

### Model Question (NEB)

**Grade: XII Subject: Physics (102)**

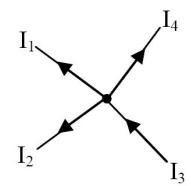
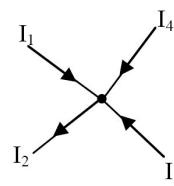
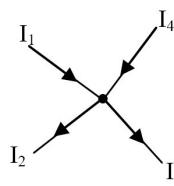
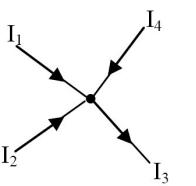
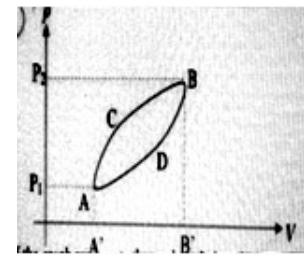
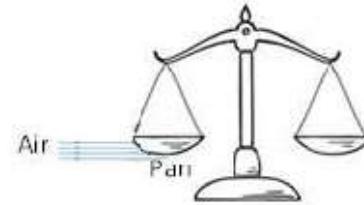
**Full marks: 75 (11 marks Obj+ 64 marks Sub)**

**Time: 3 Hours**

#### **Group A: Multiple Choice Questions (11×1 = 11) Time 25 Minutes**

**Tick the correct answer.**

1. Which of the following is a correct formula for calculating radius of gyration of a rotating object?  
 A)  $k^2 = I/m$       B)  $k = I/m$       C)  $k = m/I$       D)  $k = (I/m)^2$
2. A horizontal stream of air is blown under one of the pans of a beam balance as shown in the figure. What will be the effect of this on the pan?  
 A) goes up.      B) goes down  
 C) remains unaffected      D) rotates
3. What will be the height of a capillary on the surface of the Moon if it is „ $h$ “ on Earth?  
 A)  $h$       B)  $h/6$       C)  $6h$       D) zero
4. What is the coefficient of performance of an ideal refrigerator working between ice point and room temperature ( $27^\circ\text{C}$ )?  
 A) 0      B) 0.1      C) 1      D) 10
5. A thermodynamic system is taken from A to B via C and then returned to A via D as shown in the p-V diagram.  
 The area of which segment of the graph represents the total work done by the system?  
 A)  $P_1ACBP_2P_1$       B)  $ACBB''A''A$       C)  $ACBDA$   
 D)  $ADBB''A''A$
6. Which one of the following directly affects the quality of sound?  
 A) shape of the source      B) frequency      C) intensity  
 D) wave form
7. A diffraction pattern is obtained using a beam of red light. What will be the effect on the diffraction pattern if the red light is replaced with white light?  
 A) All bright fringes become white.  
 B) All bright fringes, except the central one, become white.  
 C) All bright fringes become colourful.  
 D) All bright fringes, except the central one, become colourful.
8. In which one of the following diagrams the currents are related by the equation  $I_1 - I_2 = I_3 - I_4$ ?  
 (Diagram options A, B, C, D show four different configurations of four resistors meeting at a junction, with arrows indicating current flow in various directions.)



A)

B)

C)

D)

9. A coil having N turns and cross-section area A carries current  $I$ . Which physical quantity does the product  $NIA$  represent?  
 A) magnetic flux of the coil      B) magnetic flux density of the coil  
 C) magnetic moment of the coil      D) magnetic susceptibility of the coil

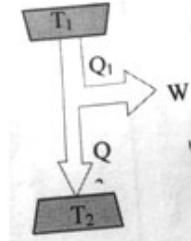
## **Attempt all the questions.**

**Group B: Short Answer Questions (8×5 = 40)**

1.
    - (i) Define „surface tension“. [1]
    - (ii) Establish a relation between surface tension and surface energy of a liquid. [2]
    - (iii) Two spherical rain drops of equal size are falling vertically through air with a certain terminal velocity. If these two drops were to coalesce to form a single drop and fall with a new terminal velocity, explain how the terminal velocity of the new drop compares to the original terminal velocity. [2]
  2. Angular speed of a rotating body is inversely proportional to its moment of inertia.
    - (i) Define „moment of inertia“. [1]
    - (ii) Explain why angular velocity of the Earth increases when it comes closer to the Sun in its orbit. [2]
    - (iii) If the Earth were to shrink suddenly, what would happen to the length of the day? Give reason. [2]
  3. 

Or

    - (i) State Bernoulli principle. [1]
    - (ii) Derive Bernoulli's equation. [2]
    - (iii) You can squirt water from a garden hose a considerably greater distance by partially covering the opening with your thumb. Explain how this works. [2]
  4.
    - (i) Define „harmonics“ in music. [1]
    - (ii) Calculate the frequency of a monotonous sound produced by a 30 cm long flute open at both ends and being played in the first harmonic. [Velocity of sound in air= 330 ms<sup>-1</sup>] [2]
    - (iii) The flute mentioned in question (ii) was being played by a passenger on a stationary bus. The bus then moves uniformly. Explain what change in the pitch of the flute sound, if any, a person sitting on a bench at the bus park will feel when the bus starts moving. [2]
  5.
    - (i) State the second law of thermodynamics. [1]
    - (ii) A refrigerator transfers heat from a cold body to hot body. Does this not violate the second law of thermodynamics? Give reason. [2]
    - (iii) In the given figure, a heat engine absorbs  $Q_1$  amount of heat from a source at temperature  $T_1$  and rejects  $Q_2$  amount of heat to a sink at temperature  $T_2$  doing some external work  $W$ .



5. A student wants to measure the magnetic flux density between the poles of two weak bar magnets mounted on a steel yoke as shown in the figure. The magnitude of the flux density is between 0.02T and 0.04T.

(i) Define Magnetic flux density. [1]

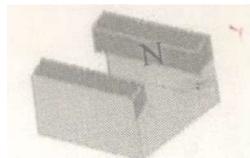
(ii) One way of measuring the magnetic flux density could be the use of a Hall probe.



Suggest one reason why Hall probe is not a suitable instrument to

measure the magnetic flux density for the arrangement shown in the above figure. [1]

(iii) Another method of measuring the magnetic flux density for the arrangement shown in the above figure is to insert a current-carrying wire between the poles of the magnet. Explain how



the magnetic flux density can be determined using this method. You are allowed to use any additional apparatus. [3]

6. (a) Law of electromagnetic induction can be expressed mathematically as .

- (b) (i) State what the symbols and [2]

(ii) Explain the significance of the negative sign. [1]

(ii) Two identical copper balls are dropped from the same height as shown in the figure. Ball P passes through a region of uniform horizontal magnetic field of flux density  $B$ .

Explain why ball P takes longer than ball Q to reach the ground. [2]

7. Ultraviolet radiation of frequency  $1.5 \times 10^{15} \text{ Hz}$  is incident on the surface of an aluminium plate whose work function is  $6.6 \times 10^{-19} \text{ J}$ .

