

MODEL QUESTIONS

Grade: XII
Subject: Physics
Subject code: 102

Full marks 75 (11 marks Obj. + 64 marks sub)
Time: 3 Hours

1

Group A (Multiple Choice Questions)

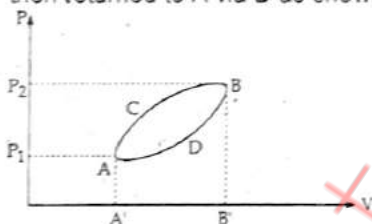
Tick the correct answer.

[11×1=11]

- Which of the following is a correct formula for calculating radius of gyration of a rotating object?
 - $k^2 = I/m$
 - $k = I/m$
 - $k = m/I$
 - $k = (I/m)^2$
- 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?



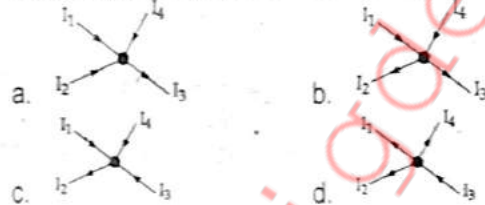
- goes up
 - goes down
 - remains unaffected
 - rotates
- What will be the height of a capillary on the surface of the Moon if it is 'h' on Earth?
 - h
 - $\frac{h}{6}$
 - 6h
 - zero
 - What is the coefficient of performance of an ideal refrigerator working between ice point and room temperature (27°C)?
 - 0
 - 0.1
 - 1
 - 10
 - A thermodynamics 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?

- $P_1ACBP_2P_1$
 - ACBB'A'A
 - ACBDA
 - ADBB'A'A
- Which one of the following directly affects the quality of sound?
 - shape of the source
 - frequency
 - intensity
 - wave form
 - 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?
 - All bright fringes become white
 - All bright fringes, except the central one, become white
 - All bright fringes become colourful
 - All bright fringes, except the central one, become colourful

- In which one of the following diagrams the currents are related by the equation $I_1 - I_2 = I_3 - I_4$?



- magnetic flux of the coil
 - magnetic flux density of the coil
 - magnetic moment of the coil
 - magnetic susceptibility of the coil
- What happens to the neutral temperature if the cold junction of a thermocouple is decreased?
 - increases
 - decreases
 - remains the same
 - approaches inversion temperature
- What is the point where the seismic waves start called?
 - epicenter
 - hypocenter
 - metacentre
 - seismic centre

Group B (Short Answer Questions)

Attempt all the questions.

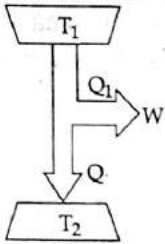
[8×5=40]

- Define 'surface tension'. [1]
 - Establish a relation between surface tension and surface energy of a liquid. [2]
 - 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]
 - Angular speed of a rotating body is inversely proportional to its moment of inertia.
 - Define 'moment of inertia'. [1]
 - Explain why angular velocity of the Earth increases when it comes closer to the Sun in its orbit. [2]
 - If the Earth were to shrink suddenly, what would happened to the length of the day? Give reason. [2]
- OR
- State Bernoulli principle. [1]
 - Derive Bernoulli's equation. [2]
 - You can squirt water from a garden house a considerably greater distance by partially covering the opening with your thumb. Explain how this works. [2]
 - Define 'harmonics' in music. [1]
 - Calculate the frequency of a monotonous sound produced by a 30 cm long flute open at both ends and

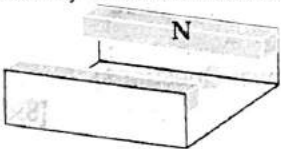
being played in the first harmonic. [Velocity of sound in air = 330 ms^{-1}] [2]

- 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]

4. 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 .

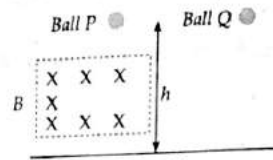


- a. Obtain an expression for the efficiency of this heat engine. [1]
 b. Under what condition does the efficiency of such engine become zero percentage, if at all? [1]
5. A student wants to measure the magnetic flux density between the poles of two weak bar magnets mounted on a steel yoke as shown in the figure. The magnitude of the flux density is between 0.02 T and 0.04 T .

