CLASS XI PHYSICS FULL MOCK TEST - 1

Max Marks: 70

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 MCQs, and four Assertion Reasoning based questions 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.
5. There is no overall choice. However, an internal choice has been provided in one question in Section B, two questions 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.
7. You may use the following values of physical constants wherever necessary:

   i. $c = 3\times10^{8}$ m/s ii. $me = 9.1\times10^{-31}$ kg iii. $e = 1.6\times10^{-19}$ iv. $\mu_0 = 4\pi\times10^{-7}$ T mA^{-1}

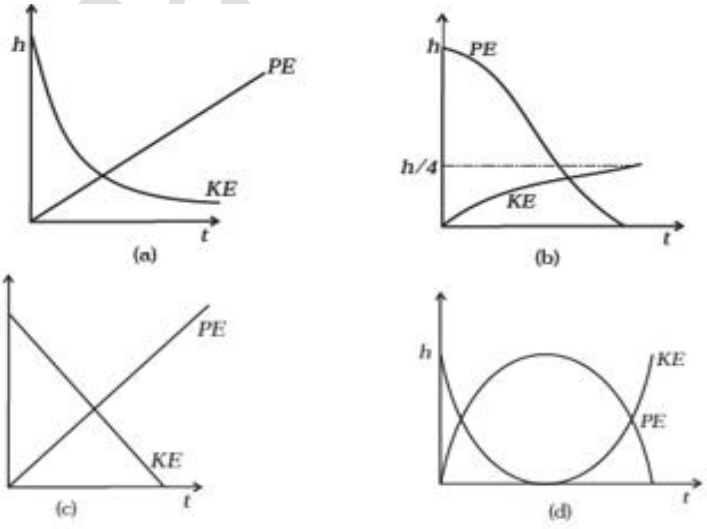
   v. $h = 6.63\times10^{-34}$ Js vi. $\varepsilon_0 = 8.854\times10^{-12}$ $C^2N^{-1}m^{-2}$ vii. Avogadro's number = 6.023×10^{23} per gram mole

SECTION - A

Q1. In SI system the fundamental units are:
a) meter, kilogram, second, ampere, Kelvin, mole, and watt
b) meter, Newton, second, ampere, Kelvin, mole, and candela
c) meter, kilogram, second, coulomb, Kelvin, mole, candela, and horsepower
d) meter, kilogram, second, ampere, Kelvin, mole, and candela

Q2. Identify the correct statement:
a) Static friction depends on the area of contact.
b) Kinetic friction depends on the area of contact.
c) Coefficient of static friction does not depend on the surfaces in contact.
d) Coefficient of kinetic friction is less than the coefficient of static friction.

Q3. A raindrop falling from a height h above ground, attains a near terminal velocity when it has fallen through a height $(\frac{3}{4})h$. Which of the diagrams shown in the figure correctly shows the change in kinetic and potential energy of the drop during its fall up to the ground?



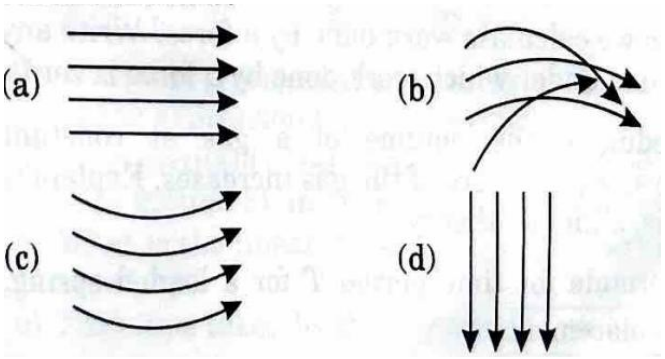
Q4. Total angular momentum of a rotating body remains constant if the net torque acting on the body is:
a) zero b) maximum c) minimum d) unity

Q5. The motion of a particle is described by the equation $x = a+bt^2$, where a=15 cm and b=3 cm s^{-2}. Its instantaneous velocity at t=3 s will be:
a) 36 cm s^{-1} b) 18 cm s^{-1} c) 16 cm s^{-1} d) 32 cm s^{-1}