- (i) Show that the maximum speed of the electrons emitted from the surface of the aluminium is  $8.6 \times 10^5 \text{ ms}^{-1}$ . [3]
- (ii) State and explain what change, if any, occurs to the maximum speed of the emitted electrons when the intensity of the ultraviolet radiation is increased. [2]

8. (i) State Bohr's postulates of atomic model. [3]

- (ii) The figure shows Lyman series of energy transmission in hydrogen atom.

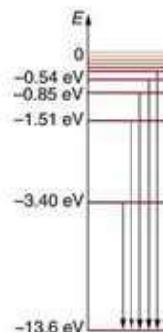
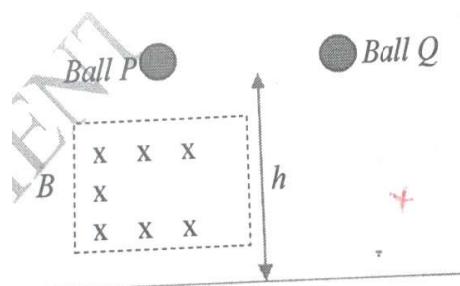
Calculate the frequency of a photon emitted by an electron jumping from the second excited state to the ground level. [2]

Or

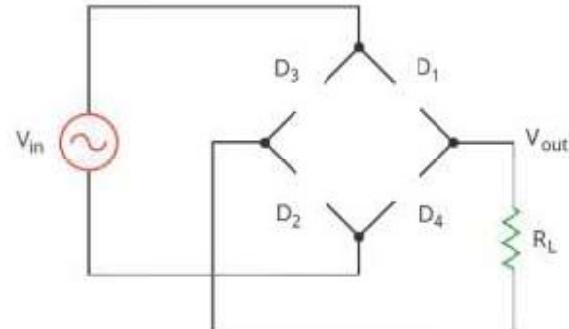
- (i) Sketch the symbol of a p-n junction diode and indicate the polarity of its ends. [1]

- (ii) Copy the outline of a diode bridge rectifier and complete it by adding diodes in the gaps. [2]

- (iii) Explain what will happen if one of the four diodes is damaged so that it stops conducting totally in any direction. Sketch a graph to show how the pd across the Load  $R_L$  would vary with time in this situation. [2]



### Section C: Long Answer Questions. ( $3 \times 8 = 24$ )



9. Earthquake sets rocks and buildings in motion. When a rock is subjected to compression, a restoring force develops inside it. This restoring force is given by an equation  $F = -Ax$  where  $x$  is displacement and  $A$  is a constant.

- (i) Prove that this force will make the rock vibrate with simple harmonic motion. [2]

- (ii) Show that the speed of an object undergoing simple harmonic motion is given by the expression  $v = \pm \omega \sqrt{(A^2 - x^2)}$  where the symbols carry standard meanings. [2]

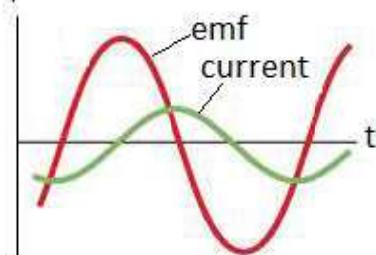
- (iii) Calculate the maximum speed of a building shaken by S-waves of 21Hz and amplitude 0.05m. [2]

- (v) Explain why tall buildings are more susceptible to damage by S-waves which generally have low frequency. [2]

10. The figure below shows the variation of emf and current with time in a typical LRC circuit.

- (i) Explain whether the phase constant is positive or negative. [2]

emf, current



- (ii) Sketch a phasor diagram for the given case. [2]  
(iii) Is the circuit more inductive or capacitive? Explain. [2]  
(iv) To increase the rate at which energy is transferred to the resistive load, should the inductance be increased or decreased? Justify your answer. [2]

Or

A student sets up a circuit as shown in the figure given below to measure the emf of a test cell.

- (a) Explain why he is unable to find a balance point and state the change he must make in order to achieve the balance. [2]

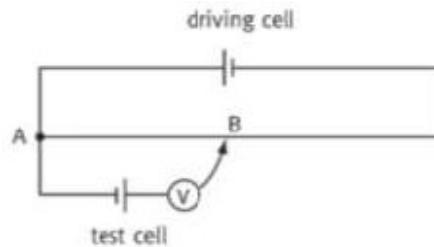
(b) State how he would recognize the balance point. [1]

(c) He obtained the balance point for distance 37.5cm using standard cell of emf 1.50V. And for the test cell, the balance distance AB was 25.0 cm. Calculate the emf of the test cell. [2]

(d) He could have used an ordinary voltmeter to measure the emf of the test cell directly. The student, however, argues that the above instrument is more precise than an ordinary voltmeter. Justify his logic. [2]

11. (a) Explain what is meant by quantization of charge. [2]

(b) In a Millikan's oil drop experiment, an oil drop of weight  $1.5 \times 10^{-14}$ N is held stationary between plates 10mm apart by applying a p.d. of 470V between the plates.



## **Model Question -1**

**Grade: XII Subject: Physics (102)**

**Full marks: 75 (11 marks Obj + 64 marks Sub)**

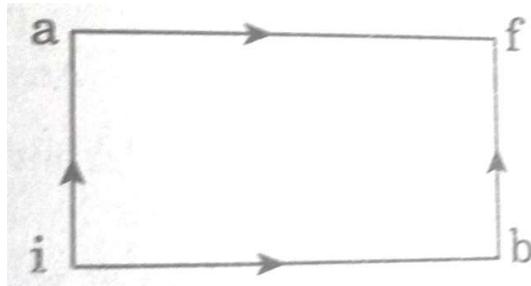
**Time: 3 Hours**

**Attempt all the questions:**

## **Group “A”**

**Rewrite the correct option in your answer sheet:**

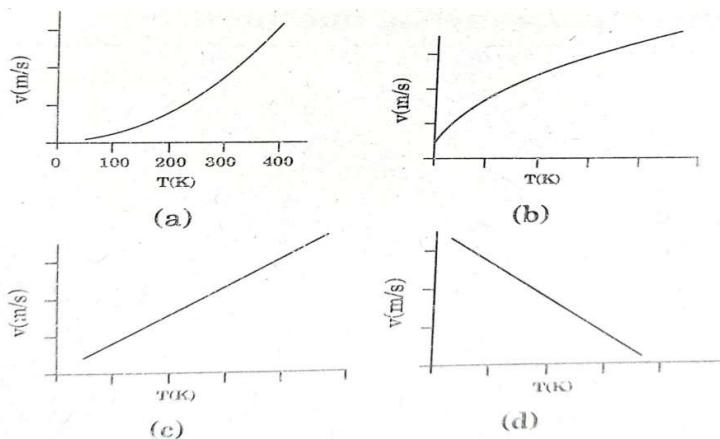
$$11 \times 1 = 11$$



- a. 56 Cal      b. 16 Cal      c. 14 Cal      d. 6 Cal

3) A wave is represented by the equation  $y=7 \sin\left(7\pi t - 0.04x + \frac{\pi}{3}\right)$ , where x is in meters and t is in seconds. The speed of the wave is  
a.  $175\pi m/s$     b.  $49\pi m/s$     c.  $\frac{49}{\pi} m/s$     d.  $0.28\pi m/s$