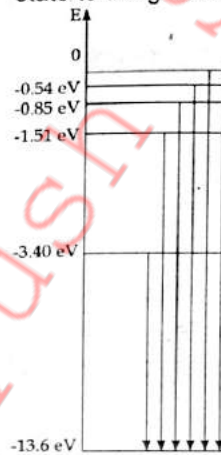


- i. Define magnetic flux density. [1]
 ii. One way of measuring the magnetic flux density could be the use of a Hall probe. Suggest one reason why Hall probe is not a suitable instrument to measure the magnetic flux density for the arrangement shown in the above figure. [1]
 iii. Another method of measuring 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 $\epsilon = -N \frac{d\phi}{dt}$.

- b. i. State what the symbols ϵ and $\frac{d\phi}{dt}$ represent in the equation. [2]
 ii. Explain the significance of the negative sign. [1]
 iii. 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]

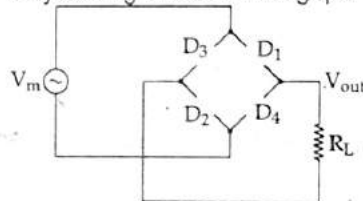


7. Ultraviolet radiation of frequency $1.5 \times 10^{15} \text{ Hz}$ is incident on the surface of an aluminium plate whose work function is $6.6 \times 10^{-19} \text{ J}$.
- i. Show that the maximum speed of the electrons emitted from the surface of the aluminium is $8.6 \times 10^5 \text{ ms}^{-1}$. [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]



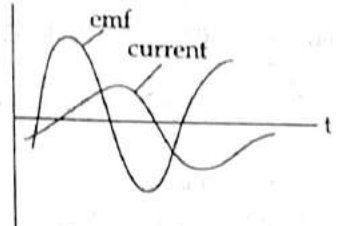
- iii. Explain what will happen if one of the four diodes is damaged so that it stops conducting totally in any direction. Sketch a graph to show how the pd across the Load R_L would vary with time in this situation. [2]

Group C (Long Answer Questions) [3×8=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 21 Hz and amplitude 0.05 m . [2]

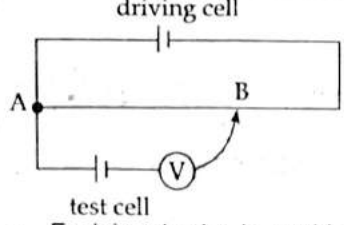
iv. Explain why tall buildings are more susceptible to damage by S-waves which generally have low frequency. [2]

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

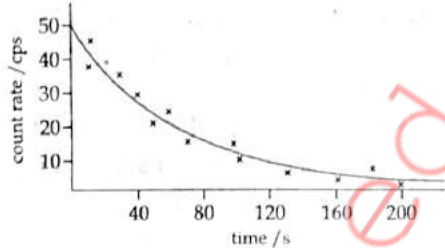


- Explain whether the phase constant is positive or negative. [2]
- Sketch a phasor diagram for the given case. [2]
- Is the circuit more inductive or capacitive? Explain. [2]
- To increase the rate at which energy is transferred to the load, should the inductance be increased or decreased? Justify your answer. [2]

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



- Explain why he is unable to find a balance point and state the change he must make in order to achieve the balance. [2]
- State how he would recognize the balance point. [1]
- He obtained the balance point for distance 37.5 cm using standard cell of emf 1.50 V. 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]

- Explain what is meant by quantization of charge. [2]
- In a Millikan's oil drop experiment, an oil drop of weight 1.5×10^{-14} N is held stationary between plates 10 mm apart by applying a p.d. of 470 V between the plates.
 - State the condition necessary for the drop to remain stationary. Also, sketch the forces acting on the oil drop. [2]
 - Calculate the charge on the oil-drop. [2]
 - Explain what would happen if the above oil drop is suddenly struck by a stray alpha particle. [2]

- OR
- Derive an expression $N = N_0 e^{-\lambda t}$ for a radioactive process where the symbols carry their standard meanings. [3]
 - A student measured the activity of a sample of radioactive rock. Her results are presented in the graph.
 - Explain why the data are scattered. [1]
 - Determine the half-life of this sample. [2]
 - How will the shape of this curve will change if she repeats the experiment with a sample with a larger decay constant. Given reason to your answer. [2]

2

Group A (Multiple Choice Questions)

