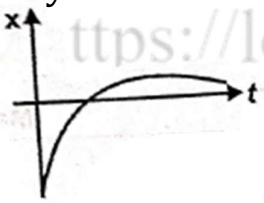
CLASS XI - PHYSICS

✣ General instructions:

(1) There are 35 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. All the sections are compulsory.
(3) Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, section D contains three long questions of five marks each and Section E contains two case study based questions of 4 marks each.
(4) There is no overall choice. However, an internal choice has been provided in section B, C, D and E. You have to attempt only one of the choices in such questions.
(5) Use of calculators is not allowed.

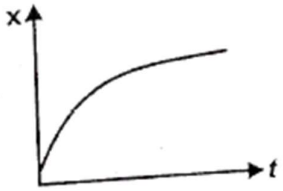
✣ SECTION A

1. The mass and volume of a body are 4.237 g and 2.5 cm^3, respectively. The density of the material of the body in correct significant figures is
   (a) 1.6048 g. cm^3 (b) 1.69 g cm^3
   (c) 1.7 g cm^3 (d) 1.695 gcm^{-3}
2. Among the four graphs shown in the figure, which one is most suited graph for which average velocity over the time interval (0, t) can vanish for a suitably chosen t?

(a) 

(b) 

(c) 

(d) 

3. The Angle between A=i+j and B=i-j is
   (a) 45 (b) 90° (c) -45° (d) 180°
4. No force is required for
   (a) An object moving in straight line with constant velocity
   (b) An object moving in circular motion
   (c) An object moving with constant acceleration

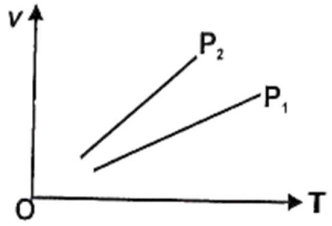
(d) An object moving in elliptical path

5. If $\lambda i + 2\lambda j + 2\lambda k$ is a unit vector, then the value of λ is
   (a) 1/3 (b) ½
   (c) ¼ (d) 1/9
6. A bullet of mass 10 g leaves a rifle at an initial velocity of 1000 m/s and strikes the earth at the same level with a velocity of 600 m/s. The work done in joule overcoming the resistance of air will be
   (a) 375 (b) 3750 (c) 5000 (d) 500
7. A shell, in flight, explodes into unequal parts. Which of the following is conserved?
   (a) Potential energy (b) Momentum
   (c) Kinetic energy (d) Both (a) and (b)
8. Three masses of 2 Kg, 4Kg and 4 Kg are placed at the three points (1, 0, 0), (1, 1, 0) and (0, 1, 0) respectively. The position vector of its centre of mass is
   (a) $3/5\ i + 4/5\ j$ (b) $3i + j$
   (c) $2/5\ i + 4/5\ j$ (d) $1/5\ i + 3/5\ j$
9. A body rolls without slipping. The radius of gyration of the body about an axis passing through its centre of mass is K. If radius the body be R, then what is the ratio of its rotational K.E. transitional K.E.?
   (a) K^2/R^2 (b) $K^2/(K^2 + R^2)$
   (c) $R^2/(K^2 + R^2)$ (d) $K^2 + R^2$
10. Satellites orbiting the earth have finite life and sometimes debris of satellites fall to the earth. This is because
    (a) the solar cells and batteries in satellites run out
    (b) the laws of gravitation predict a trajectory spiralling inwards
    (c) of viscous forces causing the speed of satellite and hence height To gradually decrease
    (d) of collisions with other satellites
11. Modulus of rigidity of ideal liquids is
    (a) infinity (b) zero
    (c) unity (d) some finite small non-zero constant value
12. Heat is associated with
    (a) kinetic energy of random motion of molecules
    (b) kinetic energy of orderly motion of molecules
    (c) total kinetic energy of random and orderly motion of

molecules

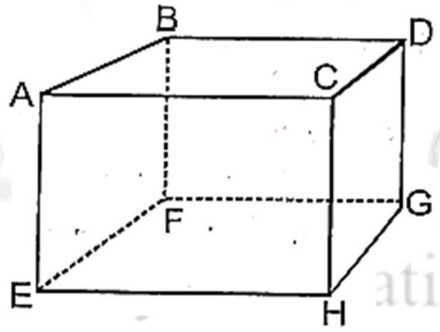
(d) kinetic energy of random motion in some cases and kinetic energy of orderly motion in other

13. The volume (V) versus temperature(T) graphs for a certain amount of a perfect gas at two pressures P_1 and P_2 are shown in figure. It follows from the graphs that



