INDIAN SCHOOL AL WADI AL KABIR

FINAL EXAMINATION (2023-2024)
Sub: PHYSICS (042)
SET-I

Date: 02.03.2024   Max Marks: 70

Class: XI   Time Allowed: 3 hours

General Instructions:

(1) There are 33 questions in all. All questions are compulsory.

(2) This question paper has five sections: Section A, Section B, Section C, Section D and Section E.

(3) All the sections are compulsory.

(4) **Section A** contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, **Section B** contains five questions of two marks each, **Section C** contains seven questions of three marks each, **Section D** contains two case study-based question of four marks each and **Section E** contains three long answer questions of five marks each.

(5) There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.

(6) Use of calculators is not allowed.

SECTION A

1. Given below is the velocity-time graph of a body having
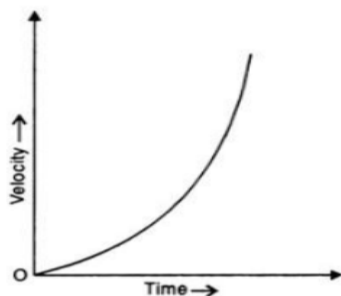
    a) uniform velocity   b) uniform acceleration
    c) decreasing acceleration   d) increasing acceleration

2. The maximum range of a gun of horizontal terrain is 10km. If $g=10m/s^2$, what must be the muzzle velocity of the shell?
   a) 400 m/s
   b) 200 m/s
   c) 100 m/s
   d) 50 m/s

3. A ball moves on a frictionless inclined table without slipping. The work done by the table surface on the ball is
   a) Negative   b) Zero   c) Positive   d) None of the options

4. According to work-energy theorem, the work done by the net force on a particle is equal to the change in its
   a) kinetic energy
   b) potential energy
   c) linear momentum
   d) angular momentum

5. When a torque acting on a system is zero, which of the following should not change?
   a) Linear velocity
   b) Angular momentum
   c) Angular displacement
   d) Force acting on the body

6. The torque of a force $F = -3\hat{i} + \hat{j} + 5\hat{k}$ acting at the point $r = 7\hat{i} + 3\hat{j} + \hat{i}$ is
   a) $14\hat{i} - 38\hat{j} + 16\hat{k}$
   b) $4\hat{i} + 4\hat{j} + 6\hat{k}$
   c) $-21\ddot{i} + 4\ddot{j} + 4\hat{k}$
   d) $-14\ddot{i} + 38\ddot{j} - 16\ddot{k}$

7. The dimensional formula of Universal Gravitation constant is
   a) $M^{-1}L^{3}T^{-2}$
   b) $M^{0}L^{0}T^{0}$
   c) $M^{-1}L^{3}T^{2}$
   d) $M^{-1}L^{2}T^{-2}$

8. The maximum velocity of the liquid up to which the flow is streamlined does not depend upon
   a) radius of the tube.
   b) pressure of the liquid.
   c) density of the liquid.
   d) viscosity of the liquid.

9. A given system undergoes a change in which work done by the system equals decrease in its internal energy. The system must have undergone
   a) Isothermal change
   b) Isobaric change
   c) Isochoric change
   d) Adiabatic change

10. 25200 J of heat is supplied to the system while the system does 6000 J of work. Find the change in internal energy of the system.
    a) 31200 J
    b) 19200 J
    c) 24600 J
    d) 25800 J

11. The energy associated with each degree of freedom of a gas molecule is

    a) zero   b) $\frac{1}{2}k_BT$ c) k_BT d) $\frac{3}{2}k_BT$

12. Energy is not carried by
    a) Longitudinal progressive wave
    b) Electromagnetic waves
    c) Transverse progressive waves
    d) Stationary waves

    For Questions 13 to 16, two statements are given – one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.
    a) **If both Assertion and Reason are true and Reason is the correct explanation of Assertion.**
    b) **If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.**
    c) **If Assertion is true but Reason is false.**
    d) **If both Assertion and Reason are false.**

13. **Assertion:** It is harder to open and shut the door if we apply force near the hinge.
    Reason: Torque is maximum at hinge of the door.

14. **Assertion:** Work done by a gas in isothermal expansion is more than the work done by the gas in the same expansion, adiabatically.
    Reason: Temperature remains constant in isothermal expansion and not in adiabatic expansion.

15. **Assertion:** The value of acceleration due to gravity i.e. 'g' is different at different places on the surface of earth.
    Reason: Earth is flattened at poles and bulging out at the equator. Therefore, radius is smaller at poles and larger at equator and g α $1/R^2$, so, g is smaller at equator than at poles.