4) Following graph shows the variation of velocity with temperature. The correct answer is:



- 5) A closed organ pipe and an open organ pipe have their first overtone identical in frequency. Their lengths are in the ratio  
 a. 1:2      b. 2:3      c. 3:4      d. 4:5
- 6) Which can produce maximum pitch of sound?  
 a. lion      b. man      c. woman      d. mosquito
- 7) Huygen's wave theory of light cannot explain  
 a. diffraction      b. interference      c. polarization      d. Photoelectric effect
- 8) A cell has an emf of 1.5 V when short circuited, it gives a current of 3A. the internal resistance of the cell is:  
 a.  $0.5\Omega$       b.  $2.0\Omega$       c.  $4.5\Omega$       d.  $1.5\Omega$
- 9) When the temperature of a semiconductor is increased, its electrical conductivity  
 a. increases      b. remains same  
 c. decreases      d. first increases then decreases
- 10) An LCR series circuit, the capacitance is made one fourth when in resonance. Then what should be the change in inductance so that the circuit remains in resonance.  
 a. 4 times      b.  $\frac{1}{4}$  times      c. 8 times      d. 2 times
- 11) What are bosons?  
 a. elementary crew members on merchant vessels.  
 b. Subatomic particles that carry forces  
 c. A term in particle physics used to describe matter.  
 d. An electron switch used in nano circuits.

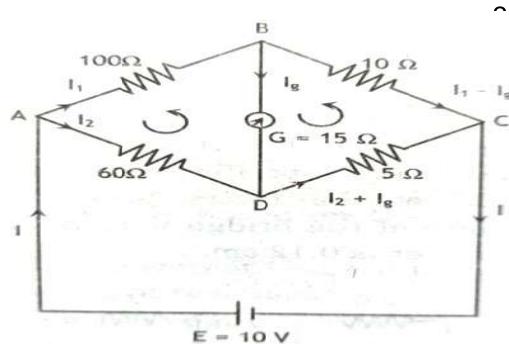
### Group "B"

**Short answer questions:**

**8X5=40**

- 1.
- Describe angular simple harmonic motion. 1
  - Differentiate between simple harmonic and angular harmonic motion. 2
  - A particle executes S.H.M. in a line 4 cm long. Its velocity when passed through the center of the line is 12 cm/s. Find the period.
- OR
- State the law of flotation. 1
  - Establish the relation between surface tension and surface energy. 2
  - Find the work done in blowing a soap bubble of surface tension  $0.06 \text{ Nm}^{-1}$  from 2 cm radius to 5 cm radius. 2

- 2.
- a) State Second law of thermodynamics. 1
  - b) What do you mean by a heat engine and its efficiency? 1
  - c) A Carnot engine whose high temperature reservoir is at 400 K takes in 100 calories of heat at this temperature in each cycle and gives up 80 cal to the low temperature reservoir. What is the temperature of the latter reservoir? What is the thermal efficiency of the cycle? 3
- 3.
- a) Define Doppler effect. 1
  - b) Two vibrating tuning forks have identical frequencies, but one is stationary and the other is mounted at the rim of a rotating platform. What does a listener hear? Explain. 2
  - c) If a listener L is at rest and the siren is moving away from L at 30 m/s. what frequency does the listener hear? 2
- 4.
- a) What are coherent sources? 1
  - b) Does the interference of light waves obey the law of conservation of energy? Explain. 2
  - c) Two sources give interference patterns which are observed on a screen. D is distance apart from the sources. The fringe width will be  $2w$ . If the distance D is now doubled, what will be the fringe width? 2
- 5.
- a) Write about Wheatstone bridge. 1
  - b) Show the circuit diagram with the balance condition of Wheatstone bridge. 1
  - c) The four arms of a Wheatstone bridge in figure have the following resistances, AB = 100Ω, BC = 10Ω, CD = 5 Ω, DA = 60Ω. The galvanometer of 15Ω resistance is connected across BD. Calculate the current through the galvanometer when the potential difference of 10V is maintained across AC.



OR

- a) What is a thermocouple? 1
- b) Discuss the variation of thermo emf in a thermocouple with the change in temperature. 2
- c) Generally, Sb-Bi thermocouple is preferred in all experimental work, why? Explain. 2

- 6.
- a) Write the expression for the force on a charge  $q$  moving with a velocity  $v$  in a magnetic field  $B$ . 1
  - b) State and explain the right hand rule for finding the direction of magnetic force on a moving charge in a magnetic field. 2
  - c) What is the force on a wire of length 4 cm placed inside a solenoid near its center making an angle  $60^\circ$  with the axis? The wire carries a current of 12A and the magnetic field due to solenoid has magnitude of 0.25T. 2
- 7.
- a) Draw a neat labeled diagram of Millikan's oil drop experiment set up for determination of charge on an electron. 1
  - b) What is the nature of the path for electrons in electric and magnetic fields? 1
  - c) An electron moves in a circular path of radius 20 cm in a uniform magnetic field of  $2 \times 10^{-3}$  T. Find the speed of the electron and period of revolution. 3
- 8.
- a) What is the depletion layer? 1
  - b) Why is NOT gate called an inverter? 1
- Explain operations of AND, OR and NAND gates with a truth table and circuit diagram.

**Group "C"**

**Long answer questions:**

**3X8=24**

- 9)
- a) Define angular momentum. 1
  - b) State and prove the principle of conservation of angular momentum. 2
  - c) Does the angular momentum of a body moving in a circular path change? Give explanation to your answer. 2
  - d) A ballet dancer spins about a vertical axis at 1 r.p.s. with her arms outstretched with her arms folded her moment of inertia about the vertical axis decreases by 60%. Calculate the new rate of revolution. 3
- 10)
- a) State Lenz's law of electromagnetic induction. 1
  - b) How will you verify it experimentally. 2
  - c) Show that Lenz law is in accordance with the law of conservation of energy. 2
  - d) An aeroplane with wing span 50 m flying horizontally with a speed of 360 km/hr. over the earth's magnetic field is 0.4 T. find the potential difference between the tip of the wings.
- OR**
- a) What is meant by magnetic hysteresis? 1
  - b) Sketch a typical hysteresis curve and explain what can be deduced from this about the magnetic properties of the material. 2
  - c) Can we have magnetic hysteresis in paramagnetic or diamagnetic substances? 2
  - d) A soft iron ring has a mean diameter of 0.2 m and an area of cross-section of  $5 \times 10^{-4} \text{ m}^2$ . It is uniformly wound with 2000 turns carrying a current of 2A and the magnetic flux in the iron is  $8 \times 10^{-3}$  Wb. What is the relative permeability of the iron? 3
- 11)
- a) What do you mean by radioactivity? 1
  - b) Explain radioactive disintegration law and derive decay equation. 3
  - c) What is health hazard of nuclear radiation and what are safety precautions? 2
  - d) The half life of radon is 1600 yrs. What is the fraction of sample undecayed after 6400 yrs? 2

## Model Question -2

Grade: XII Subject: Physics (102)

Full marks: 75 (11 marks Obj+ 64 marks Sub)

