Class 11 - Physics

Maximum Marks: 70
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. All the sections are compulsory.
3. 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 questions of four marks each and Section E contains three long answer questions of five 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 number of significant digits in 2.64×10^{24} is

    a) 1
    b) 2
    c) 3
    d) 4

2. The pitch of a note depends upon its

    a) Intensity
    b) Frequency
    c) Amplitude
    d) Velocity

3. The front wheel on an ancient bicycle has radius 0.5 m. It moves with angular velocity given by the function $\omega(t) = 2 + 4t^2$, where t is in seconds. About how far does the bicycle move between t = 2 and t = 3 seconds?

    a) 27 m
    b) 14 m
    c) 36 m
    d) 21 m

4. Bernoulli's equation is an example of conservation of

    a) momentum
    b) angular momentum
    c) mass

d) energy

5. The ratio of escape velocity at earth (v_e) to the escape velocity at a planet (u_p) whose radius and mean density are twice as that of earth is:

a) $1 : 2\sqrt{2}$
b) 1 : 4
c) $1 : \sqrt{2}$
d) 1 : 2

6. Electromagnetic waves are different from sound waves in that:

a) they need no medium and are longitudinal.
b) they need medium and are transverse.
c) they need no medium and are transverse.
d) they need medium and are longitudinal.

7. A body sliding down on a smooth inclined plane slides down one fourth distance in 2s. It will slide down the complete plane in:

a) 3 s
b) 5 s
c) 2 s
d) 4s

8. Change in temperature of the medium changes

a) frequency of sound waves
b) wavelength of sound waves
c) amplitude of sound waves
d) loudness of sound waves.

9. 8 mercury drops coalesce to form 1 mercury drop, the energy changes by a factor of

a) 4
b) 2
c) 6
d) 1

10. The period of a planet around sun is 27 times that of earth. The ratio of radius of planet's orbit to the radius of earth's orbit is:

a) 27
b) 4
c) 9
d) 64

11. A flywheel is attached to an engine to

a) decrease its speed
b) decrease its energy

c) increase its speed
d) help in overcoming the dead point

12. When a body is heated, then maximum rise will be in its

a) surface area
b) density
c) volume
d) length

13. **Assertion (A):** If momentum of a body increases by 50%, its kinetic energy will increase by 125%.
Reason (R): Kinetic energy is proportional to the square of velocity.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

14. **Assertion (A):** A refrigerator transfers heat from lower temperature to higher temperature.
Reason (R): Heat cannot be transferred from lower temperature to higher temperature.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

15. **Assertion:** Escape velocity of a satellite is greater than its orbital velocity.
Reason: Orbit of a satellite is within the gravitational field of planet whereas escaping is beyond the gravitational field of planet.

a) Assertion and reason both are correct statements and reason is correct explanation for assertion.
b) Assertion and reason both are correct statements but reason is not correct explanation for assertion.
c) Assertion is correct statement but reason is wrong statement.
d) Assertion is wrong statement but reason is correct statement.

16. **Assertion (A):** Whenever a particle moves in a circular path with uniform speed, an acceleration exists which is directed towards the centre.
Reason (R): The net acceleration of a particle in circular motion is always radially inward.

a) Both A and R are true and R is the correct explanation of A.
b) Both A and R are true but R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

Section B

17. A metre-long tube open at one end, with a movable piston at the other end, shows resonance with a fixed frequency source (a tuning fork of frequency 340 Hz) when the tube length is 25.5cm or 79.3cm. Estimate the speed of sound in air

at the temperature of the experiment. The edge effects may be neglected.

18. Differentiate between dimensional and non-dimensional variables.

19. State the rules for finding the number of significant figures in a measurement.

20. Explain why a cricketer moves his hands backward while holding a catch.

21. What would happen if the force of gravity were to disappear suddenly?

OR

What is Kepler's law of periods? Show it mathematically.

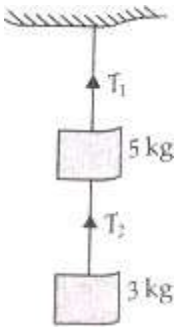
Section C

22. Water from a tap emerges vertically downward with an initial speed of 1.0 ms^{-1}. The cross-sectional area of the tap is 10^{-4} m^2. Assume that the pressure is constant throughout the stream of water, and that the flow is steady. What is the cross- sectional area of the stream 0.15 m below the tap?

23. Define the three modes of transfer of heat from one object to another. Also cite one example for each one of them.

24. Establish the relation S_{nth} = u + a$\frac{(2n-1)}{2}$where the letters have their usual meanings.

25. Two masses of 5 kg and 3 kg are suspended with help of massless inextensible strings as shown in Figure. Calculate T_1 and T_2 when whole system is going upwards with acceleration = 2 ms^{-2} (use g = 9.8 ms^{-2})



26. What is a refrigerator? Draw a schematic representation of a refrigerator.

27. A small body tied to one end of the string is whirled in a vertical circle. Represent the forces on a diagram when the string makes an angle θ with initial position below the fixed point. Find an expression for the tension in the string. Also, find the tension and velocity at the lowest and highest points respectively.

