Time: 3hr   M.M.70

NOTE: ALL QUESTIONS ARE COMPULSORY.
Q1 to Q 5 carry 1 mark each.
Q 6 to Q10 carry 2 marks each.
Q 11 to Q 22 carry of 3 marks each.
Q23 carry 4 mark.
Q 24 to 26 carry 5 marks each.
Use of Calculators not permitted.

1.   Does it possible to have a situation E – U < 0?   **(1)**

2.   Two equal forces have their resultant equal to either. What is the   **(1)**
        inclination between them?

3.   An astronaut accidentally gets thrown out of his small spaceship   **(1)**
        accelerating in interstellar space at a constant rate of 100m/s². What is the
        acceleration of the astronaut the instant after he is outside the spaceship?

4.   Handle to open the door, is always provided at the free edge of a door   **(1)**
        why?

5.   Why a body weighs more at the poles than at the equator?   **(1)**

6.   How can we measure the height of a mountain by knowledge of   **(2)**
        elasticity?

                                            OR

        Derive the expression of potential energy stored in a stretched thin wire.

7.   Explain Newton's law of cooling.   **(2)**

8.   A 8kg body performs SHM of amplitude 30cm. The restoring force is 60N,
        when the displacement is 30cm. Find time period & acceleration, when the
        displacement is 12cm.

9.   Prove the expression of work done in an adiabatic process.   **(2)**

10.   Derive equation of continuity.   **(2)**

11.   a) Derive an expression for the rotational K.E of a rigid body rotating   **(2)**
        with angular velocity ω and hence define moment of Inertia.
        b) The angular velocity of revolution of the earth around the sun   **(1)**
        increases, when it comes closer to the sun why?

12. A cricket ball is thrown at a speed of 28m/s in a direction 30^0 above the horizontal. Calculate (a) the maximum height (b) the time taken by the ball to return to the same level (c) the horizontal distance from the thrower to the point where the ball returns to the same level. **(3)**

13. A body tied to one end of a string is made to revolve in a vertical circle. Derive the expression for the velocity of the body and tension at the bottom and the top of the circle. **(3)**

14. Obtain an expression for a stationary wave formed by two sinusoidal waves travelling along the same path in opposite directions in case of stretched string and also discuss first and second mode of vibrations. **(2)** **(1)**

15. a) Derive the expression of escape velocity **(2)**
b) Show that the moon would depart for ever if its speed were increased by 42%. **(1)**

16. Derive the expression of pressure exerted by an ideal gas on basis of kinetic theory of gases. **(3)**

17. A newly designed thermometer has its lower fixed point and upper fixed point marked 5^0 and 95^0 respectively. Compute the temperature on this scale corresponding to 50^0C. **(3)**

18. Explain Bernoulli's equation & Derive it also. **(3)**

OR

a) Derive Stoke's formula for spherical body falling in a viscous medium **(2)**
b) At what speed will the velocity head of stream of water be 40cm? **(1)**

19. Derive expression of the following when a particle is executing S .H.M.
a) Displacement at any instant of time **(3)**
b) Velocity
c) acceleration

20. Explain Doppler's effect in sound and hence find expression for apparent frequency. **(3)**

21. Prove Mayer's formula $(Cp - Cv = R)$ **(3)**

22. Explain Banking of Road obtain an expression for the maximum speed with which a vehicle can safely negotiate a curved road banked at an angle θ. Coefficient of friction $= \mu$. **(3)**

23. Vinay, the younger brother of Shiva told Shiva that a magician performed a show in his school. The magician was lying on the bed of nails. All students were stunned by the action of magician. Vinay told Shiva that magician had super natural power. Shiva told Vinay that magician had no super natural power. He also told Vinay that even he could have a nap on a bed of nails. Shiva performed the action and Vinay was satisfied that magician had no super natural power. **(4)**

    a) How is possible for a person to have a nap on a bed of nails?
    b) Can a person stand on a bed of nails?
    c) What values are shown by Shiva?

24. Explain working of carnot heat engine and hence find its efficiency also. **(5)**

OR

    a) Derive expression for rate of flow of liquid through horizontal cylindrical pipe of radius r and length 'l'
    b) Explain working of venturimeter.

25. a) Prove that the oscillation of a simple pendulum are in S.H.M. **(5)**
    b) What is the effect on time period of simple pendulum when the length of pendulum is equal to a) Radius of earth b) infinite length

OR

    a) Prove that the oscillation of liquid in U-tube are simple harmonic. **(5)**
    b) Calculate the length of a simple pendulum which ticks two second?

26. a) Write Newton's formula for the speed of sound in air. What was wrong with this formula? What correction was made by laplace in this formula. **(3)**

    b) Discuss the effect of following factors on the speed of sound through air: (a) Pressure   (b) Density **(2)**

OR

    a) The distances of two planets from the sun are 10^{13}m & 10^{12}m respectively. Find the ratio of time periods and speeds of the two planets. **(2)**
    b) Explain the Kepler's laws of planetary motion and derive law of periods. **(3)**