- Tick the correct answer. [11x1=11]
- For a body undergoing rotational motion, its radius of gyration depends on
 - Size
 - Shape
 - Axis of rotation
 - All of the above
 - A mass M attached to a horizontal spring, executes SHM with an amplitude A_1 . When the mass M passes through its mean position then a smaller mass m is placed over it and both of them move together with amplitude A_2 . The ratio of $\left(\frac{A_1}{A_2}\right)$ is
 - $\frac{M}{M+m}$
 - $\frac{M+m}{M}$
 - $\left(\frac{M}{M+m}\right)^{1/2}$
 - $\left(\frac{M+m}{M}\right)^{1/2}$
 - The lower end of a capillary tube touches a liquid whose angle of contact is 90° . The liquid,
 - will neither rise nor fall inside the tube
 - will rise inside the tube
 - will rise to the top of the tube
 - will be depressed inside the tube
 - If one mole of an ideal gas at STP is heated through 1 K, the work done by the gas in heat unit will be
 - 1.98 cal
 - 8.31 cal
 - 0.831 cal
 - 83.1 cal
 - The efficiency of a Carnot cycle when the hot body temperature (T_1) is increased by x or when the cold body temperature (T_2) is decreased by y will be the same. What is the relation between x and y?
 - $y = x$
 - $y = \frac{T_2 x}{(T_1 + x)}$
 - $y = \frac{T_1 x}{(T_2 + x)}$
 - None of the above
 - In stationary wave, the particle velocity at the nodal positions is
 - zero
 - maximum and finite
 - minimum but non-zero
 - infinity
 - Two beams of light having intensities I and 4I interfere to produce a fringe pattern on a screen. The phase difference between the beams is $\pi/2$ at point A and π at point B. Then the difference between the resultant intensities at A and B is
 - 3I
 - 4I
 - 5I
 - 7I

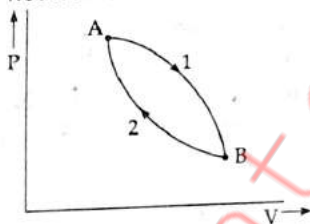
8. To draw maximum current from a combination of cells, how should the cells be grouped?
- Series
 - Parallel
 - Mixed
 - Depends upon the relative values of external and internal resistance
9. The neutral temperature of a thermocouple is 300°C . What is the inversion temperature if the temperature of cold junction is 10°C ?
- 590°C
 - 610°C
 - 310°C
 - 290°C
10. The self-inductance of the motor of an electric fan is 10 H . In order to impart maximum power at 50 Hz , it should be connected to a capacitance of
- $1\ \mu\text{F}$
 - $2\ \mu\text{F}$
 - $4\ \mu\text{F}$
 - $8\ \mu\text{F}$
11. In Millikan's oil drop experiment, the spray of oil droplets is produced by
- Atomizer
 - Sprayer
 - Oil pack
 - None of above

Group B (Short Answer Questions)

Attempt all the questions.

[8×5=40]

- Two beakers, one containing water and another containing glycerin, are whirled with sticks at equal angular speed and left at a time, then which liquid comes to rest first and why? [2]
 - Water flows through a pipe. Which of its layers moves faster? [1]
 - Two drops of a liquid of radii R and $\frac{R}{2}$ with terminal velocities v_1 and v_2 respectively, find the ratio v_1 to v_2 . [2]
- How can you justify first law of thermodynamics that obeys principle of conservation of energy? [1]
 - If the thermodynamic process starts from A and comes to A using the path 1 and 2 as shown by arrow, does the net work done zero? If not explain. [2]



- In adiabatic process, no heat is exchanged but work is done, does it mean that adiabatic process violates first law of thermodynamics? [2]
3. Young's double slit experiment is one of the ground breaking experiment in wave optics. There are many important features associated in this experiment.
- "In Young's double slit experiment performed with a source of white light, only black and white fringes are observed". Is this statement true? [1]
 - What happens when one of the slits in double slit experiment is covered with opaque material? [2]

- Why is it so much easier to perform interference experiments with a laser than with an ordinary light source? [2]
4. Kirchoff's law in electricity is very useful in solving the complicated circuit connections.
- What is the significance of first law? [2]
 - Show that its second law describes the conservation of energy. [2]
 - Describe the possibility of charge accumulation at the junction point. [1]
5. a. What is the importance of mutual induction? [1]
- Write the relation of emf induced in primary and secondary coils in terms of number of turns in the coils. [1]
 - Find the direction of current flow, clockwise or anticlockwise, in the following coils a and b. [2]



6. Explain and draw sketch
- Giving example of each type, distinguish between periodic and harmonic motion. [2]
 - Justify that $\sin \theta$ and $\cos \theta$ are periodic functions. [1]
 - Nature of kinetic and potential energy in harmonic motion. [2]