16. **Assertion:** In change of state from solid to liquid, the temperature decreases until the entire amount of the solid substance melts.
    Reason: The phenomenon of refreezing is called melting

SECTION B

17. The equation, $F = at+bt^2$ represents the force acting on a body where F is the force, t is the time. Find the dimensions of 'a 'and 'b'

18. How does a ballet dancer or an acrobat take advantage of conservation of angular momentum?

19. Cooking is faster in a pressure cooker than in an ordinary vessel. Explain.

20. a) A car initially moving with a constant velocity suddenly comes to a stop. Sketch a position-time graph to represent the car's motion.

b) A bike accelerates uniformly from rest for 5s; then it travels at a steady velocity for 5s. And then it decelerates uniformly for the next 5s. Draw velocity – time graph to represent this situation.

OR

A parachutist after bailing out falls 50m without friction. When parachute opens, it decelerates at $2m/s^2$. He reaches the ground at the rate of 3m/s. At what height, did he bail out?

21. The equation of a wave is $y = 4.0 \, sin\pi(0.010x - 2.0 \, t)$ where x and y are in cm and t is in s.
    a) Is the wave travelling or stationary?
    b) Find its amplitude, wavelength and frequency.

SECTION C

22. a) State the law of conservation of linear momentum.

b) A shell of mass 0.020 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?

23. a) Write the expression for the potential energy of a stretched spring.
    b) 20 J work is required to stretch a spring through 0.1 m. Find the force constant of the spring. If the spring is stretched further through 0.1m, calculate work done?

24. a) Write the expression for the acceleration due to gravity at a depth.
    b) What is the depth from the surface of the earth at which acceleration due to gravity is 25% of acceleration due to gravity at the surface? Given radius of earth is 6400 km.

OR

a) State Kepler's laws of planetary motion.
b) The time period of a satellite of earth is 7 hours. If the separation between the earth and the satellite is increased to two times the previous value, what will be its new time period?

25. a) State Hooke's law.
    b) Steel is more preferred in heavy industries than copper and brass. Give reason.
    c) A wire stretches by a certain amount under a load. If the load and radius are increased to four times, find the stretch caused in the wire.

26. a) Ploughing of fields is essential for preserving moisture in the soil. Explain.
    b) Derive the expression for terminal velocity attained by a spherical body when it is dropped in a viscous fluid.

27. a) State law of equipartition of energy.
    b) Give any four assumptions (postulates) of kinetic theory of gases.

28. a) Show that the motion of a simple pendulum for small oscillation is simple harmonic in
       nature.
    b) The time period of a body executing SHM is 0.05s and the amplitude of vibration is 40 cm.
       What is the maximum velocity of the body?

SECTION D
Case Study Based Questions

29. A wire of uniform area of cross-section is suspended vertically from a rigid support
    through one end with the help of an attached hanger by putting different known weights in
    the hanger. The graph shown below shows qualitatively the relation between stress and
    strain as the deformation gradually increases.
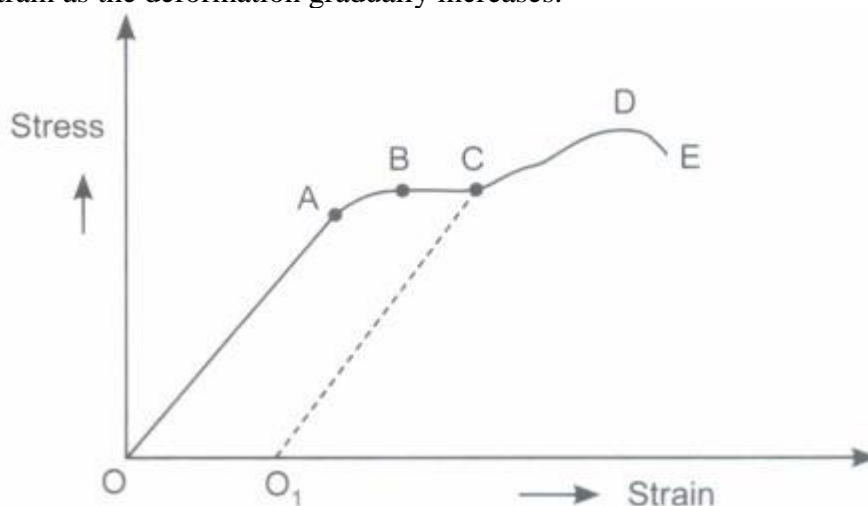
   i) If deforming forces are removed, up to which point will the curve be retraced?
      a) up to OA only
      b) up to OB
      c) up to C
      d) Never retraced its path

   ii) Which point represents the elastic limit?
       a) A
       b) B
       c) C
       d) D

   iii) Which region represents permanent set?
           a) OA   b) OB   c) OO_1 d) DE
                          OR
       Which point represents the yield point?
           a) point B   b) point C   c) point D   d) point E

iv) Which point corresponds to breaking point or breaking stress?
    a) The stress corresponding to point A
    b) The stress corresponding to point B
    c) The stress corresponding to point D
    d) The stress corresponding to point E