Q6. The areal velocity and the angular momentum of the planet are related by which of the following relations? (where m_p is the mass of the planet)
a) $\frac{\Delta\vec{A}}{\Delta t} = \frac{\vec{L}}{2m_p}$ b) $\frac{\Delta\vec{A}}{\Delta t} = \frac{\vec{L}}{m_p}$ c) $\frac{\Delta\vec{A}}{\Delta t} = \frac{2\vec{L}}{m_p}$ d) $\frac{\Delta\vec{A}}{\Delta t} = \frac{\vec{L}}{\sqrt{2}m_p}$

Q7. The area of a cross-section of a steel wire is 0.1 cm^2 and Young's modulus of steel is 2×10^{11} N/m^2. The force required to stretch by 0.1% of its length is:
a) 1000 N b) 2000 N c) 4000 N d) 5000 N

Q8. Which of the following diagrams does not represent a streamline flow?



Q9. The temperature of a radiating body increases by 30%. Then the increase in the amount of radiation is
(a) 186% (b) 285% (c) 325% (d) 130%

Q10. An ideal gas is heated at constant volume until its pressure doubles. Which one of the following statements is correct?
a) The mean speed of the molecules doubles.
b) Root mean square speed of the molecules doubles.
c) Mean square speed of the molecules doubles.
d) Mean square speed of the molecules remains unchanged.

Q11. The amplitude of the given SHM is $x = 5[sin\ 3\pi t + \sqrt{3}\ cos\ 3\pi t]$
a) 10 b) 20 c) 1 d) 5

Q12. The velocity of sound is affected by change in
a) temperature b) medium c) pressure d) both (a) and (b)

For Questions 13 to 16, two statements are given — one labelled Assertion (A) and the 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.

Q13. Assertion (A): For a projectile, the time of flight of a body becomes n times the original value if its speed is made n times.
Reason (R): For a projectile, this is due to the range of the projectile which becomes n times.

Q14. Assertion (A): Centre of mass of a system does not move under the action of internal forces.
Reason (R): Internal forces are non-conservative forces.

Q15. Assertion (A): In a string, during reflection from a fixed boundary, the reflected wave is inverted.
Reason (R): The force on the string by the clamp is in the downward direction while the string is pulling the clamp in the upward direction.

Q16. Assertion (A): Force on a body A by body B is equal and opposite to the force on the body B by A.
Reason (R): Forces in nature always occur between pairs of bodies.

SECTION - B

Q17. How do we calculate work done by a force? Write any two conditions under which work done by a force is zero.

Q18. On reducing the volume of a gas at constant temperature, the pressure of the gas increases. Explain it on the basis of kinetic theory.

Q19. The formula for the time period T for a loaded spring,

$$T = 2\pi\sqrt{\frac{displacement}{acceleration}}$$

Does the time period depend on the length of the spring?

Q20. No material is perfectly elastic. Why?

OR

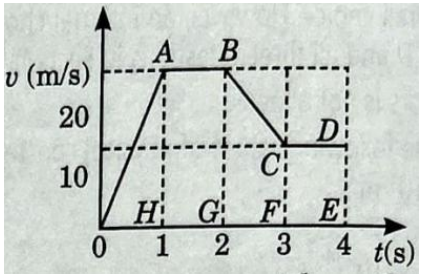
Why does modulus of elasticity of most of the materials decrease with the increase of temperature?

Q21. The displacement of a wave propagating in the positive x-direction is given by:

$y = \frac{1}{1+x^2}$ at $t = 0$ and $y = \frac{1}{1+(x-2)^2}$ at $t = 1\ s$. What is the wave speed?

SECTION - C

Q22. The following graph represents the velocity-time relation of a particle moving in a straight line.



(i) Did the particle ever move with uniform velocity?

(ii) Did the particle ever move with uniform acceleration?

(iii) What is the distance traversed by the particle in 4 seconds?

Q23. (i) Two forces of magnitude F have a resultant of the same magnitude F. What will be the angle between the forces?

(ii) A uniform rope of length L, resting on a frictionless horizontal surface, is pulled at one end by a force F. What is the tension in the rope at a distance l from the end where the force is applied?