28. On the basis of Bernoulli's principle, explain the lift of an aircraft wing.

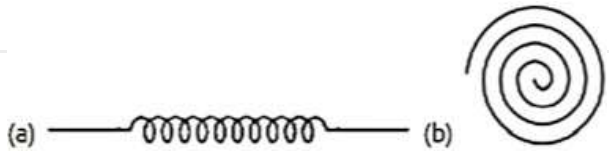
OR

If a number of little droplets of water, each of radius r, coalesce to form a single drop of radius R, show that the rise in temperature will be given by $\Delta\theta = \frac{3\sigma}{J}\left(\frac{1}{r} - \frac{1}{R}\right)$ where σ is the surface tension of water and J is the mechanical equivalent of heat.

Section D

29. **Read the text carefully and answer the questions:**

There are many types of spring. Important among these are helical and spiral springs as shown in the figure.



Usually, we assume that the springs are massless. Therefore, work done is stored in the spring in the form of the elastic potential energy of the spring. Thus, the potential energy of a spring is the energy associated with the state of compression or expansion of an elastic spring.

i. The potential energy of a spring increases in which of the following cases?

a) If work is done against conservative force
b) If work is done by non-conservative force
c) If work is done by conservative force
d) If work is done against non-conservative force

ii. The potential energy, i.e. U(x) can be assumed zero when

a) gravitational force is constant
b) x = 0
c) infinite distance from the gravitational source
d) All of these

iii. The ratio of spring constants of two springs is 2 : 3. What is the ratio of their potential energy, if they are stretched by the same force?

a) 3 : 2
b) 9 : 4
c) 2 : 3
d) 4 : 9

OR

The potential energy of a spring when stretched through a distance x is 10 J. What is the amount of work done on the same spring to stretch it through an additional distance x?

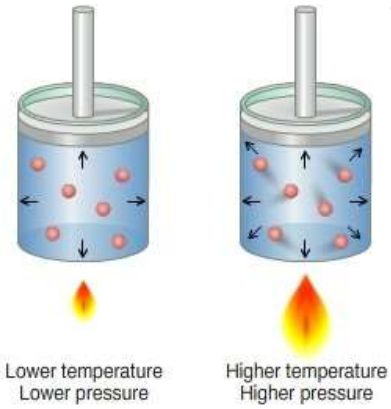
a) 40 J
b) 10 J
c) 30 J
d) 20 J

iv. The potential energy of a spring increases by 15 J when stretched by 3 cm. If it is stretched by 4 cm, the increase in potential energy is

a) 36 J
b) 30 J
c) 27 J
d) 33 J

30. **Read the text carefully and answer the questions:**

In a gas the particles are always in a state of random motion, all the particles move at different speed constantly colliding and changing their speed and direction, as speed increases it will result in an increase in its kinetic energy.



i. If the temperature of the gas increases from 300 K to 600 K then the average kinetic energy becomes:

a) same
b) becomes double
c) becomes half
d) become triple

ii. What is the average velocity of the molecules of an ideal gas?

a) Infinite
b) Same
c) Increase
d) Zero

iii. Cooking gas containers are kept in a lorry moving with uniform speed. The temperature of the gas molecules inside will _____.

a) decrease
b) Rises
c) increase
d) remains same

iv. Find the ratio of average kinetic energy per molecule of Oxygen and Hydrogen:

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

OR

The velocities of the three molecules are 3v, 4v, and 5v. calculate their root mean square velocity?

a) 4.0 v
b) 4.02 v
c) 4.08 v

d) 4.04 v

Section E

31. A cylindrical piece of cork of base area A, density ρ and height L floats in a liquid of density ρ_L. The cork is depressed slightly and then released. Show that the cork oscillates up and down simple harmonically and find its time period of oscillations.

OR

Explain the total energy in simple harmonic motion and show the graphical representation of energy in SHM.

32. A particle is thrown from a satellite revolving around earth in such a way that it escape from earth. Prove that its escape velocity should be $\sqrt{2}$ times the orbital velocity of satellite.

OR

State triangle law of vector addition. Give analytical treatment to find the magnitude and direction of a resultant vector by using this law.

33. Derive an expression for moment of inertia of a circular disc about an axis passing through its centre and perpendicular to its plane.

OR

a. Find the moment of inertia of a sphere about a tangent to the sphere, given the moment of inertia of the sphere about any of its diameters to be $^{2MR^2}$, where M is the mass of the sphere and R is the radius of the sphere.
b. Given the moment of inertia of a disc of mass M and radius R about any of its diameters to be $\frac{MR^2}{4}$, find its moment of inertia about an axis normal to the disc and passing through a point on its edge.