BUDHA DAL PUBLIC SCHOOL, PATIALA
Final Examination (1 March 2025)
Class XI (Science)
Subject – Physics (Set - B)

Time: 3hrs **M.M. 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 16 questions, 12 MCQ and 4 Assertion Reasoning based of 1 mark each, **Section B** contains 5 questions of two marks each, **Section C** contains 7 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) Use of calculators is not allowed.

Section - A

Q1. The distance between two consecutive antinodes is

a) 2λ b) $\lambda/4$ c) $\lambda/2$ d) λ

Q2. A child, swinging on a swing in sitting position, stands up. Then, the time period of swing will

a) increase b) decrease c) remains same

d) increase, if the child is long and decrease, if child is short

Q3. Specific heat of a gas during an isothermal process is

a) zero b) positive c) negative d) infinity

Q4. Poise is the unit of

a) surface tension b) capillarity c) viscosity d) buoyancy

Q5. The surface tension of soap is σ. The work done in blowing a soap bubble of diameter D to that of a diameter 2 D is

a) $2\pi D^2\sigma$ b) $4\pi D^2\sigma$ c) $6\pi D^2\sigma$ d) $8\pi D^2\sigma$

Q6. The escape speed of a cat of mass m is v on the surface of earth. The escape speed of a dog of mass $2m$ would be

a) $v/2$ b) v c) $2v$ d) $4v$

Q7. If ε_1 *and* ε_2 are the strains produced in succession in a material, then the total true strain is

a) $\varepsilon_1/\varepsilon_2$ b) $\varepsilon_2 - \varepsilon_1$ c) $\varepsilon_1 + \varepsilon_2$ d) $\varepsilon_1 \times \varepsilon_2$

Q8. A bomb travelling in parabolic path under the effect of gravity explodes in mid air. The centre of mass of fragments will

a) Move in irregular path

b) Move vertically downward

c) Move in parabolic path, the unexploded bomb will have travelled

d) Move vertically upward and then vertically downwar

Q9. Two stones A and B are thrown at angles θ *and* $(90^0 - \theta)$ with horizontal. The ratio of their horizontal range is

a) 1:1 b) $\tan\theta : 1$ c) $\tan^2\theta : 1$ d) $1 : \tan\theta$

Q10. If R and H represent the horizontal range and maximum height achieved by a projectile, then which of the following relation holds?

a) $\frac{H}{R} = 4\cot\theta$ b) $\frac{R}{H} = 4\cot\theta$ c) $\frac{H}{R} = 4\tan\theta$ d) $\frac{R}{H} = 4\tan\theta$

B-1

Q11. The vectors $\vec{P} = a\hat{i} + a\hat{j} + 3\hat{k}$ and $\vec{Q} = a\hat{i} - 2\hat{j} - \hat{k}$ are perpendicular to each other. The positive value of a is

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

Q12. A mass of 10 kg is suspended by a rope of length 4m, from the ceiling. A force F is applied horizontally at the mid-point of the rope such that the top half of the rope makes an angle of 45^0 with the vertical. Then F equals : [Take, $g = 10\ ms^{-2}$ and the rope to be massless]

a) 100 N b) 90 N c) 70 N d) 75 N

In the following questions, a statement of Assertion (A) is followed by a statement of Reason (R). Mark the correct choice as:

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

Q13. **Assertion (A) :** All the rain drops hit the surface of the earth with same constant velocity.

Reason (R) : An object falling through a viscous medium eventually attains a terminal velocity.

Q14. **Assertion (A) :** It is not possible for a system, unaided by an external agency to transfer heat from a body at lower temperature to another body at higher temperature.

Reason (R) : According to Clausis statement, "No process is possible whose sole result is the transfer to heat from a colder object to hotter object."

Q15. **Assertion (A) :** A hollow shaft is found to be stronger than a solid shaft made of the same material.

Reason (R) : The torque required to produce a given twist in hollow cylinder is greater than that required to twist a solid cylinder of same size and material.

Q16. **Assertion (A) :** Surface energy of a liquid is numerically equal to surface tension.

Reason (R) : The dimensional formula of surface energy and surface tension is $[ML^0T^{-2}]$.

Section - B

Q17. Discuss the principle, construction and working of hydraulic lift.

OR

Two syringes of different cross-sections (without needles) filled with water are connected with a tightly fitted rubber tube filled with water. Diameters of smaller piston and larger piston are 1.0 cm and 3.0 cm respectively.

