AEEJAY COMMON ANNUAL EXAMINATION, 2012
CLASS – XI
PHYSICS

TIME ALLOWED : 3 Hrs.  
MAXIMUM MARKS : 70

General instructions:

- All the questions are compulsory.
- Question no 1 to 8 carry one mark each, question no 9 to 18 carry two marks each, question no 19 to 27 carry three marks each and question no 28 to 30 carry five marks each.
- There is no overall choice though there is an internal choice has been provided in one question of 2 marks, one question of three marks and all questions of 5 marks.
- Use of calculators is not allowed. However, you may use log tables, if required.

1. What is the nature of the graph between pressure (P) and volume (V) for a given mass of an ideal gas at a fixed temperature? [1]

2. If earth were to be at one eighth of its present distance from the sun, how many days will there be in one year? [1]

3. Arrange in increasing order the tensions T₁, T₂ and T₃ in the given figure. [1]

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m     T₁     m  
m     T₂     m  
m     T₃     m  
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4. The stress and strain graphs for material A and B are shown in figures below.

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Stress  Stress
|      |      |
|      |      |
Strain  Strain
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[P.T.O.]
The graphs are drawn to the same scale.

(A) Which of the materials has the greater Young's modulus? 
(B) Which of the two is the stronger material? 

5. State the conditions necessary for a satellite to appear stationary. 

6. What is the difference between 2.0 and 2.000? 

7. Why is the tip of the nib of a pen split? 

8. A marble floor appears colder than wooden floor in winter though both are at the same temperature. Why? 

9. Find the dimensions of a and b in the relation

\[ E = \frac{b - x^2}{at} \]

where E, x and t represent energy, distance and time respectively. 

10. Derive the second equation of motion. Also draw a position – time graph for negative acceleration. 

11. A pebble of mass 0.05 kg is thrown vertically upwards. Give the magnitude of the net force on the pebble, 
(a) during its upward motion,  
(b) during its downward motion, 
(c) at the highest point where it is momentarily at rest. 
(d) Do your answers change if the pebble was thrown at an angle of 45° with the horizontal direction? 

Ignore air resistance. 

12. A reversible engine operates with an efficiency of 50%. If during each cycle, it rejects 150 cal to a reservoir of heat at 30°C, then 
(a) What is the temperature of the other reservoir ?  
(b) How much work does it carry out per cycle ? 

13. At what temperature is the rms velocity of hydrogen molecule equal to that of an oxygen molecule at 47°C? 

14. A transverse harmonic wave on a string is described by 

\[ y(x, t) = 3 \sin \left( 36t + 0.018x + \pi/4 \right) \]

where x and y are in cm and t in second. The positive direction of x is from left to right. 

What is the direction of propagation of this wave? Find the speed, amplitude and frequency of this wave?
15. State the law of equipartition of energy. Using this law show that $\gamma = \frac{5}{3}$ for an ideal monoatomic gas, where $\gamma = \frac{C_p}{C_v}$.

16. Derive an expression for the work done during an isothermal process.

17. State the principle of conservation of linear momentum. Calculate the recoil velocity of the gun when a bullet is fired from it.

18. The velocity time graph of an object moving along a straight line is as shown in figure:

![Velocity Time Graph](image)

Calculate the distance travelled by the object:

(a) between $t = 0$ sec to $t = 5$ sec.
(b) between $t = 0$ sec to $t = 10$ sec.

OR

Rain is falling vertically with a speed of $30 \text{ ms}^{-1}$. A woman rides a bicycle with a speed of $10 \text{ m s}^{-1}$ in the north to south direction. What is the direction in which she should hold her umbrella?

19. (a) What do you understand by the terms 'nodes' and 'antinodes' for a stationary wave.
(b) A child swinging on a swing in sitting position stands up. How will the time period of the swing change?
(c) What will be the change in the time period of a simple pendulum when taken to the moon?

20. State the theorems of perpendicular axes and parallel axes. The moment of inertia a solid sphere about tangent is $\frac{7}{5}MR^2$, where $M$ is mass and $R$ is radius of the sphere.

Find the moment of inertia the sphere about its diameter.
21. Four particles of masses 2m, m, 4m and 3m are placed at the corners A, B, C and D respectively of a square of each side 'a' as shown in figure. Find the position of the centre of mass of the system.

22. A cricket ball is thrown at a speed of 28 ms\(^{-1}\) at an angle of 30° to the horizontal. Calculate
(a) The maximum height.
(b) The time taken by the ball to return to the same level.
(c) The distance from the thrower to the point where the ball returns to the same level.

23. A particle starts from the origin at \( t = 0 \) second with a velocity of \( 10 \hat{i} \) m/s and moves in the x-y plane with a constant acceleration of \( (8\hat{i} + 2\hat{j}) \) m/s\(^{-2}\).
(a) At what time is the x-coordinate of the particle 16 m?
(b) What is the y-coordinate of the particle at that time?
(c) What is the speed of the particle at that time?

24. Show that the value of 'g' decreases with the altitude. Hence find the value of 'g' at a height \( h \), when \( h \) is very small as compared to the radius \( R \) of the earth.

25. A liquid drop of diameter 4mm breaks into 1000 droplets of equal size. Calculate the resultant change in energy. The surface tension of the liquid is 0.07 N/m.

26. Show that when two bodies of equal masses undergo an elastic collision in one dimension they exchange their velocities after collision.

27. State work energy theorem. The momentum of a body of mass 5 Kg is 500 Kg-ms\(^{-1}\). Find its kinetic energy.

OR

A body of mass 1 kg initially at rest is moved by a horizontal force of 0.5 N on a smooth frictionless table. Calculate the work done by the force in 10s and show that it is equal to the change in the kinetic energy of the body.
28. What is banking of circular tracks? Calculate the maximum permissible speed with which a car can negotiate a circular track of radius \( R \) banked at an angle \( \theta \) given that the coefficient of limiting friction between tyres and the road is \( \mu_s \). [5]

OR

(a) What do you understand by angle of repose? Obtain its relation with the angle of friction.

(b) The driver of a three-wheeler moving with a speed of 36 km/h sees a child standing in the middle of the road and brings his vehicle to rest in 4.0 s just in time to save the child. What is the average retarding force on the vehicle? The mass of the three-wheeler is 400 kg and the mass of the driver is 65 kg. [5]

29. (a) State Pascal’s law. With the help of a diagram explain the working of hydraulic lift.

(b) A U tube contains water and olive oil separated by mercury. The mercury column in the two arms are in level with 12 cm of water in one arm and 7.5 cm olive oil in the other. What is the relative density of the olive oil? (relative density of mercury = 13.6). [5]

OR

(a) State and prove Bernoulli’s theorem.

(b) In a test experiment on a model airplane in a wind tunnel, the flow speeds on the upper and lower surfaces of the wing are 70 ms\(^{-1}\) and 63 ms\(^{-1}\) respectively. What is the lift on the wing if its area is 2.5 m\(^2\) ? Take density of air to be 1.3 kg m\(^{-3}\). [5]

30. Derive expressions for the kinetic and potential energies of a harmonic oscillator. Show that the total energy is conserved in S.H.M. Also draw a energy –time graph representing energy conservation. [5]

OR

(a) Derive an expression for the time period of simple pendulum.

(b) A string of mass 2.50 kg is under a tension of 200 N. The length of the stretched string is 20.0 m. If a transverse jerk is struck at one end of the string, how long does the disturbance take to reach the other end? [5]