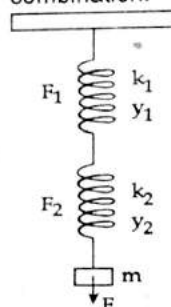
OR

Explain the properties of x-rays in comparison with cathode rays on the basis of:

- Deflection in electric and magnetic fields [5]
 - Speed in vacuum
 - Rest mass
7. Half-life of radioactive materials is very useful in determining the age of archaeological specimens.
- What the half-life of radioactive source actually mean? Relate it with of decay constant. [3]
 - A certain radioactive substance has a half-life period of 30 days. What is the disintegration constant? [2]
8. There are several causes of sinking or floating of a body on a liquid. Give reason in the following conditions.
- Does a ship sink more in river water or in sea water? Explain. [1]
 - Steel balls sink in water but don't sink in mercury. Why? [2]
 - In still air, a helium filled balloon rises up to a certain height and then stops rising. Why? [2]

OR

In the figure given, two springs are set in series combination.



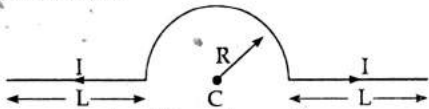
- Is there any difference of force acting in upper and lower springs? [1]
- Find the value of k in series combination. [2]
- Find time period of combination. [2]

Group C (Long Answer Questions) [3×8=24]

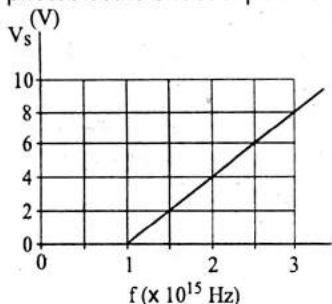
- Discuss the effect of pressure, temperature and humidity of elastic medium on the speed of sound. [3]
 - The velocity of sound in air being 332 ms^{-1} at 0°C . Find the change in velocity per degree rise in temperature. [2]
 - At what temperature the velocity of sound is double than at the temperature 27°C ? [3]

OR

- The equation of continuity shows that $A_1v_1 = A_2v_2$. Use this relation to explain the speed of water emerging from a PVC pipe increases when we press its outlet. [2]
 - A loaded Boeing aircraft 747 has a mass of $3.0 \times 10^5 \text{ kg}$. Its total wing area is 500 m^2 . It is in level flight with a speed of 950 kmh^{-1} . [5]
 - Estimate the pressure difference between the lower and upper surfaces of the wings.
 - Estimate the fractional increase in the speed of the air on the upper surface of the wing relative to the lower surface. The density of air is $\rho = 1.29 \text{ kgm}^{-3}$. Take $g = 9.81 \text{ ms}^{-2}$.
- Derive the expression for the magnetic field at the center of a circular current carrying conductor. [4]
 - A semi-circular wire of radius $R = 9.26 \text{ cm}$ has two (radial) straight segments each of length $L = 13.1 \text{ cm}$ as shown in figure. If the current in the wire is $I = 32.3 \text{ mA}$, find (a) magnitude (b) direction (into or out of page) of the net magnetic field at the center of curvature 'C' of semicircle. [4]



- The graph in the given figure was measured in a photoelectric effect experiment.



- Obtain the general relation between stopping potential and frequency of incident radiation. [3]
- Find the work function (in eV) of the cathode. [2]
- What experimental value of Planck's constant is obtained from these data? [3]

OR

- Describe the mechanism of torque produced by magnetic field in current carrying rectangular conductor. [2]
- The plane of a $5.0 \text{ cm} \times 8.0 \text{ cm}$ rectangular loop of wire is parallel to a 0.19 T magnetic field. The loop carries a current of 6.2 A . [6]
 - What torque acts on the loop?
 - What is the magnetic moment of the loop?
 - What is the maximum torque that can be obtained with the same total length wire carrying the same current in this magnetic field?