Time: 3 Hours

Attempt all the questions:

### Group "A"

Rewrite the correct option in your answer sheet:

11X1=11

- 1) The product of moment of inertia and angular acceleration gives
  - a. linear momentum
  - b. angular momentum
  - c. Torque
  - d. Force
- 2) If 1500 Cal of heat is supplied to a system and 1000J of work is done. What is the increase in internal energy?
  - a. 2000 J
  - b. 5000 J
  - c. 4300 J
  - d. 6000 J
- 3) In an open end pipe, first overtone is produced when the length of pipe is
  - a.  $\frac{\lambda}{4}$
  - b.  $\frac{\lambda}{3}$
  - c.  $\frac{\lambda}{2}$
  - d.  $\lambda$
- 4) The phenomenon of interference is based on the principle of conservation of
  - a. energy
  - b. momentum
  - c. momentum
  - d. All of these
- 5) Electromotive force is most closely related to
  - a. electric field
  - b. magnetic field
  - c. wavelength
  - d. All of these
- 6) Susceptibility above Curie temperature is valid for
  - a. Ferrimagnetic material
  - b. Paramagnetic material
  - c. Diamagnetic material
  - d. Ferrimagnetic material
- 7) A hole in a p-type semiconductor is
  - a. an excess electron
  - b. a missing electron
  - c. a missing atom
  - d. a donor level
- 8) The ratio of de Broglie wavelength of proton and  $\alpha$  - particle having same kinetic energy is
  - a. 1:4
  - b. 1:2
  - c. 2:1
  - d. 4:1
- 9) Which of the following is the slowest?
  - a. P waves
  - b. S waves
  - c. Surface tension
  - d. Tsunami
- 10) If the liquid does not wet the solid surface, the angle of contact is
  - a. zero
  - b. acute
  - c.  $90^\circ$
  - d. obtuse
- 11) In the wave equation  $y = 10^{-4} \sin\left(100t - \frac{x}{10}\right)$ . The velocity of the wave will be
  - a.  $100 \text{ ms}^{-1}$
  - b.  $250 \text{ ms}^{-1}$
  - c. 750m/s
  - d. 1000 sec

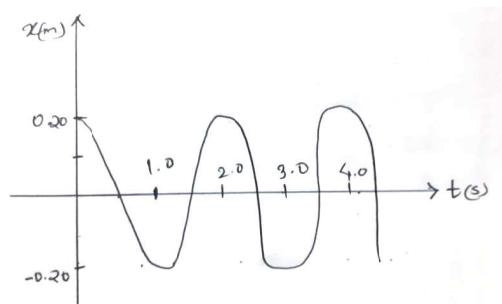
### Group "B"

Short answer questions:

8X5=40

1)

- a) Define Simple harmonic motion and state it's equation.
- b) The displacement of an oscillating object as a function of time is shown in figure:



- Calculate its:
- Time period
  - Frequency
  - Amplitude

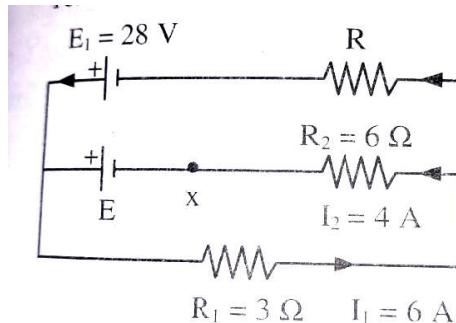
3

OR

- a) Describe the Bernoulli's equation and explain its use. 2
  - b) Explain the equation of continuity. 1
  - c) Air is streaming past a horizontal air plane wing such that its speed is 129 m/s at the lower surface. If the density of air is  $1.3 \text{ kg/m}^3$ . Find the difference in pressure between the top and bottom of the wing. 2
- 2)
- a) Explain the meaning of work done by the system and work done on the system. 1
  - b) Describe how work done by gas during expansion can be calculated from indicator (p-v) diagram. 2
  - c) A tyre pumped to a pressure of 6 atmosphere bursts suddenly. Calculate the temperature of escaping air. Given initial room temperature is  $150^\circ \text{C}$  and  $\gamma$  for air is 1.4. 2
- 3)
- a) Write Newton's equation for velocity of sound in air. 1
  - b) What correction was applied by Laplace and why? 2
  - c) At normal temperature and pressure, 4g of helium occupies a volume of 22.4 litre. Determine the speed of sound in helium. For helium,  $\gamma = 1.67$  and 1 atmospheric pressure =  $1.05 \times 10^5 \text{ N/m}^2$  2
- 4)
- a) What do you mean by interference of light? 1
  - b) Explain the terms constructive and destructive interference. 2
  - c) In a Young's experiment, light of wavelength  $6 \times 10^{-7} \text{ m}$  is used, the set are 0.6 mm apart and the bright bands formed on a screen at 0.8 mm apart. Calculate the distance of the slits from the screen. 2
- 5)
- a) Describe principle of potentiometer.
  - b) The potentiometer wire must be long and of uniform thickness. Why? Explain.
  - c) When a cell of emf 1.5V is connected to the potentiometer wire, the balancing length is found to be 650 cm, when a cell of unknown emf is connected to the potentiometer, the balancing length is found to be 468 cm. What is the emf of the second cell?

OR

- Two batteries and three resistors are connected in a circuit as shown in figure. Find
- a) The current in resistor R. 1
  - b) The unknown emf E 1
  - c) The resistance R 1
  - d) If the circuit is broken at point X, what is the current in the resistor R. 2

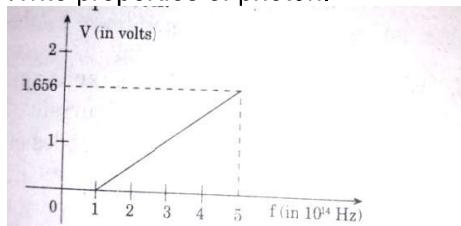


- 6)
- a) Sketch magnetic field lines around a straight current carrying conductor and long solenoid. 1

- b) Discuss force on a current carrying conductor placed in uniform magnetic field. 2  
 c) A horizontal wire 0.5 m long and mass 50 g is placed uniform matnetic field of 0.2 T perpendicularly. Calculate the current in the wire to make it self supporting? (g = 10m/s<sup>2</sup>) 2

7)

- a) State Planck's theory of quantum radiation. 1  
 b) The plot of stopping potential versus, the frequency of light used in an experiment on photoelectric effect is shown in figure. Calculate. 2  
 i) Work function  
 ii) The ratio  $\frac{b}{e}$   
 c) Write properties of photon.



