

**CBSE Class – XI**  
**Physics (Set 3)**  
**Last year Paper (2015-16)**

Time: 3 Hrs. M.M: 70

**General Instructions:**

- (i) Question 1 to 5 one mark.
- (ii) Question 6 to 10 each two mark.
- (iii) Question 11 to 22 each three mark.
- (iv) Question 23 is value based question and carry four marks.
- (v) Questions 24 to 26 each five mark.

**Section A**

1. Find the dimensional formula for coefficient of viscosity ( $\eta$ ).
2. Write properties of an ideal fluid.
3. If pressure is made 16 times, what will be the effect on the velocity of sound?
4. Given that for two vectors A and B,  $|A \times B| = |AB|$ . Find the acute angle between A and B.
5. A body of mass m is oscillating harmonically suspended from a mass less spring of spring constant k. What is the time period?

**Section B**

6. If  $a = 2\hat{i} + 3\hat{j} - 4\hat{k}$  and  $b = 4\hat{i} + 3\hat{j} - 2\hat{k}$ . Find the angle between a and b.

**Or**

Establish the given vector inequality geometrically or otherwise  $|a + b| \leq |a| + |b|$  When does the equality sign above apply?

From the properties of a triangle, one side of a triangle is always less than the sum of the lengths of its two other sides.

7. Define inertial and non-inertial frame of references. What is pseudo force?
8. Solve the expression for potential energy of a spring when elongation in the spring is x.

9. Write expression for work done in blowing a soap bubble from radius  $r_1$  to  $r_2$ . Calculate it to increase radius from  $r$  to  $2r$ .

10. A Carnot's engine has the same efficiency

(i) between 500 K and 100 K

(ii) between 1000 K and  $T$  K

Find the value of  $T$ .

### Section C

11. (i) Using the relation  $E = h\nu$ , obtain the dimensions of Planck constant.

(ii) The resistance  $R$  is given by relation

$R = V/I$ . If potential difference  $V$  is  $100 \pm 5V$  and current  $I$  is  $10 \pm 0.2$  A. Calculate the percentage error in  $R$ .

12. A car accelerates from rest to a constant rate  $a$  for some time, after which it decelerates at a constant rate  $p$  to come to rest. If  $t$  is the total time elapsed, then calculate

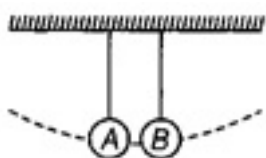
(i) the maximum velocity attained by the car.

(ii) the total distance travelled by the car.

13. A projectile is fired horizontally from the top of a tower. Find the expression for its time of descent and horizontal range.

14. Distinguish between static friction, limiting friction and kinetic friction. How do they vary with the applied force, explain by diagram.

15. Two pendulums with identical bobs and lengths are suspended from a common support such that in rest position the two bobs are in contact as shown in figure alongside. One of the bobs is released after being displaced by  $10^\circ$  so that it collides elastically head-on with the other bob.



(i) Describe the motion of two bobs.

(ii) Draw a graph showing variation in energy of either pendulum with time, for  $0 \leq t \leq 2t$ , where  $T$  is the time period of each pendulum.

16.  $(n-1)$  equal point masses each of mass  $m$  are placed at the vertices of a regular  $n$  polygon. The vacant vertex has a position vector  $a$  with respect to the centre of the polygon. Find the position vector of centre of mass.

17. Obtain an expression for escape velocity from energy considerations.
18. (i) Write the Hooke's law.
- (ii) A steel wire of length 4 m and diameter 0.5 mm is stretched by a one-kilogram weight. Find the increase in its length if the Young's modulus of steel wire is  $2.4 \times 10^{11} \text{ N/m}^2$

Or

Two mercury droplets of radii 0.1 cm and 0.2 cm collapse into one single drop. What amount of energy is released? The surface tension of mercury is  $435.5 \times 10^{-3} \text{ N/m}$ .

19. Consider a cycle tyre being filled with air by a pump. Let  $V$  be the volume of the tyre (fixed) and at each stroke of the pump  $\Delta V$  ( $\ll V$ ) of air is transferred to the tube adiabatically. What is the work done when the pressure in the tube is increased from  $p_1$  to  $p_2$ ?
20. A gas mixture consists of molecules of types A, B and C with masses  $m_A > m_B > m_C$ . Rank three types of molecules in decreasing order of
- (i) average KE
- (ii) rms speeds
21. A cylindrical piece of cork of density  $\rho$ , base area  $A$  and height  $h$  floats in a liquid of density  $\rho_1$ . The cork is depressed slightly and then released. Show that the cork oscillates up and down simple harmonically with a period

$$T = 2\pi \sqrt{\frac{h\rho}{\rho_1 g}}$$

where,  $\rho$  is the density of cork. (Ignore damping due to viscosity of the liquid).

22. Show that when a string fixed at its two ends vibrates in 1 loop, 2 loops, 3 loops and 4 loops, then frequencies are in the ratio 1 : 2 : 3 : 4.

### Section D

23. Kailash and Kamal were going to the market when they spotted a man who left a black bag in the corner of a stall and ran away. They went near to it and heard some sound tic-tic coming from it. They immediately informed the police and alerted the people nearby. By their alertness, a major tragedy was averted.

- (i) How can we appreciate Kailash and Kamal?
- (ii) A bomb at rest explodes into 2 fragments of mass 3 kg and 1 kg. The total KE of fragments is  $6 \times 10^4 \text{ J}$ . Calculate the KE of bigger fragment.
- (iii) Which type of collision, elastic or inelastic, is momentum conserved?

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### Section E

24. (i) The displacement of a body is given to be proportional to the cube of time elapsed. What is the nature of the acceleration of the body? Justify your answer.
- (ii) A car accelerates from rest at a constant rate of  $\alpha$  for some time after which it decelerates at constant rate of  $\beta$  to come to rest. If the total time elapsed is T second.
- (a) Draw a velocity-time graph for the motion.
- (b) Calculate maximum velocity attained in terms of  $\alpha, \beta$  and T.

Or

- (i) From the top of a building, a ball is dropped while another is projected horizontally at the same time.
- (a) Which ball will strike the ground first?
- (b) Which will strike the ground with more speed?

**Justify your answer in each case.**

- (ii) A body is projected with speed  $u$  at an angle  $\theta$  to the horizontal to have maximum range. What is velocity at the highest point?
- (iii) What is the angle of projection of a projectile motion whose range  $R$  is  $n$  times the maximum height?
25. (i) Is the centrifugal force a reaction of the centripetal force? Give reason for your answer.
- (ii) What is the effect of reversing the sense of revolution on the centripetal force?
- (iii) What provide the centripetal force to a car taking a turn on level road?
- (iv) What is angle of banking?
- (v) What is the advantage of banking?

Or

- (i) A lawn mover is pulled with some external force. Draw a free body diagram of the system to show all the forces acting on it. Why is it easier to pull it rather than push it?
- (ii) Why vehicles are provided with round tyres only and not any other shape?
- (iii) Mention two instances when friction between two surfaces is deliberately increased. Justify the action in each case.

26. Explain the Magnus effect with respect to the motion of a moving ball. What do you understand by viscosity? Give its dimensions and SI unit. On what factors does the coefficient of viscosity of a liquid depend?

**Or**

State Stoke's law for the viscous drag experienced by the spherical body falling through a viscous liquid. Why does a spherical body achieve terminal speed? On what factors does the terminal speed depend? Give one example each of motion around us with

- (i) positive and
- (ii) negative terminal velocity.