Q24. The volume of a gas is reduced by compressing it under adiabatic conditions. If the work done on the gas is 200 J, find the change in the internal energy of the gas and also the amount of heat absorbed by the gas.

OR

A thermos flask contains coffee. It is vigorously shaken. Consider the coffee as the system.

(a) Has any heat been added to it?

(b) Has any work been done on it?

(c) Has its internal energy changed?

(d) Does its temperature rise?

Q25. The moment of inertia of a circular disc of mass M and radius R about an axis passing through the centre of mass is I_0. What is the moment of inertia of another circular disc of the same mass and thickness but half the density about the same axis?

Q26. A man cycles up a hill, whose slope is 1 in 20, with a velocity of 6.4 km/h along the hill. The weight of the man and the cycle is 98 kg. What work per minute is he doing? What is his horsepower?

Q27. Two waves having the same frequency travel in the same direction and have amplitudes in the ratio 3:1. Find the ratio of $I_{max} : I_{min}$ on superposition of the two waves.

OR

The possible resonant frequencies of a string are 60, 100, and 140 Hz. What is the possible fundamental frequency of vibration of the string, if the speed of the transverse wave is 80 m/s? Find the length of the string.

Q28. Derive an expression for the acceleration of a body of mass mmm moving with a uniform speed v in a circular path of radius r.

SECTION – D

Case Study Based Questions

Q29. Read the following paragraph and answer the questions that follow.

The first law of thermodynamics is the general law of conservation of energy applied to any system in which energy transfer from or to the surroundings (through heat and work) is taken into account. It states that the energy supplied to the system goes partly to increase the internal energy of the system and the rest in work on the environment. Mathematically, $\Delta Q = \Delta U + \Delta W$

Where ΔQ is the heat supplied to the system, ΔW is the work done by the system, and ΔU is the change in internal energy of the system. ΔQ and ΔW depend on the path taken to go from initial to final states, but the combination ΔQ − ΔW is path independent.

(i) The first law of thermodynamics is concerned with which conservation law?

a) Conservation of momentum b) Conservation of charge

c) Conservation of energy d) None of these

(ii) Which of the following is not a path function?

a) ΔQ b) ΔQ+ΔW c) ΔW d) ΔQ−ΔW

iii) An electric heater supplies heat to a system at a rate of 120 W. If the system performs work at a rate of 80 J/s, then calculate the rate of increase in internal energy.

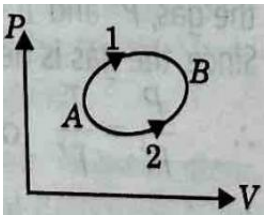
a) 14 J/s b) 25 J/s c) 22 J/s d) 15 J/s

OR

1 kg of water is heated from 40°C to 70°C. If its volume remains constant, then the change in internal energy is (specific heat of water = 4184 J kg^{-1}):

a) 2.44×10^5 J b) 1.62×10^5 J c) 1.24×10^5 J d) 2.62×10^5 J

(iv) A system goes from A to B by two different paths in the P–V diagram as shown in the figure. Heat given to the system in path 1 is 1100 J, the work done by the system along path 1 is more than path 2 by 150 J. Calculate the heat exchanged by the system in path 2.



a) 750 J b) 600 J c) 950 J d) 550 J

Q30. Read the following paragraph and answer the questions that follow

Displacement and Velocity

Average velocity is defined as the change in position or displacement (Δx) divided by the time interval (Δt), in which the displacement occurs $\overline{v} = \frac{x^2-x_1}{t_2-t_1} = \frac{\Delta x}{\Delta t}$, where x_2 and x_1 are the position of the object at time t_2 and t_1, respectively.

Geometrically, this is the slope of the straight line connecting the initial position to the final position. The average velocity can be positive or negative depending upon the sign of the displacement. It is zero if the displacement is zero.

(i) Which of the following statements are incorrect?