2

8)

- a) What is Zener diode? 1  
 b) Plot forward and reverse characteristics of semiconductor diode including the concept of Zener diode. 1  
 c) Explain the operation of AND, OR and NAND gates. 3

### Group "C"

#### Long answer questions:

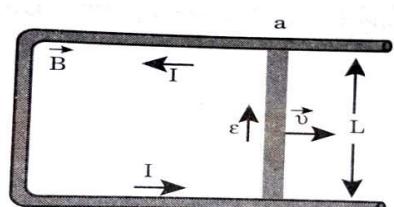
3X8=24

9)

- a) What is meant by the moment of inertia of an object about an axis? 1  
 b) A uniform circular disc of  $(I^2) = \frac{MR^2}{2}$  mass 20 kg and radius 0.15 m is mounted on a horizontal cylindrical axle of radius 0.015 m and negligible mass. Neglecting frictional losses in the bearings. Calculate  
 i) The angular velocity acquired from rest by the application for 12second of a force of 20N tangential to the axle. 3  
 ii) The KE of the disc at the end of this period. 1  
 iii) The time required to bring the disc to rest if a breaking force of 1N were applied to its rim. 3

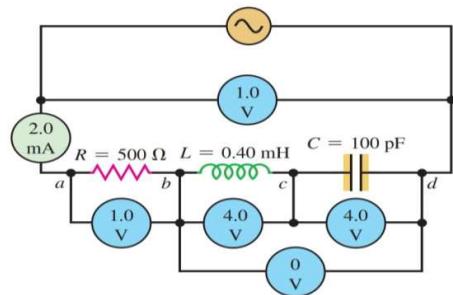
10)

- a) State Faraday's laws of electromagnetic induction. 2  
 b) How would you determine the direction of induced current? 1  
 c) In figure, a rod with length L = 85.0 cm moves in a magnetic field B = 0.850 T. the emf induced in the moving rod is 0.620V.  
 i) What is the speed of the rod? 1  
 ii) If the total circuit resistance is 0.750  $\Omega$ . What is the induced current? 1  
 iii) What force (magnitude and direction) does the field exert on the rod as a result of this current? 2



**OR**

- a) What do you mean by resonance in series L-C-R circuit? 2
- b) The series L-C-R circuit is similar to arrangement that are sometimes used in radio tuning circuit. The circuit is connected to the terminal's of an ac source with constant rms terminal voltage of 1.0V and a variable frequency. Find
- i) The resonance frequency. 1
  - ii) The inductive reactance, the capacitive reactance and impedance at the resonance frequency. 2
  - iii) The rms current at resonance. 1
  - iv) The rms voltage across each circuit element at resonance. 2



11)

- a) State the laws of radioactive disintegration. 2
- b) Differentiate types of radiations coming from radioactive sources. 1
- c) A radioactive element of atomic weight 99 has a half life of 6 hours. Find the activity in a solution containing 1 gram of this element in the beginning, and after 1 hour. The Avogadro's number is  $6.023 \times 10^{23} \text{ mol}^{-1}$ . 3
- d) Explain the meaning of natural and artificial radioactivity. 2

**Model Question -3**

**Grade: XII Subject: Physics (102)**

**Full marks: 75 (11 marks Obj+ 64 marks Sub)**

**Time: 3 Hours**

**Attempt all the questions:**

**Group "A"**

**Rewrite the correct option in your answer sheet:**

**11X1=11**

- 1) The spokes are used in bicycle wheel to
  - a) Increases frictional force
  - b) Decreases frictional force
  - c) Increases moment of inertia
  - d) Increase angular momentum
- 2) An iceberg floats in sea water of density of 1g/cc. the % of volume outside water is if density of iceberg is 0.9 g/cc
 

a. 90%	b. 10%	c. 45%	d. 5%
--------	--------	--------	-------

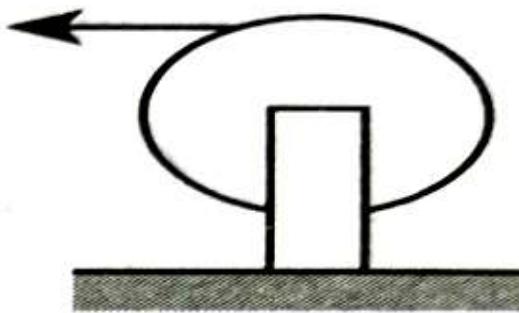
- 3) Two solids A and B floats in water. A floats with  $2/3^{\text{rd}}$  of its volume immersed and B floats with half of its volume immersed. The ratio of density of A and B is  
 a. 4:3      b. 3:4      c. 1:3      d. 3:1
- 4) The weight of 1kg block of iron having volume  $1.3 \times 10^{-4} \text{ m}^3$  immersed in water is measured by spring balance is  
 a. 6.7N      b. 6N      c. 9.7 N      d. 7.7N
- 5) The efficiency of heat engine can be increased by  
 a) Decreasing sink temperature  
 b) Increasing source temperature  
 c) Increasing difference between source and sink temperature  
 d) All of these
- 6) The displacement of a particle is given by  $5 \times 10 \sin(100t - 50x)$  where x and y are metre. The velocity of the wave is  
 a. 2m/s      b. 150m/s      c. 500 m/s      d. 2500 m/s
- 7) The fact that light can be polarized establish the light  
 a) Travels in the form of particles.  
 b) Is an electromagnetic wave  
 c) Is a longitudinal wave  
 d) Is a transverse wave
- 8) Kirchhoff's second law is based on the law of conservation of:  
 a. Momentum b. Charge      c. Mass      d. Energy
- 9) A resistance of  $5\Omega$  is connected in the left gap of a meter bridge and  $15\Omega$  in the other gap. The position of the balancing point is  
 a. 25 cm      b. 15 cm      c. 60 cm      d. 75 cm
- 10) A potentiometer wire is 10 m long. It has a resistance  $20\Omega$ . It is connected in series with a battery of 3V and negligible internal resistance and resistance of  $10\Omega$ . The potential gradient along the wire in volt/meter is  
 a. 0.02      b. 0.1      c. 0.2      d. 1.2
- 11) An electron of mass m and charge e accelerated from rest through a potential difference of v volts in vacuum. The speed of electron will be  
 a.  $\sqrt{\frac{m}{eV}}$       b.  $\sqrt{\frac{eV}{m}}$       c.  $\sqrt{\frac{eV}{m}}$       d.  $\sqrt{\frac{2eV}{m}}$

### Group "B"

#### Short answer questions:

**8X5=40**

- 1)
- a) Define angular momentum .  
 b) A plane revolves around a massive star in a high elliptical orbit. Is its angular momentum constant over the entire orbit?  
 c) A string is wrapped around the rim of a wheel of moment of inertia  $0.20 \text{ kg m}^3$  and radius 20 cm. The wheel is free to rotate about its axis as in Fig. initially, the wheel is in rest. The string is now pulled by a force of 2N. Find the angular velocity of the wheel after 5.0 seconds.



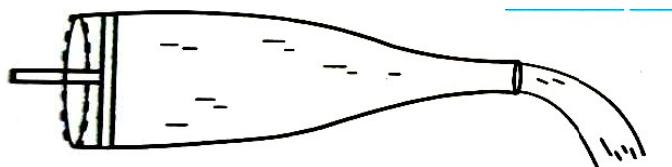
**OR**

- a) Define simple harmonic motion and state it's equation.