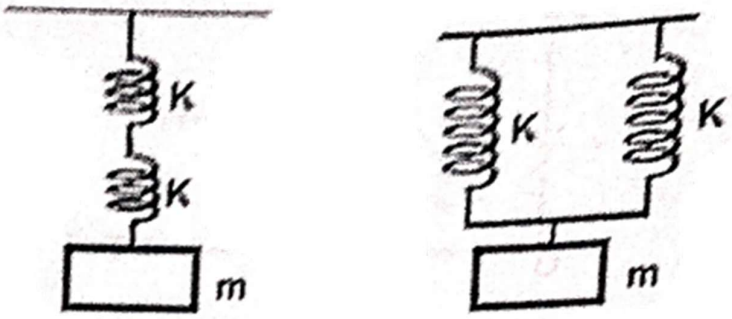
(a) $P_1 > P2$ (b) $P_1 < P2$
(c) $P_1 = P2$ (d) Information is insufficient to draw any conclusion

14. 1 mole of an ideal gas is contained in a cubical volume V, ABCDEFGH at 300 K (figure). One face of the cube (EFGH) is made up of a material which totally absorbs any gas molecule incident on it. At any given time,



(a) the pressure on EFGH would be zero
(b) the pressure on all the faces will be equal
(c) the pressure of EFGH would be double the pressure on ABCD
(d) the pressure on EFGH would be half that on ABCD

15. Two identical springs of constant k are connected in series and parallel as shown in the figure



A mass m is suspended from then. The ratio of their frequencies of vertical oscillations will be

(a) 2:1 (b) 1:1 (c) 1: 2 (d) 4:1

16. Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.
    a) Both A and R are true and R is the correct explanation of A
    b) Both A and R are true and R is NOT the correct explanation of A
    c) A is true but R is false
    d) A is false and R is also false

    ASSERTION(A): It is difficult to move a cycle along the road with its brakes on.

    REASON(R): Sliding friction is greater than rolling friction

17. Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.
    a) Both A and R are true and R is the correct explanation of A
    b) Both A and R are true and R is NOT the correct explanation of A
    c) A is true but R is false
    d) A is false and R is also false

    ASSERTION(A): Torque on a body can be zero even if there is a net force on it.

    REASON(R): Torque and force on a body are always perpendicular.

18. Two statements are given-one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below.
    a) Both A and R are true and R is the correct explanation of A
    b) Both A and R are true and R is NOT the correct explanation of A
    c) A is true but R is false
    d) A is false and R is also false

    Assertion(A): When a bottle of cold carbonated drink is opened, a slight fog forms around the opening.

    REASON(R): Adiabatic expansion of the gas causes lowering of temperature and condensation of water vapours.

✣ SECTION B

19. If $x=2at-5bt^2$, where x is in meters and t in seconds, find the

dimensions of a and b.

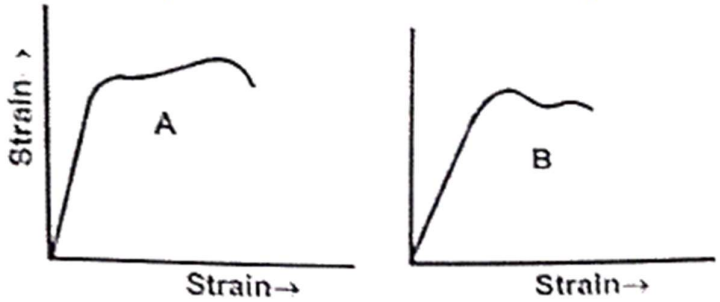
20. A projectile is projected with velocity u making angle with horizontal direction, find (a) time of flight (b) horizontal range
21. A man weighs 70 kg. He stands on a weighing machine in a lift, which is moving
    (i) Upwards with a uniform speed of 10m/s.
    (ii) Downwards with a uniform acceleration of 5 m/s.
    Calculate his apparent weight in the two cases.
22. Assuming the earth to be sphere of uniform mass density, how much would a body weigh half way down to the centre of earth if it weighed 250 N on the surface?
23. A U-shaped wire is dipped in a soap solution, and removed. the thin soap film formed between the wire and a light slider supports a weight of 1.5×10^{-2} N (which includes the small weight of the slider). The length of the slider is 30 cm. What is the surface tension of the film?

    OR

    A hydraulic automobile lift is designed to lift cars with a maximum mass of 3000kg. the area of cross-section of the piston carrying the load is 425 cm^2. What maximum pressure would the smaller piston have to bear?
24. What do you understand by reversible process and irreversible process? Give an example of each
25. Define wave velocity or phase velocity. Deduce its relation with angular frequency and propagation constant k.

✣ SECTION C

26. Draw the following graphs for an object projected upward with a velocity vo, which comes back to the same point after some time:
    (i) acceleration versus time graph
    (ii) speed versus time graph
    (iii) velocity versus time graph
27. Define Angular velocity and Angular acceleration. Derive an expression for centripetal acceleration of uniform circular motion of an object.
28. The stress strain graphs for materials A and B are shown in fig. The graphs are drawn to same scale.



