# PT4/ANNUAL EXAMINATION, 2022-23

## PHYSICS

**Time - 3 hrs.** **Class – XI (Set-B)** **M.M. – 70**

*Name of the student _____ Section ____ Date - 15.02.2023 (Wednesday)*

**GENERAL INSTRUCTIONS:**

- There are 35 questions in all. All questions are compulsory.
- This question paper has five sections: Section A, B, C, D and E.
- All the sections are compulsory.
- Section A contains 18 MCQ of 1 mark each,
- Section B contains 7 questions of two marks each,
- Section C contains 5 questions of three marks each,
- Section D contains 3 long questions of five marks each and
- Section E contains 2 case study-based questions of 4 marks each.
- There is no overall choice. However, an internal choice has been provided in section B, C, D and E.
- You must attempt only one of the choices in such questions.
- Use of calculators is not allowed.
- **Cos $70^0 30' = 0.333$**

Q1. The unit of Planck's constant h is the same as that of: **1**

a) Linear momentum b) Angular momentum c) Work d) Energy

Q2. What energy does a stretched bow possess? **1**

a) Potential energy b) Kinetic energy

c) Gravitational energy d) Elastic potential energy

Q3. The radius and mass of earth are increased by 0.5%. Which of the following statements are true at the surface of the earth? **1**

a) g will increase b) g will decrease

c) Potential energy will remain unchanged d) Escape velocity will remain unchanged

Q4. Which of the following statements is correct for any thermodynamic system? **1**

a) The work done in an adiabatic process is always zero

b) The change in entropy can never be zero

c) The internal energy changes in all processes

d) Internal energy and entropy are state functions

Q5. A man standing on a turn-table is rotating at a certain angular frequency with his arms outstretched. He suddenly folds his arms. If his moment of inertia with folded arms is 75% of that with outstretched arms, his rotational kinetic energy will **1**

a) decrease by 33.3% b) decrease by 25%

c) increase by 33.3% d) increase by 25%

Q6. A tuning fork of frequency 580 Hz is employed to produce transverse waves on a long rope. The distance between the nearest crests is found to be 20 cm. The velocity of the wave is **1**

a) 58 $ms^{-1}$ b) 20 $ms^{-1}$ c) 580 $ms^{-1}$ d) 116 $ms^{-1}$

Q7. Which of the following physical quantities has unit Watt hour? **1**

a. Energy b. Force c. Momentum d. Pressure

Q8. A boy starts from a point A, travels on straight line to a point B at a distance of 3 km from A and returns to A. If he takes 2 hours to do so, his average speed is **1**

a. zero b. 3 km/h c. 1.5 km/h d. 2 km/h

Q9. When a satellite revolves close to the surface of the earth, orbital velocity becomes **1**

a. $(g R)^{1/2}$ b. $(g R)^{3/2}$ c. $(g R)^{5/2}$ d. $(g R)^{7/2}$

Q10. Soap helps in cleaning clothes because **1**

a) chemicals of soap changes b) it increases surface tension of the solution

c) it absorbs dirt d) it lowers the surface tension of the water

Q11. Which of the following is equivalent of a calorie? **1**

a) 4.186 J b) 1J c) 8.2J d) none of these

Q12. Mathematical form of first law of thermodynamics **1**

a) dQ = dU – PdV b) dQ = dU + PdV c) dQ +dU = PdV d) dQ + PdV= dU

Q13. Acceleration of a body moving with constant speed in a circle is **1**

a) zero b) rω c) $\omega^2/r$ d) $\omega^2 r$

Q14. Correct relation between torque and angular momentum **1**

a) $\tau = dL/dt$ b) $L = d\tau/dt$ c) $t = Lx\,\tau$ d) $L = \tau$

Q15. The torque of a force $\vec{F} = -3\hat{i} + \hat{j} + 5\hat{k}$ acting at a point $\vec{r} = 7\hat{i} + 3\hat{j} + \hat{k}$ is **1**

a) $14\hat{i} - 38\hat{j} + 16\hat{k}$ b) $4\hat{i} + 4\hat{j} + 6\hat{k}$ c) $-21\hat{i} + 4\hat{j} + 4\hat{k}$ d) $-14\hat{i} + 38\hat{j} - 16\hat{k}$

**For Question number 16 to 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

Q16. Assertion (A) - The perpendicular vector of $(\hat{i} + \hat{j} + \hat{k})$ is $(\hat{i} - 2\hat{j} + \hat{k})$ **1**

Reason (R) - Two vectors are perpendicular if their dot product is equal to zero.