Group A (Multiple Choice Questions)

Tick the correct answer. [11×1=11]

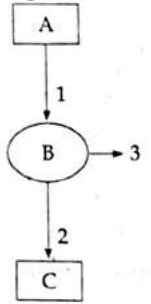
- A solid cylinder rolls without slipping down an inclined plane of height h . The velocity of the cylinder when it reaches the bottom is
 - $\sqrt{\frac{2gh}{3}}$
 - $\sqrt{\frac{4gh}{3}}$
 - $\sqrt{\frac{3gh}{3}}$
 - \sqrt{gh}
- The cause of Surface Tension is,
 - Adhesive force between molecules.
 - Cohesive force between molecules.
 - Gravitational force between molecules.
 - All of the above.
- Which of the following is a true statement?
 - The total entropy of thermally interacting systems is conserved.
 - Carnot engine has 100% efficiency.
 - Total entropy does not change in reversible process.
 - Total entropy in an irreversible process can either increase or decrease.
- The maximum efficiency of an engine operating between 30°C and 300°C is
 - 4.71%
 - 47.1%
 - 90%
 - 9%
- Where does the energy go from the low intensity position of interference pattern?
 - Vanishes
 - Shifts to high intensity position
 - Violates conservation of energy
 - Remains of same position but inaudible
- The ratio of velocity of sound in hydrogen gas ($\gamma = 7/5$) to that in helium gas ($\gamma = 5/3$) at the same temperature is:
 - $\sqrt{21} : 5$
 - 1 : 1
 - $\sqrt{42} : 5$
 - 2 : 1
- Thomson's effect is the combination of which following effects?
 - Seebeck effect and Peltier effect
 - Seebeck effect and Joule's effect
 - Joule's effect and Peltier effect
 - Ohm's effect and Joule's effect
- A straight wire of mass 200 g and length 1.5 m carries a current of 2 A . It is suspended in mid-air by a uniform horizontal magnetic field B . The magnitude of B (in tesla) is (Assume $g = 9.9 \text{ ms}^{-2}$),
 - 2
 - 1.5
 - 0.55
 - 0.66
- A coil of resistance 400Ω is placed in a magnetic field. If the magnetic flux ϕ (W) linked with the coil varies with time t (in s) as $\phi = 50 t^2 + 4$, the current in the coil at $t = 2 \text{ s}$ is,
 - 1 A
 - 0.5 A
 - 0.1 A
 - 2 A
- Einstein's photoelectric equation states that $E_k = E - \phi$. In this equation E_k refers to,
 - K.E. of all the emitted electrons
 - Mean K.E. of the emitted electrons

- c. Maximum K.E. of the emitted electrons
 - d. Minimum K.E. of emitted electrons
11. When a semiconductor is doped with a donor impurity, then
- a. The hole concentration increases.
 - b. The hole concentration decreases.
 - c. The electron concentration increases.
 - d. The electron concentration decreases.

Group B (Short Answer Questions)

Attempt all the questions. [8×5=40]

1. Figure aside is the schematic diagram of Carnot engine.



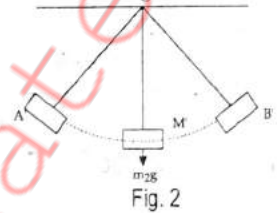
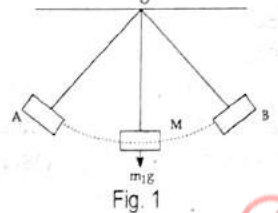
- a. What do A, B and C represent? [1]
- b. What are physical quantities that associated in arrow 1, 2 and 3? [2]
- c. Find the efficiency of Carnot engine in terms of 1, 2 and 3. [2]

OR

Petrol engine and diesel engine are four stroke practical engines. They have some fundamental differences in their working.

- a. What difference is there in the supply procedure of fuel in engine? [1]
 - b. What different process occur during the heat supply into the petrol and diesel engine? [2]
 - c. What are the main reasons of higher efficiency of diesel engine than that of petrol engine? [2]
2. The time period and velocity of a simple pendulum are to be calculated in the following condition (Fig. 1 and Fig. 2).

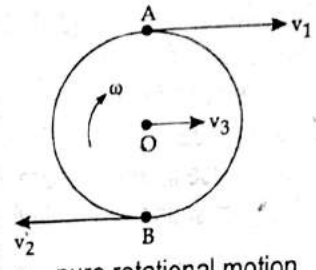
- a. What happens to the time period (i) when $OM > O'M'$ (ii) $OM = O'M'$ (iii) $m_1 < m_2$ and (iv) $AB > A'B'$. [1]
- b. What would be the frequency of oscillation of the pendulum if $m_1 > m_2$? [2]
- c. If $AB > A'B'$, what would be the velocity at the mean position? [2]