- b) The displacement of an oscillating object as a function of time shown in Fig. Calculate its  
 (i) time period (ii) frequency and the amplitude? 2+3

2)

- a) Define the term centre of buoyancy and meta centre. Why should the metal centre lie above the centre of gravity of floating body?  
 b) Explain the equation of continuity and its application.  
 c) Fig. shows a liquid being pushed out of tube by pressing a piston. The area of cross-section of the piston is  $1.0 \text{ cm}^2$  and that of the tube at the outlet is  $20\text{mm}^2$ . If the piston is pushed at a speed of  $2 \text{ cm/s}^{-1}$ . What is the speed of the outgoing liquid? 2+1+2



3)

- a) Explain the meaning of work done by system and work done on the system.  
 b) Describe how work done by gas during expansion can be calculated from indicator (P-V) diagram.  
 c) A tyre pumped to a pressure of 6 atmosphere bursts suddenly. Calculate the temperature of escaping air. Given initial room temperature is  $150^\circ\text{C}$  and  $\gamma$  for air is 1.4.

4)

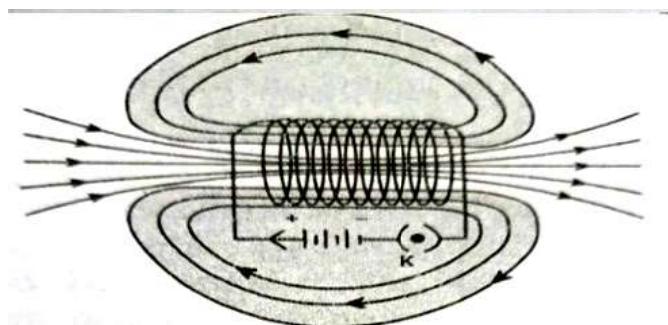
- a) What are the factors on which velocity sound in the open air depends and in what may they do so?  
 b) It is noticed that a sharp made in front of a flight of stone steps gives to a ringing sound.  
 c) Explain this assuming that each step is 0.25 m apart estimate the frequency of the sound. (Velocity of sound may be taken to be  $340 \text{ ms}^{-1}$ ) 2+1+2

5)

- a) Describe the concept of perfect conductors.  
 b) Distinguish them from superconductors.  
 c) A moving coil galvanometer of resistance 10 produces full scale deflection when a current 25 mA is passed through it. How will you convert the galvanometer into a voltmeter range (0-120V?) 1+1+3

6)

- a) Differentiate between solenoid and toroid.  
 b) Magnetic field lines produced by a current carrying solenoid is as shown in Fig. Describe the nature of the magnetic field lines through and around the current carrying solenoid.



- c) A solenoid is designed to produce a magnetic field of 0.027 T at its centre. It has radius 1.4 cm and length 40.0 cm, and the wire carry a maximum current of 12.0 A. What minimum number of turns must the solenoid have? 1+2+2
- 7) a) Write an expression for energy stored in inductor.  
 b) Soft iron is used in making core of a transformer, why? Explain.  
 c) The ratio of number of turns in the primary and secondary windings of a step-up transform is 1:200. It is connected at a.c. mains of 2 V. Calculate:  
 i) Voltage developed in secondary  
 ii) The current in the secondary when primary current is 2A. 1+2+2
- 8) a) Which property of a semiconductor did permits it to be used as a rectifier? Explain the working of a PN diode when it is forward biased and reverse biased. What is a truth table? Draw such a for two inputs AND gate. 1+2+2  
 b) Define radio isotopes.  
 c) A radioactive source has decayed to  $1/128^{\text{th}}$  of its initial activity after 50 days. What is its half-life? What are medical uses of nuclear radiation? 1+3+1

### Group "C"

#### Long answer questions:

**3X8=24**

- 9) a) Discuss Huygen's principle. Use it explain reflection of light.  
 b) Light travels through a pool of water in a parallel beam incident on the horizontal surface. Its speed in water is  $2.2 \times 10^8$  m/s. Calculate the maximum angle which the beam can make with vertical if light is to escape into the air  $10^8$  m/s. Ans:  $47.2^{\circ}$
- 10) a) Write the cause of electric current thermo electricity.  
 b) Distinguish between seebeck effect and Peltier effect. Define inversion temperature and write the factors on which it depends.  
 c) Thermo e.m.f. Cu-Fe thermocouple varies temperature at  $0^{\circ}\text{C}$  as,  $E(\mu\text{V}) = 14\theta - 0.02\theta^2$ . Determine neutral and inverse temperature. 2+3+3
- OR**
- a) Discuss series circuits contains combination of resistance, capacitance and inductance.  
 b) Describe series resonance condition.  
 c) A 100 V a.c. source frequency 50 Hz is connected to a LCR circuit with  $L = 8.1 \times 10^{-3}$  H,  $C = 12.5 \mu\text{F}$  and  $R = \Omega$ , all connected in series. Find the potential difference across the resistance. 3+2+3
- 11) a) State Bohr's postulates for atom model.  
 b) Calculate the energy of electron in  $n^{\text{th}}$  orbit of hydrogen atom.  
 c) Compare the velocity of the electron in the 9<sup>th</sup> B orbit. How many times does the electron around the orbit in 1s? 2+3+3

### Model Question -4

**Grade: XII Subject: Physics (102)**

**Full marks: 75 (11 marks Obj+ 64 marks Sub)**

**Time: 3 Hours**

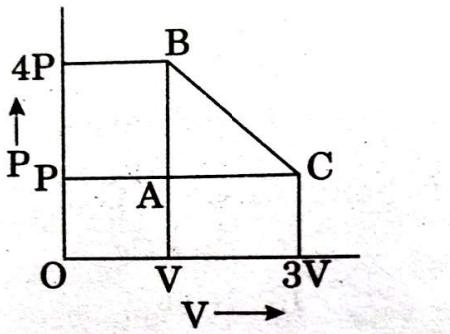
**Attempt all the questions:**

### Group "A"

**Rewrite the correct option in your answer sheet:**

**11X1=11**

- 1) When water is heated from  $0^{\circ}\text{C}$  to  $4^{\circ}\text{C}$  then  
 a.  $C_p > C_V$    b.  $C_p < C_V$    c.  $C_p = C_V$    d. None
- 2) An ideal gas is taken through series of changes represented in the diagram below. The net work done by the gas at the end of the cycle is equal to



- a.  $12P_I V_I$    b.  $6P_I V_I$    c.  $3P_I V_I$    d.  $P_I V_I$
- 3) Elastic waves in a solid are  
 a. only transverse   b. only longitudinal  
 c. Either transverse or longitudinal   d. Neither transverse nor longitudinal
- 4) The variation of speed of sound in a gas with its pressure is best represented by curve:
- (a) (b)   
 (c) (d)
- 5) A string has mass 0.01 kg and has length 1 m. if the tension is 1000N, the velocity of transverse wave in the string is  
 a. 316m/sec   b. 340m/sec   c. 336m/sec   d. 366m/sec
- 6) When both source and listener move in same direction with a speed equal to half the speed of sound, the change in frequency of the sound is  
 a. zero   b. 25%   c. 50%   d. 100%
- 7) What happens to fringe pattern when the Young's double slit experiment is performed in water instead of air?  
 a. shrinks   b. disappears   c. unchanged   d. enlarged
- 8) To send 10% of the main current through a moving coil galvanometer of resistance  $99\Omega$ . The shunt required is  
 a.  $9.9\Omega$    b.  $10\Omega$    c.  $11\Omega$    d.  $9\Omega$
- 9) The time period of a freely suspended thin magnet is 4 seconds. If it is broken in length in two equal parts and one part is suspended in the same way, then its time period (in seconds) will be  
 a. 2   b. 4   c. 0.5   d. 0.25
- 10) In a semiconductor crystal if the current flows due to breakage of crystal bonds, then the semiconductor is called  
 a. acceptor   b. donor  
 c. extrinsic semiconductor   d. intrinsic semiconductor
- 11) Analysis of what particles began the search for the Higgs boson?  
 a. up and down quark   b. neutrino and photon  
 c. mesons and baryons   d. w and z bosons