Q17. Assertion (A) - Pressure can be subtracted from pressure gradient. **1**

Reason (R) - Only like quantities can be added or subtracted from each other.

Q18. Assertion (A) - On a rainy day, it is difficult to drive a car or bus at high speed. **1**

Reason: (R) - The value of coefficient of friction is lowered due to wetting of the surface.

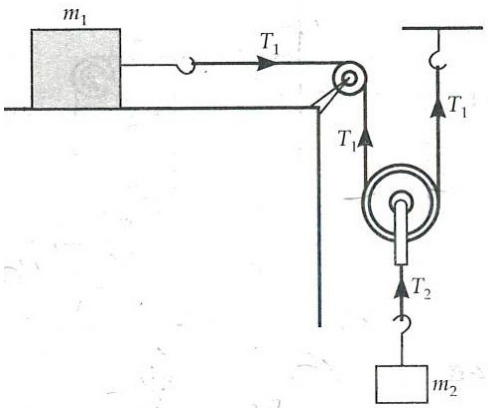
## SECTION - B

Q19. In the equation: y= a sin (ωt- kx), t and x stand for time and distance respectively. Obtain the dimensional formula for a and k . **2**

Q20. If unit vectors $\vec{a}$ and $\vec{b}$ are inclined at an angle α, then prove that **2**

$|\vec{a} - \vec{b}| = 2 \sin\alpha/2$.

Q21. In terms of masses $m_1$, $m_2$ and g, find the acceleration of both the blocks as shown. Neglect all friction and masses of the Pulley. **2**




**OR** **2**

A man weighs 70kg. He stands on a weighing machine in a lift. What will be the weight shown by the machine when the lift is moving. **2**

a) downwards with a uniform acceleration of 5 $m/s^2$.

b) upwards with a uniform acceleration of 5 $m/s^2$.

Q22. Determine the maximum speed with which a vehicle able to go round a level curved road safely. **2**

Q23. Assuming the Earth to be a sphere of uniform mass density, how much would a body weigh half way down to the centre of the Earth if it weighed 250 N on the surface? **2**

**OR**

A body weighs 63N on the surface of the earth. What is the gravitational force on it due to the earth at a height equal to half the radius of the earth?

Q24. What will be the duration of the day, if earth suddenly shrinks to 1/64 of it's original volume, mass remaining the same? **2**

Q25. In Millikan's oil drop experiment, what is the terminal speed of a drop of radius $2\times10^{-5}$ m and density $1.2\times10^{3}$ kg $m^{-3}$? Take the viscosity of air at the temperature of the experiment to be $1.8\times10^{-5}$ $Nsm^{-2}$. How much is the viscous force on the drop at that Speed? Neglect buoyancy of the drop due to air. **2**

## SECTION - C

Q26. A fighter plane flying horizontally at an altitude of 1.5 km with a Speed of 720 km/hr passes directly overhead an antiaircraft gun. At what angle from the vertical should the gun be fired for the muzzle speed 600m/s to hit the plane? At what maximum altitude should the pilot fly the plane to avoid being hit? Take g = $10m/s^2$. **3**

Q27. A cylinder is rolling down (without slipping) along an inclined plane having rough surface and of inclination α. Show that the coefficient of static friction μ= 1/3 tanα. **3**

Q28. What is escape velocity? Derive an expression for escape velocity and show that it doesn't depend upon mass of the body to be projected. **3**

**OR**

Define orbital velocity of a satellite. Derive expressions for the orbital velocity of a satellite. Show that the escape velocity of a body from the earth's surface is $\sqrt{2}$ times it's velocity in a circular orbit just above the earth's surface.

