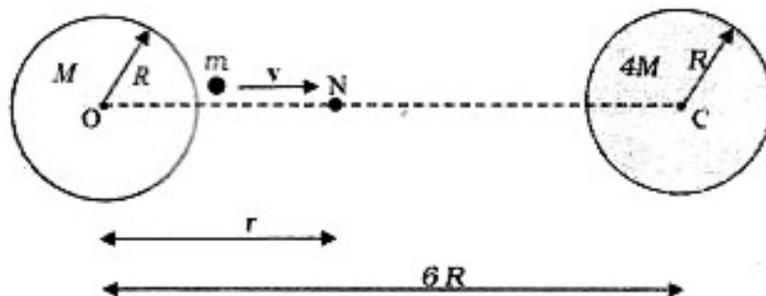
18.   **a.** Derive an expression for maximum velocity of a car taking a circular turn
       on a level road.
                                        Or   **3**
       b. State Newton's second law of motion. Prove that impulse is equal to the
       change in momentum.

   19. Two masses M_1 and M_2 are connected at the two ends of a light
       inextensible string that passes over a frictionless pulley as shown in the figure.
       Calculate the acceleration of the masses and the tension in the
       string, when the masses are released. Given $M_2 > M_1$.   **3**
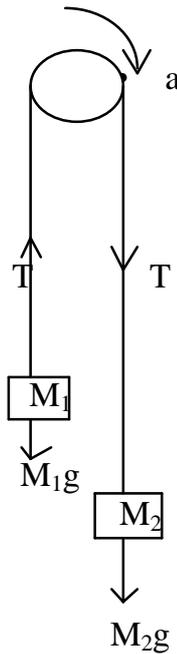
20.   Show that for a freely falling body, the mechanical energy is conserved.   **3**

21.   Derive the relation between torque and angular momentum of a body.   **3**

22.   **a.** If the diameter of earth becomes two times its present value and its
       mass remains unchanged; then how would the weight of an object
       on the surface of the earth be affected?
                                        Or   **3**
       b. Show that total energy of an orbiting satellite is equal to the negative
       of its kinetic energy.

23.   Derive an expression for time period of a satellite.   **3**

24.   Derive an expression for the energy stored in a wire due to extension on
      applying a stretching force.   **3**

25.   **a.**   Show that work done is equal to area under the P – V diagram.
                                    Or   **3**
      b.   Draw the block diagram of a refrigerator. Derive the expression
               for coefficient of performance of a refrigerator.

26.   **a.**   Obtain the expression for specific heat of monoatomic gas at constant
               pressure and volume. Also find the value of 'γ'.
                                    Or   **3**
      b.   State any three gas laws and write its mathematical expressions.

27.   Derive an expression for frequency of oscillations of mass M attached to a
      spring of force constant K.   **3**

28.   **a.**   Using the velocity-time graph, derive the three kinematics equations for
               uniformly accelerated motion.
                                    Or   **5**
      b.   What is meant by rectangular component of a vector? Explain how a
               vector can be resolved into two rectangular components in a plane.

29.   **a.**   Derive the expression for excess pressure inside a liquid drop and a
               bubble.
                                    Or   **5**
      b.   i. Show that u=½ stress x longitudinal strain.
               ii. Prove Stoke's law dimensionally.

30.   **a**.   Explain the formation of standing waves in a string and the different
               modes of vibration.
                                    Or   **5**
      b.   Derive the expression for velocity and acceleration of a body executing
               simple harmonic motion.

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