**Group “B”**

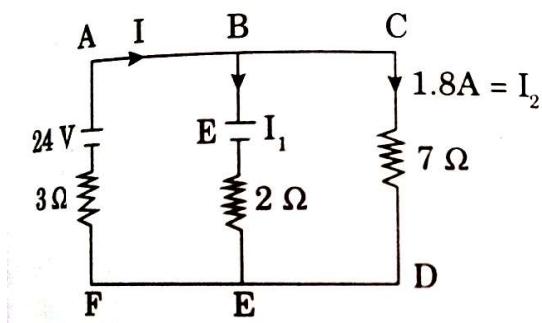
**Short answer questions:**

**8X5=40**

- 1) a) You are provided with a light spring, meter scale and a known mass. How will you find the time period of oscillation of the mass attached to the spring without the use of clock? 1
- b) Why the mass of spring is usually neglected in such type of problem? 1
- c) A mass  $m$  attached to a spring oscillates with a period of 2 seconds. If the mass is increased by 2 kg, the period increases by 1 second. Find the initial mass  $m$ , assuming Hooke's law is obeyed. 3

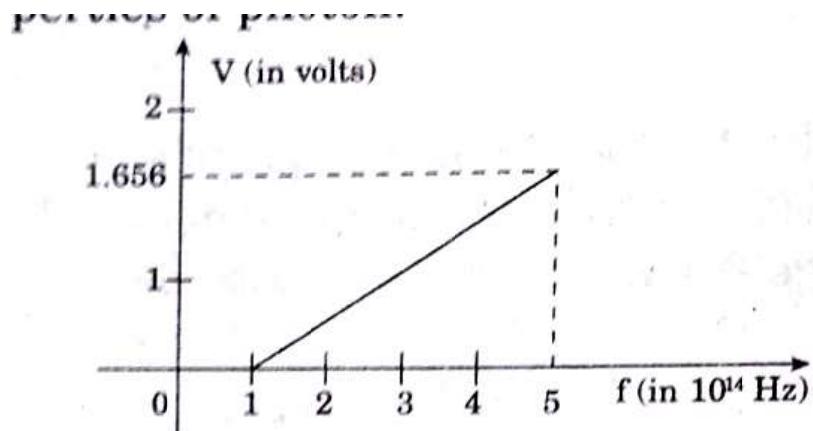
**OR**

- a) Define angle of contact. 1
- b) Where is the angle of contact obtuse, acute or zero degree? 1
- c) Water rises in a capillary tube to a height of 8 cm. calculate the height to which a liquid rises in the tube when the tube is immersed in the liquid. [Surface tension of water is  $7.0 \times 10^{-2} \text{ Nm}^{-1}$  and that of the liquid is  $5.0 \times 10^{-2} \text{ Nm}^{-1}$ . The angle of contact of the liquid is  $30^\circ$  and its density =  $800 \text{ kgm}^{-3}$ .] 3
- 2) a) What do you mean by adiabatic process? 1
- b) Write adiabatic gas equation in terms of
  - i) Pressure and volume
  - ii) Volume and temperature
 1
- c) A sample of gas ( $\gamma = 1.5$ ) is taken through an adiabatic process in which the volume is compressed from  $1600 \text{ cm}^3$  to  $400 \text{ cm}^3$ . If the initial pressure is 150 KPa.
  - i) What is the final pressure and
  - ii) How much work is done by the gas in the process?
 3
- 3) a) Write Newton's formula for velocity of sound in air. 1
- b) What discrepancy was there in Newton's formula for velocity of sound in air? Discuss in brief. 2
- c) Speed of sound in air at STP is 332 m/sec. what will be its value in hydrogen at STP, density of hydrogen at STP is  $1/16$  that of air? 2
- 4) a) What do you mean by diffraction of light? 1
- b) We do not observe diffraction from a wide slit illuminated by monochromatic light. Why? 2
- c) A single slit is used to obtain diffraction pattern on a screen. Calculate the wavelength of light for which fourth maxima in diffraction pattern coincide with third minima for wavelength  $6000\text{\AA}$ . 2
- 5) a) Kirchhoff's law is preferred over Ohm's law, describe it. 1
- b) On what principles Kirchhoff's laws depend? 1
- c) What must be the emf  $E$  in its circuit so that the current flowing through the  $7\Omega$  resistor is  $1.80 \text{ A}$ ? each emf source has negligible internal resistance. 3



**OR**

- a) Define thermoelectric effect. 1
  - b) Define inversion temperature and write the factors on which it depends. 2
  - c) The temperature of cold junction of a thermocouple is  $10^{\circ}\text{C}$  and the neutral temperature is  $270^{\circ}\text{C}$ . calculate temperature of inversion. 2
- 6)
- a) The mean or average value of a.c. over a complete cycle is zero. Explain, why? 1
  - b) Define r.m.s. value of alternating current and write the importance of r.m.s. value. 2
  - c) The natural frequency of a circuit of negligible resistance, capacitance C and inductance L is 1600 Hz. Calculate the frequency if the values of C and L each are doubled. 2
- 7)
- a) Write properties of photon. 1
  - b) What is photoelectric effect? 1
  - c) The plot of stopping potential versus the frequency of light used in an experiment on photoelectric effect is shown in figure. Calculate
    - i) Work function
    - ii) The ratio  $h/e$



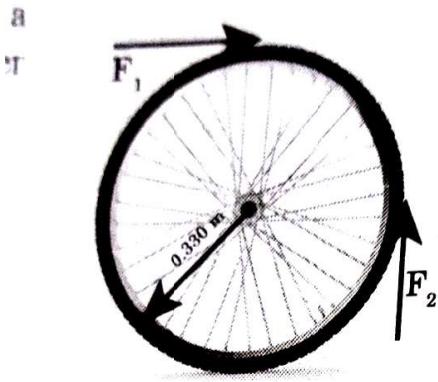
- 8)
- a) Define excitation energy and excitation potential. 1
  - b) The life time of an excited state of an atom is about  $10^{-8}$  secs. Calculate the minimum uncertainty in the determination of the energy of the excited state. 2
  - c) In 9<sup>th</sup> Bohr orbit, how many times does the electron go around the orbit in 1 second? 2

**Group "C"**

**Long answer questions:**

**3X8=24**

- 9)
- a) Define torque. 1
  - b) A wrench of longer arm is preferred than a wrench of shorter arm. Why? 2
  - c) Establish the relation between torque and angular acceleration of a rigid body. 2
  - d) Forces  $F_1 = 7.5 \text{ N}$  and  $F_2 = 5.3 \text{ N}$  are applied tangentially to a wheel with radius 0.33 m as shown in figure. What is the net torque on the wheel due to these two forces for an axis perpendicular to the wheel and passing through its centre? 3



10)

- a) Write an expression for energy stored in an inductor? 1
- b) Soft iron is used in making the core of a transformer, why? 2
- c) Discuss the sources of energy loss in practical transformer. 2
- d) A transformer connected to a 120 V (r.m.s.) to a portable electronic device. The total equivalent resistance of the system is  $5.0\Omega$ .
  - i) What should the ratio of primary to secondary turns of the transformer be? 3
  - ii) What r.m.s. current must the secondary supply?