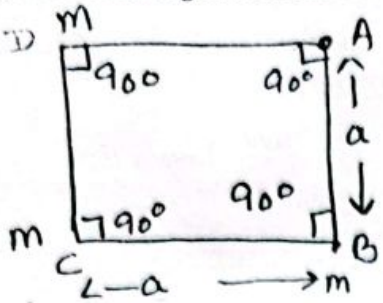
a) Find the force exerted on the larger piston when a force of 10N is applied to the smaller piston.
b) If the smaller piston is pushed in through 6•0 cm, how much does the larger piston move out?

Q18. Define escape velocity. Obtain an expression for escape velocity on earth. Why there is no atmosphere on the surface of moon? Explain.

Q19. Derive the expressions of equation of trajectory, time of flight for a projectile thrown at an angle θ with horizontal.

Q20. A structural steel rod has a radius of 10 mm and a length of 1.0 m. A 100 kN force stretches it along its length. Calculate (a) stress (b) elongation and (c) strain on the road. Young's modulus, of structural steel is $2.0 \times 10^{11}\ N\ m^{-2}$.

Find the resultant gravitational intensity at a point A due to system of masses given in the figure.



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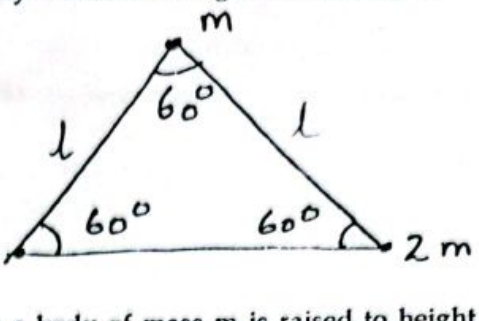
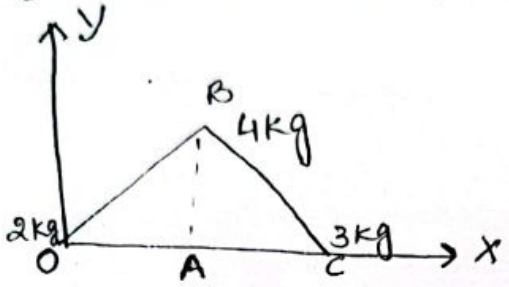


OR

What is the change in gravitational potential energy when a body of mass m is raised to height nR above the surface of earth of radius R?

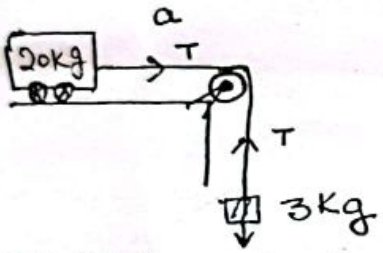
Section - C

Q22. Three masses 2kg, 3kg and 4kg are located at the corners of an equilateral triangle of side 1 m. Find out the position of C.M.



OR

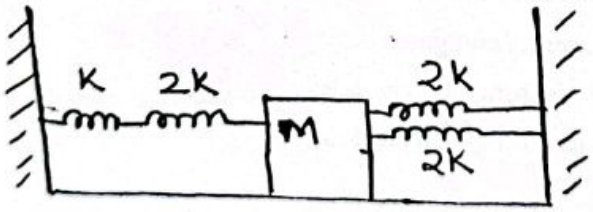
a) What will be the acceleration of the block and trolley system as shown in figure. If the coefficient of kinetic friction between the trolley and surface is 0.04?



b) What is the tension in the string? Taking $g = 10 m/s^2$

Q23. What will be the percentage decrease in weight of a body, when it is taken 32 km below the surface of earth. Take radius of earth = 6400 km.

Q24. Four massless springs whose force constants are 2K, 2K, K and 2K respectively are attached to mass M kept on a frictionless plane as shown in the figure. If the mass M is displaced in the horizontal direction, the frequency of the system is .....



Q25. Define orbital velocity of a satellite. Derive an expression for the orbital velocity of a satellite.

Q26. A ball is thrown from the ground so that it just crosses a wall 10m in height at a distance of 10 m and falls at a distance of 30m from the wall. Find the velocity and the direction of projection of the ball. Assume $g = 10 m s^{-2}$.

Q27. State and prove Bernoulli's theorem. Show that it is according to the law of conservation of energy.