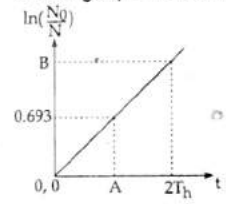
3. Give reason
- a. Which falls faster big rain drops or small rain drops? [1]
 - b. Why does an object entering the earth's atmosphere at high velocity catch fire? [2]
 - c. Why rain drops falling under gravity do not have very high velocity? [2]

OR

Consider a wheel rolling along the positive x direction with angular velocity ω . As the rolling motion is the combination of pure rotational motion and pure translational motion, using the figure, express the velocities v_1 , v_2 and v_3 in



- a. pure rotational motion [1]
 - b. pure translational motion [1]
 - c. rolling motion [3]
4. a. Draw the representative wave form in which observer recedes the stationary source with constant speed. [1]
- b. When a sound source is approaching towards us, what we observe increasing, intensity or pitch or both? [2]
- c. Write a mathematical relation that best represents all possible conditions in Doppler's effect. [2]
5. Show the direction of motion of charge particle in uniform magnetic field, for the following cases. Also, write the force experienced by charge particles in each of the cases.
- a. A negative charge particle enters the field acted perpendicularly inward to the plane of paper. [2]
 - b. A positive charge particle enters the field acting perpendicularly outward from the plane of paper. [2]
 - c. If any charge particle moves parallel/antiparallel to the magnetic field. [1]
6. Faraday's law of electromagnetic induction is the reverse effect of Oersted discovery on magnetic effect of current.
- a. Justify how is Faraday's law reverse effect of Oersted discovery. [1]
 - b. Write down the methods for detection of direction of magnetic fields in these two conditions. [2]
 - c. Give some practical applications of Faraday's laws and Oersted discovery. [2]
7. During beta-decay, the electron is ejected from the nucleus.
- a. Write β -decay reaction for neutron to proton transmutation. [2]
 - b. What happens when proton transforms to neutron? [2]
 - c. Does it violate the Heisenberg uncertainty principle that tells "no electron exist in the nucleus". [1]
8. In the graph shown aside,



- a. What does the slope of the curve give? [1]
- b. Find the value of A. [2]
- c. Find the value of B. [2]

Group C (Long Answer Questions)

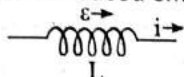
[3×8=24]

1. Ultrasound has several applications in medicine. The figure gives here is used to examine the infant growth in the uterus.



- Describe the nature of ultrasound from the aspect of reflection and refraction into the body tissues. [3]
- Explain the mechanism of image produced into the computer screen, when transducer is rubbed into the body surface. [2]
- Can we use audible sound in place of ultrasound to produce the images of body parts? Write some additional applications of ultrasound. [3]

2. Figure aside shows the direction of current at a given instant and induced emf in an inductor.



- Is the current increasing or decreasing? Give reason for your answer. [4]
- If the induced emf is 17 V and the rate of change of current is 25 kAs^{-1} , calculate the inductance of the inductor. [4]

OR

Mostly people think intensity changes due to the distance of listener from the source of sound, however Doppler's effect is different in the sense that the listener hears the different frequency, even though source is producing a fixed frequency.

- Derive an expression for the apparent frequency received by a stationary observer when a source is moving (i) towards and (ii) away from him. [5]
 - Find the change in frequency when a moving source of sound passes a stationary observer. [3]
3. Photoelectric effect provides the basic concept of quantum nature of light. This nature is quantified by Einstein's equation on photoelectric effect.
- What is photoelectric effect? Describe the associated terms in photoelectric emission. [3]
 - Discuss the Einstein's photoelectric equation. [3]
 - 400 nm wavelength of light falls on a photo sensitive material of work function 2.3 eV. Compute the maximum energy of photoelectrons. [2]

OR

- Describe the construction and explain the action of a simple form of a transformer. [3]
- Write down the advantages and disadvantages of eddy currents. [2]
- What are transformer losses? How these losses are minimized? [3]

4

Group A (Multiple Choice Questions)

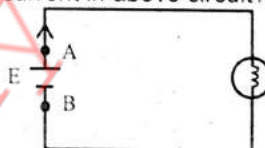
Tick the correct answer. [11×1=11]

- A cylinder has mass 'M' a length 'l' and radius 'R' then M.I. about own axis is
 - MR^2
 - $\frac{MR^2}{2}$
 - $\frac{MR^2}{4}$
 - $M\left(\frac{R^2}{4} + \frac{l^2}{12}\right)$
- Two people of 50 kg and 70 kg weight are sitting at distance of 6 m. The site where the tension is equal is at distance of:
 - 3.5 m from 50 kg man
 - 2.5 m from 50 kg man
 - At 3 m from both side
 - 4 m from 50 kg man

- Water makes a glass wet because the force of cohesion between two molecules of water is ... the force of adhesion between a molecule of water & a molecule of glass
 - greater than
 - less than
 - equal
 - none of the above
- Which of the following is a universal constant?