**OR**

- a) Explain Hall effect. 2
- b) In Hall effect, derive an expression for Hall Voltage  $V_H = \frac{BI}{net}$  where t is thickness. 3
- c) A Hall probe consists of a copper strip,  $n = 8.5 \times 10^{28}$  electrons per cubic meter which is 2.0 cm. wide and 0.10 cm. thick. Calculate the magnetic field when  $I = 50$  A and the Hall potential is
  - i)  $4.0 \mu V$  and
  - ii)  $6.0 \mu V$

11)

- a) What is the evidence that electrons emitted in a  $\beta^-$  decay comes from the nucleus rather than the atomic electrons? 2
- b) The half life of the body polonium 210 is about 140 days. During this period the average number of  $\alpha$ - emission per day from a mass of polonium initially equal to 1 microgram is about  $12 \times 10^{12}$ . Assuming that one emission takes place per atom and that the approximate density of polonium is  $10 \text{ gmcm}^{-3}$ . Estimate the number of atoms in  $1 \text{ cm}^3$  of polonium. 4
- c) Analyze some medical uses of radioactivity. 2

### Model Question -5

**Grade: XII Subject: Physics (102)**

**Full marks: 75 (11 marks Obj+ 64 marks Sub)**

**Time: 3 Hours**

**Attempt all the questions:**

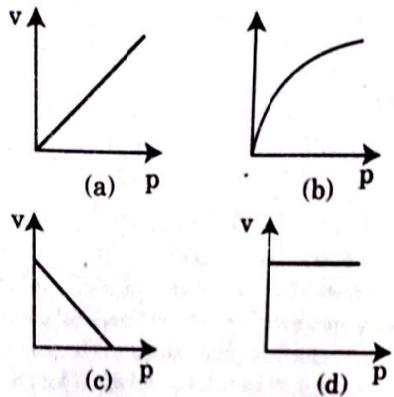
#### Group "A"

**Rewrite the correct option in your answer sheet:**

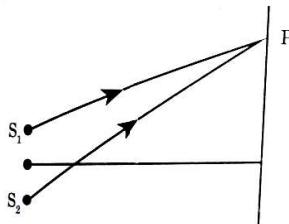
**11X1=11**

- 1) What happens in adiabatic process?
  - a. volume remains constant
  - b. Pressure remains constant
  - c. temperature remains constant
  - d. the system is insulated from the surrounding
- 2) Which of the following is the most efficient?

- a. Carnot cycle based carnot engine  
 b. petrol cycle based petrol engine  
 c. diesel cycle based diesel engine  
 d. All of these are equally efficient
- 3) What is the phase difference between two successive crest in the wave?  
 a.  $\pi$       b.  $\frac{\pi}{2}$       c.  $2\pi$       d.  $4\pi$
- 4) The variation of speed of sound in a gas with its pressure is best represented by curve



- 5) A closed organ pipe and an open organ pipe have their first overtone identical in frequency. Their lengths are in the ratio  
 a. 1:2      b. 2:3      c. 3:4      d. 4:5
- 6) Quantity of two sounds is different because  
 a. their frequency are different  
 b. their intensities are different  
 c. their amplitude are different  
 d. different overtones are there
- 7) If in the interference pattern  $S_2P - S_1P = 1.5$  microns and wavelength of light used is  $6000\text{A}^0$ , then point P is



- a. second maximum  
 b. second minimum  
 c. third minimum  
 d. an intermediate point between second maximum and third minimum
- 8) Electromotive force is most closely ranked to  
 a. electric field      b. magnetic field  
 c. potential difference      d. mechanical force
- 9) Two straight parallel conductor carrying current in opposite direction  
 a. attract each other      b. repel each other  
 c. do not experience any force      d. cancel each other's force
- 10) Which circuit element opposed the change in circuit current?  
 a. resistance      b. inductance      c. capacitance      d. impedance
- 11) The area of hysteresis loss is a measure of  
 a. Permittivity      b. energy gain per cycle  
 c. energy loss per cycle      d. magnetic flux

**Group "B"**

**Short answer questions:**

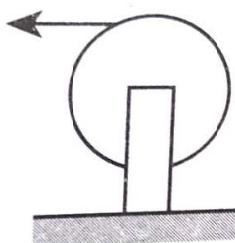
**8X5=40**

1)

- a) State and prove principle of conservation of angular momentum. Give any example of conservation of angular momentum. 2+1=3
- b) A disc of M.I.  $5 \times 10^{-4}$  kgm<sup>2</sup> is rotating freely about an axis through its centre at 40 r.p.m. Calculate the new r.p.m. if some wax of mass 0.02 kg is dropped gently on the disc 0.08 m from its axis. 2

**OR**

- a) Define angular momentum. 1
- b) A planet revolves around a massive star in a highly elliptical orbit . Is its angular momentum constant over the entire orbit? 2
- c) A string is wrapped around the rim of a wheel of M.I. 0.20 kgm<sup>2</sup> and radius 20 cm. the wheel is free to rotate about its axis as in figure. Initially the wheel is at rest. The string is now pulled by a force of 20N. find the angular velocity of the wheel after 5 second. 2



2)

- a) Define molar heat capacity of gas at constant pressure ( $C_P$ ) and molar heat capacity heat capacity of gas at constant volume. 1-1=2
- b) Why  $C_P > C_V$ ? 1
- c) Prove  $C_P - C_V = R$  2

3)

- a) Write down Newton's formula for velocity of sound in gas. How Laplace corrected Newton's formula? 0.5+1.5=2
- b) The velocity of sound is generally greater in solids than in gases at NTP. Why?2
- c) Why is the sound produced in air not heard by a person deep inside the water?1

4)

- a) Differentiate between interference and diffraction of light. 2
- b) What is the cause of diffraction? 1
- c) A screen is placed 2m away from the single narrow slit. Calculate the slit width if the first minima lies 5 mm on either side of the central of the central maximum and incident plane waves have a wavelength of 5000A<sup>0</sup>. 2

5)

- a) State Kirchhoff's laws. 1
- b)
  - i) Draw the circuit diagram of Wheatstone Bridge circuit.
  - ii) Write down the balanced condition of Wheatstone Bridge circuit.
- c) Find the value of  $I_1$ ,  $I_2$  and  $I_3$  in the circuit. 2