(a) Which of the material has greater Young's modulus?
(b) Which material is more ductile?
(c) Which of the two is stronger material? Justify your answer.

OR

What is meant by elastic potential energy? Derive an expression for the elastic potential energy of stretched wire. Prove that its elastic energy density is equal to ½ stress x strain

29. Define coefficient of linear expansion and hence Derive the relation between coefficient of linear expansion and coefficient of volumetric expansion.
30. Using suitable diagrams and necessary expressions show that only odd harmonics are formed in a closed organ pipe.

✣ SECTION D

31. What is meant by banking of roads? What is need for banking of a road? Obtain an expression for the maximum speed with which a vehicle can safely negotiate a curved road banked at an angle θ. the coefficient of friction between the wheels and road is μ

OR

Define the term static friction, limiting friction and kinetic friction. Draw the graph between friction and applied force on any object and show static friction, limiting friction and kinetic friction in graph.

32. (a) What is meant by collision in physics? Differentiate between elastic and inelastic collision. Give one example each.
(b) A molecule in a gas container hits a horizontal wall with speed 200 m/s and angle 30° with the normal and rebounds with the same speed. is momentum conserved in collision? Is the collision elastic or inelastic?

OR

How does a perfectly inelastic collision differ from a perfectly elastic collision? Two particles of mass m1 and m2 having velocities U_1 and U_2

respectively make a head on collision. Derive the relation for their final velocities. Discuss the following special cases.

(i) $m_1 = m_2$

(ii) $m_1 >> m_2$ and $U_2 = 0$

(iii) $m_1 << m_2$ and $U_1 = 0$

33. (a) State Bernoulli's equation.

(b) Name the physical quantity corresponding to each term of this equation.

(c) What type of fluid obeys this equation?

(d) Show that this equation is same as due to Pascal's law in the presence of gravity if liquid or gas is at rest.

OR

(a) How do the insects run on surface of water?

(b) Derive an expression for excess pressure inside a soap bubble.

(c) Define the term surface energy. Write down its dimensional formula and units.

✤ SECTION E

34. **Case Study**: Angular momentum is the property of a rotating body given by the product of moment of inertia and angular velocity of rotating object. It is a vector quantity, which implies that the direction is also considered here along with magnitude the law of conservation of angular momentum states that when no external torque acts on an object, no change of angular momentum occurs. A rotational or twisting effect of a force is known as torque. The relationship between torque and angular momentum is given by the formula

$$\vec{r} = d\vec{L}/d\vec{t}$$

(a) Write the dimensional formula of angular momentum.

(b) If net torque is zero, then angular Momentum is constant.

(c) Calculate the angular momentum of the object, when an object with the moment of inertia I= 5 kgm^2 is made to rotate 1 rad/sec speed

OR

How can an ice skater increases or decrease his/her spinning speed?.

35. Case study:

When we speak, the sound moves outward from us, without any flow of air from one part of the medium to another. The disturbances produced in air are much less obvious and only our ears or a microphone can detect them. These patterns, which move without the actual physical transfer or flow of matter as a whole, are called waves. The most familiar type of waves such as waves on a string, water waves, sound waves, seismic waves, etc. is the so-called mechanical waves. These waves require a medium for propagation, they cannot propagate through vacuum. They involve oscillations of constituent particles and depend on the elastic properties of the medium. The electromagnetic waves that you will learn in Class XII are a different type of wave. Electromagnetic waves do not necessarily require a medium – they can travel through vacuum. Light, radio waves, X-rays, are all electromagnetic waves. We have seen that motion of mechanical waves involves oscillations of constituents of the medium. If the constituents of the medium oscillate perpendicular to the direction of wave propagation, we call the wave a transverse wave. If they oscillate along the direction of wave propagation, we call the wave a longitudinal wave. In transverse waves, the particle motion is normal to the direction of propagation of the wave. Therefore, as the wave propagates, each element of the medium undergoes a shearing strain. Transverse waves can, therefore, be propagated only in those media, which can sustain shearing stress, such as solids and not in fluids. Fluids, as well as, solids can sustain compressive strain; therefore, longitudinal waves can be propagated in all elastic media. For example, in medium like steel, both transverse and longitudinal waves can propagate, while air can sustain only longitudinal waves. Answer the following.

1) Air can sustain
   a) Transverse waves
   b) longitudinal waves
   c) both a and b
   d) none of these
2) The electromagnetic waves can pass through
   a) Solids only

b) Fluids only
c) Any medium even through vacuum
d) None of these

3) Define Transverse waves and longitudinal waves

OR

Differentiate between Transverse waves and longitudinal waves (Any two points)

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