- $\frac{C_P}{C_V}$
- $C_P + C_V$
- $C_P - C_V$
- $\frac{C_V}{C_P}$

- In an adiabatic process on a gas with $\gamma = 1.4$, the pressure is increased by 0.5%. The volume of the gas decreases by
 - 0.36%
 - 0.7%
 - 0.5%
 - 1%
- Velocity of sound in gases doesn't depends upon
 - Pressure
 - Temperature
 - Humidity
 - Nature of gas
- What will be the apparent frequency if observer is approaching stationary source?
 - Greater than real frequency
 - Smaller than real frequency
 - First increases then decreases
 - No change
- The circuit shows a bulb and a battery connected together by a connecting wire which of the following is true for the current in above circuit?



- Current at point A is greater than at point B
 - Current is constant throughout the circuit and the bulb
 - Current is more in bulb and less in other part of circuit
 - Current is constant throughout
- A compare needle is allowed to move in horizontal plane is taken to a geomagnetic pole. It
 - Will stay in north-south direction only
 - Will stay in east-west direction only.
 - Will become rigid showing no movement.
 - Will stay in any position.
 - AC is converted in DC by
 - Transformer
 - Rectifier
 - Diode
 - Triode
 - The internal structure of crystal can be studied by
 - X-rays
 - γ rays
 - IR rays
 - UV rays

Group B (Short Answer Questions)

Attempt all the questions. [8×5=40]

- There are several applications of moment of inertia in the rotational objects.
 - Define moment of inertia. On what factors does it depend? [2]
 - Why spokes are made in the wheel of bicycle? [2]
 - How will you distinguish between a boiled egg and a raw egg by spinning it on a table top? [1]
- Explain the types of liquid meniscus in accordance with angle of contact. [2]
 - How does the angle of contact of a liquid depend on temperature? [1]

- c. The angle of contact for a solid and a liquid is less than 90° . Will the liquid wet the solid? Will the liquid rise in the capillary made of that solid? [2]

OR

Use the mechanism of capillary action to explain the following phenomena

- How is the rise of liquid affected, if the top of the capillary tube is closed? [2]
 - How does the cotton wick in an oil-filled lamp keep on burning? [1]
 - Why is it difficult to introduce mercury in a fine capillary tube? [2]
3. Usually, heat engines draw heat from hot body and reject it to cold body. But, the process on which a refrigerator works is quite opposite.
- Working of refrigerator supports the second law of thermodynamics. Explain. [3]
 - In cold countries, heat pumps are used in winter to transfer heat from some source (source as a pond of water) to the interior of houses. Do they violate the laws of thermodynamics? [2]
4. Transverse vibration of string is useful in many musical instruments.
- Give some examples of musical devices that are based on transverse vibration of string. [2]
 - How different sound notes can be produced with a single wire in "SARANGI"? [1]
 - Thickness of wire in musical devices has the great effect in producing the different frequencies of sound. Give the mathematical relation between thickness of wire and frequency produced by this wire. [2]
5. a. What is the application of torque produced by the magnetic field? Write best example. [1]
- b. What do the current sensitivity and voltage sensitivity mean in moving coil galvanometer? [2]
- c. In a current carrying rectangular coil, force acting on each of the opposite wire has equal and opposite, why it goes in rotation, rather comes to rest, in certain orientation? [2]
6. Lenz law is very useful to detect the direction of induced emf due to flux linkage in a coil.
- How does it verify the conservation of energy? [1]
 - Sketch the relation of induced emf and magnetic field. [2]
 - Is there any difference in showing the direction of induced current in Lenz's law and Fleming's left hand rule? [2]

OR

In the series LCR circuit,

- At what condition, resonance occurs? [1]
 - Draw the current versus frequency curve for the given situation. [2]
 - What would be the resonant frequency for a combination at which, $C = 33 \text{ pF}$ and $L = 1.17 \times 10^{-3} \text{ H}$? [2]
7. a. What is cross field? [2]
- b. What is the speed of electron in cross field? [2]
- c. Why is cross field named so? [1]
8. In the production of x-rays in Coolidge tube:
- What happens if current from low tension battery is increased? [1]