30. **Read the following paragraph and answer the questions that follow.**

To verify the laws of limiting friction, we take two exactly identical rectangular blocks of wood A and B, each of same weight 'mg'. Each block is provided with a hook on one side. The block is placed on a horizontal table provided with a frictionless pulley on one side, fig 3.1. One end of the string is attached to the hook of the block. The string is then passed over the pulley and a pan is attached to the free end of the string. Any number of weights can be added to the pan. We adjust the weights in the pan till the block just begins to move. The applied force 'P' at this stage gives us a measure of force of limiting friction 'F'. All blocks and weights are similar. Block applies a force equal to its weight on the table and in return table provides normal reaction 'R'. Carefully observe the blocks and number of weights in the pan and answer the following questions.
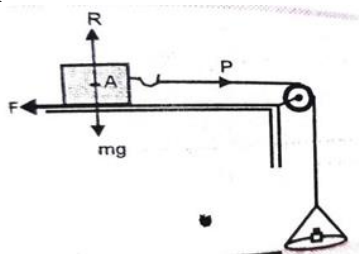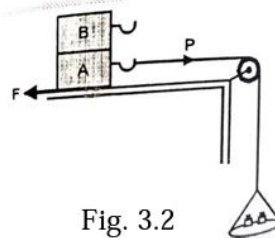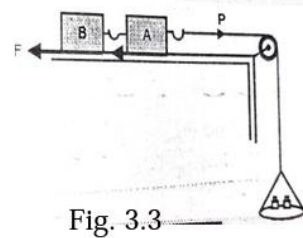

Fig. 3.1   Fig. 3.2   Fig. 3.3

i. Refer fig 3.1 and 3.2 it was observed that when only one block was placed, it could be just moved by placing one weight in pan and when two blocks were placed one over the other, then two weights were required to just move the blocks. This gives that
    a) frictional force is directly proportional to the normal reaction.
    b) frictional force is directly proportional to the square of normal reaction.
    c) frictional force is inversely proportional to the normal reaction.
    d) frictional force is inversely proportional to the square of normal reaction.

ii. Which one of the statements is not correct about friction?
    a) Friction is a self-adjusting force.
    b) Force of friction is independent of area of contact as long as normal reaction remains same.
    c) Kinetic friction is greater than static friction.
    d) Limiting friction is the maximum static friction.

iii. Take the rectangular block 'A'. Make one surface of 'A' smooth and well-polished and the opposite surface of 'A' very rough. Find the force of limiting friction by putting weights, when (i) rough surface is in contact with the table and (ii) when smooth surface is in contact with the table. We observe that more weight is required in case of (i) than in case of (ii). This suggests that

a) force of friction is directly proportional to the area of contact.
b) force of friction is always equal to applied force.
c) force of friction is independent of nature of surface.
d) force of friction is more between rough surfaces than between smooth surfaces.

  iv. A force of 49 N is just able to move a block of wood of weight 10 kg on a rough horizontal surface. The coefficient of friction is
    a) 0.5
    b) 1
    c) 1.5
    d) 2

<div align="center">OR</div>

What will be the maximum acceleration of the train in which a box lying on the floor will remain stationary? Given that the coefficient of friction between the box and train's floor is 0.15. (g= 10m/s^2).
    a) 1 ms^{-2}
    b) 2 ms^{-2}
    c) 1.5 ms^{-2}
    d) 2.5 ms^{-2}

<div align="center"><u>SECTION E</u></div>

31. What is a projectile? Show that the path followed by a projectile is parabola.
Derive an expression for the maximum height attained by the projectile, when it is fired at an angle θ with the horizontal.

<div align="center">OR</div>

a) State triangle law of vector addition.
b) Find the magnitude of the resultant of two vectors A and B inclined at an angle θ with the help of a diagram analytically.
c) What happens to the magnitude of the resultant vector when $\theta = 0^0$ and $\theta = 90^0$?

32. State and prove Bernoulli's theorem with suitable diagram and explain an application of Bernoulli's theorem.

<div align="center">OR</div>

a) Distinguish between streamline and turbulent flow of a liquid.

b) Discuss Pascal's law with an example.

c) A hydraulic jack has an input piston of area 0.050 m/s^2 and an output piston of area 0.70 m/s^2. How much force on the input piston is required to lift a car weighing 12000 N? What pressure is applied on the input piston?

33. Define simple harmonic motion. Derive an expression for the displacement, velocity and acceleration of a particle executing simple harmonic motion.
Draw the graph relating the [i] displacement with time [ii] velocity with time.

OR

a) Derive an expression to find the total energy of a particle executing simple harmonic motion. Represent graphically, the variations of energy with displacement.

b) Derive an expression for time period of a simple pendulum with the help of diagram.