Q29. Derive an expression for the excess pressure inside a liquid drop. **3**

**OR**

A sphere of aluminium of 0.047kg is placed for sufficient time in a vessel containing boiling water, so that the sphere is at 100°c. It is then immediately transferred to 0.14 kg copper calorimeter containing 0.25 kg of water at 20°c. The temperature of water rises and attains a steady state at 23°c. Calculate the specific heat capacity of aluminium.

Q30. Applying the first law of thermodynamics, obtain the relation between the two specific heats $C_p$ and $C_v$ of a gas. **3**

## SECTION - D

Q31. i) State Bernoulli's Principle. **5**

ii) Derive Bernoulli's equation for a non viscous fluid with labelled diagram.

**OR**

Derive an expression for the rise of liquid in a capillary tube and show that the height of the liquid column supported is inversely proportional to the radius of the tube. Also draw labelled diagram.

Q32. i) Why $C_p > C_v$ ? **5**

ii) Derive an expression for the work done during the isothermal expansion of an ideal gas.

**OR**

i) What are the essential conditions for an adiabatic process to occur?

ii) Derive an expression for the work done during the adiabatic expansion of an ideal gas.

Q33. i) Derive expressions for displacement, velocity, acceleration of a particle executing S.H.M. **5**

ii) A body oscillates with SHM according to the equation,

$X = (5.0m) \cos [(2\pi \text{ rad/s})t + \pi/4]$

At t = 1.5s, calculate a) displacement, b) speed and c) acceleration of the body.

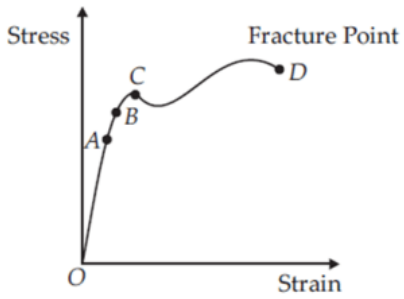
**OR**

Obtain an expression for a stationary wave formed by two sinusoidal waves travelling along the same path in opposite directions in a stretched string fixed at both ends. Also discuss three modes of vibrations along with diagrams.

## SECTION - E

Q34. **Case Study: Read the following paragraph and answer the questions.** **4**

The graph shown below shows qualitatively relation between the stress and the strain as the deformation gradually increases. Within Hooke's limit for a certain region stress and strain relation is linear. Beyond that up to a certain value of strain the body is still elastic and if deforming forces are removed the body recovers its original shape




(i) If deforming forces are removed up to which point the curve will be retraced?

(a) upto *OA* only (b) upto *OB* (c) upto *C* (d) Never retraced its path

(ii) In the above question, during loading and unloading the force exerted by the material are conservative up to

(a) *OA* only (b) *OB* only (c) *OC* only (d) *OD* only

(iii) A cable is replaced by another of the same length and material of twice diameter. How does this affect elongation under a given load ?

**OR**

(Iii) The spherical ball contracts in volume by 0.1% when subjected to a uniform normal pressure of 100 atmosphere. Calculate the bulk modulus of the material of the ball.

Q35. **Case Study: Read the following paragraph and answer the questions.** **4**

Radius of gyration: The radius of gyration of a body about an axis may be defined as the distance from the axis of a mass point whose mass is equal to the mass of the whole body and whose moment of inertia is equal to the moment of inertia of the body about the axis.The moment of inertia of a rigid body analogous to mass in linear motion and depends on the mass of the body, its shape and size; distribution of mass about the axis of rotation, and the position and orientation of the axis of rotation.

(i) SI unit of radius of gyration

a) Metre (m) b) $M^2$ c) $M^3$ d) None of these

(ii) Quantity in rotational motion is analogous to force in linear motion is

a) Torque b) Velocity c) Power d) None of these

(iii) State Theorem of perpendicular axes.

**OR**

(iii) State Theorem of parallel axes.