1. Average velocity is path length divided by time interval.
2. In general, speed is greater than the magnitude of velocity.
3. A particle moving in a given direction with a non-zero velocity can have zero speed.
4. The magnitude of average velocity is the average speed.

a) (ii) and (iii) b) (ii) and (iv) c) (i), (iii), and (iv) d) All four

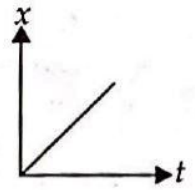
(ii) A cyclist moving on a circular track of radius 40 m completes half a revolution in 40 s. Its average velocity is:

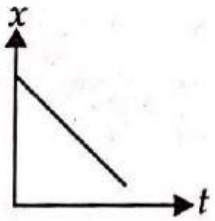
a) zero b) $4\ \pi$ m s^{-1} c) 2 m s^{-1} d) 8π m s^{-1}

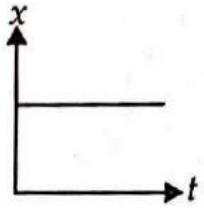
(iii) The area under the velocity-time graph for a particle in a given interval of time represents:

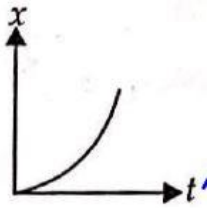
a) velocity b) acceleration c) work done d) displacement

(iv) Which of the following graphs represents the position-time graph of a particle moving with negative velocity?

a) 

b) 

c) 

d) 

OR

The position of an object moving along the x-axis is given by: $x = a+bt^2$,
where a=8.5 m and b=2.5 m s^{-2}, and t is measured in seconds. The average velocity of the object between t=2 s and t=4 s is:

a) 5 m s^{-1} b) 10 m s^{-1} c) 15 m s^{-1} d) 20 m s^{-1}

SECTION – E

Q31. (i) A body is projected at an angle θ with the horizontal, derive the expression for the trajectory.
(ii) A projectile of mass 1 kg is thrown with a velocity of 40 m/s from the ground at an angle of 45° with the horizontal.
(a) What is the linear momentum at the highest point of its trajectory?
(b) Find the time taken by the projectile to reach the ground.

OR

The position vector of a particle is given by:
$\vec{r} = 3.0\,t\,\hat{\imath} - 2.0t^2\hat{\jmath} + 4.0\hat{k}$
Where t is in seconds, and the coefficients have the proper units for $\vec{r}$ to be in meters.
(a) Find the $\vec{v}$ and $\vec{a}$ of the particle.
(b) What is the magnitude and direction of velocity of the particle at t=2 s?

Q32. Given $\vec{a} + \vec{b} + \vec{c} + \vec{d} = 0$, which of the following statements are correct:
i. $\vec{a}, \vec{b}, \vec{c}$ *and* $\vec{d}$ must each be a null vector.
ii. The magnitude of $(\vec{a} + \vec{c})$ equals the magnitude of $(\vec{b} + \vec{d})$.
iii. The magnitude of $\vec{a}$ can never be greater than the sum of the magnitudes of $\vec{b}$, $\vec{c}$ and $\vec{d}$.
iv. $\vec{b} + \vec{c}$ must lie in the plane of $\vec{a}$ *and* $\vec{d}$ *if* $\vec{a}$ *and* $\vec{d}$ are not collinear, and in the line of $\vec{a}$ *and* $\vec{d}$, if they are collinear?

OR

A fighter plane is flying horizontally at an altitude of 1.5 km with a speed of 720 km/h. At what angle of sight (w.r.t horizontal) when the target is seen, should the pilot drop the bomb in order to attack the target?
Main concept used: $u = 720\ km/h = 720 \times \frac{5}{18} m/s = 200\ m/s.$

Q33. Explain the following
(i) A body with large reflectivity is a poor emitter?
(ii) A brass tumbler feels much colder than a wooden tray on a chilly day?
(iii) The Earth without its atmosphere would be inhospitably cold?
(iv) Heating systems based on the circulation of steam are more efficient in warming a building than those based on the circulation of hot water?

OR

(iv) We would like to make a vessel whose volume does not change with temperature. We can use brass and iron ($\gamma_B = 6 \times 10^{-5}\ K^{-1}$ *and* $\gamma_I = 3.55 \times 10^{-5} K^{-1}$) to create a volume of 100 cc. How do you think you can achieve this?