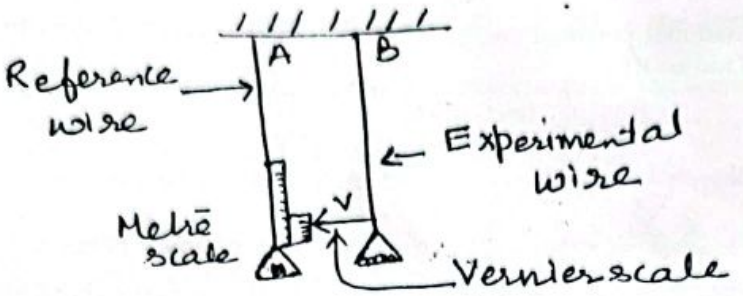
Q28. The equation of plane progressive wave is $y = 10 \sin 2\pi (t + 0.005 x)$, where y and x are in cm and t is in seconds. Calculate the frequency, wavelength and velocity of wave.

Section - D

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

A typical experimental arrangement to determine the Young's modules of a material of the wire under same tension is as shown in figure.

It consists of two long wires of same length and equal radii suspended side by side from a rigid support. The reference wire (A) carries a millimeter scale and pan to place the weight.



The experimental wire (B) is of uniform area of cross-section also carries a pan in which known weights can be placed. The vernier scale is attached to a pointer at the bottom of experimental wire B and main scale is fixed to the reference wire A.

Based on the above information, answer the following:

(i) On placing the weights in the pan, which type of stress is produced in it?

(a) tensile stress (b) compressive stress (c) tangential stress (d) bulk stress

(ii) The difference between which two readings gives the elongation produced in wire.

(a) original wire (b) reference wire (c) main (d) vernier

(iii) If M be the mass of the wire that produces an elongation ΔL in the wire, then applied force is equal to

(a) Ma (b) Mg (c) Mv (d) Mv^2

(iv) The Young's Modulus of experimental wire is

(a) $\frac{Mg\,L}{\pi r^2 \Delta L}$ b) $\frac{Mg \times \pi r^2 \Delta L}{Mg \times L}$ c) $\frac{\Delta L \times \pi r^2}{Mg \times L}$ d) $\frac{Mg \times \pi r^2 \times \Delta L}{(\Delta L)^2}$

OR

(iv) Identify the incorrect statement

(a) Young's modulus and shear modulus are relevant only in solids.

(b) Bulk modulus is relevant for solids, liquids and gases

(c) Alloys have larger values of Young's modulus than metals

(d) Metals have large values of Young's modulus than elastomers.

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

Heat flows from a body at higher temperature to a body at lower temperature. This is called as transfer of heat. There are three modes of transfer of heat: Conduction, Convection and Radiation.

In conduction the heat transfer from one point or one particle to another point or particle without the dislocation of the particles from their equilibrium position. In convection the heat transfers from one point to another point of medium by the actual or bodily motion of particles of medium. Whereas in case of radiations heat transfer does not require a medium e.g. radiations from sun. Radiation is composed of time varying electric and magnetic fields called electromagnetic waves propagating through space.

(i) Which of the following processes is the fastest process of heat transfer?

(a) conduction (b) convection (c) radiation (d) none of these

(ii) The amount of heat conducted through a metal rod is directly proportional to

(a) time during which heat flows (b) area of cross section

(c) temperature gradient (d) all the above

(iii) Which of the following surfaces will radiate more heat at a given temperature?

(a) Black and rough (c) White and rough (b) White and polished (d) Black and polished

OR

(iii) The thermal resistance of an ideal heat conductor is

a) zero b) one c) two d) infinity

Section – E

Q31. Define an adiabatic process. What are conditions for a process to be adiabatic ? Derive an expression for work done during an adiabatic process.

OR

What is an isothermal process? State essential conditions for this type of process. Show analytically that the work done by one mole of the gas during an isothermal process during expansion from volume V1 to V2 is given by $W = RT \log_e \frac{V_2}{V_1}$

Q32. What is a simple pendulum? Show that the motion of a simple pendulum is S.H.M. and hence deduce an expression for the time period of simple pendulum. Discuss the various cases on which the time period of simple pendulum depends.

OR

Prove Ascent formula (height of capillary rise) why liquid does not spill from capillary tube of small length?

Q33. What are stationary waves? Why are they so called? Obtain an expression for the stationary wave formed in a string fixed at both the ends, hence obtain the position of nodes and antinodes.

OR

What are beats? Discuss the formation of beats analytically. Prove that the beat frequency is equal to the difference between the frequency of two superposing waves.