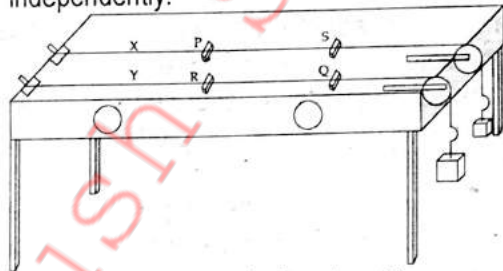
- b. What happens in wavelength of x-rays, if the potential difference from high tension battery is halved? [2]
- c. Show the graphical relation between λ_{\min} and V that is applied from high tension battery. [2]

Group C (Long Answer Questions) [3×8=24]

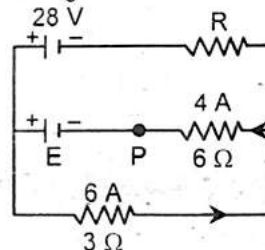
1. Constructive and destructive patterns of light intensity is observed in interference of light.
- Explain the production of constructive and destructive patterns of two waves in terms of phase difference and path difference. [3]
 - What happens in phase difference and path difference if a transparent diffraction medium is inserted in the path of one of the coherent sources? [3]
 - What is superposition theorem? How is it important in superposition of two light waves? [2]

OR

In the given figure, two wires are connected in a sonometer independently.



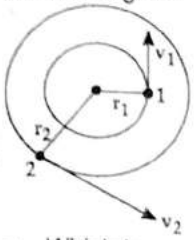
- First consider a single wire either x or y. What would be the frequency of vibration of the diameter of the wire is (i) doubled (ii) halved. Then, find the relation of frequency produced in case of (i) and (ii). [3]
 - If length, tension and diameter of the wires are taken equal, can we produce the sound of different frequencies from these wires? If possible, explain which factor is associated in producing different frequencies. [3]
 - If the tension on wire x is doubled and the diameter of wire is halved, find the relation of resonating length if both wires are made with same material. [2]
2. a. What are the possible independent loops to apply the Kirchhoff's law in given circuit. Write the voltage and current relation in them. [4]
- b. Using Kirchhoff's rules in the circuit, find [4]



- the current in resistor R
 - the resistance R
 - the unknown emf E
 - If the circuit is broken at P, what is the current in resistor R?
3. GM counter is a very useful device that is basically used in nuclear labs to study the activity of radioactive sources.
- Describe the construction and working principle of GM counter. [4]
 - Write the associated terms that are used in the operation of GM counter. [2]
 - Are there some limitations of GM counter in its measurement? If yes, describe them. [2]

OR

Two electrons 1 and 2 are revolving through two orbits as shown in figure.



- Which is greater v_1 or v_2 ? [2]
- Which electron has greater angular momentum? Derive. [4]
- Where does electron jump to get the lower velocity? [2]

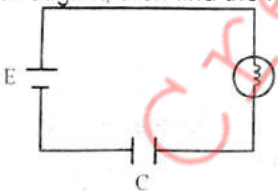
5

Group A (Multiple Choice Questions)

Tick the correct answer.

[11×1=11]

- Two solid spheres of the same material have radii in the ratio 1:2. Their moments of inertia will be in the ratio
 - 1 : 4
 - 1 : 8
 - 1 : 16
 - 1 : 32
- The time period of simple pendulum is double when
 - Length is increased by 2 times
 - Mass is increased by 2 times
 - Length is increased by 4 times
 - Length is reduced to half
- Capillary tube A and B having diameter of $A > B$ is dipped vertically in a beaker then rise of water will be maximum in
 - A
 - B
 - Equal in both
 - Water doesn't rise of up
- What is the process during the working stroke of heat engine?
 - Isothermal
 - Adiabatic
 - Isobaric
 - Isochoric
- In an isothermal process taking place in a gas:
 - no heat energy is applied to the gas
 - change in internal energy of the gas is equal to the work done
 - the amount of heat supplied to the gas is equal to the work done
 - the amount of heat supplied to the gas is equal to the change in internal energy
- Which of the following is a mechanical wave?
 - Radio waves
 - Light waves
 - X-rays
 - Sound waves
- The quality of sound depends upon
 - Amplitude
 - Pitch
 - No. of overtone
 - Frequency
- If the power of a heater is 1 W. 1 A of current is passed through it, then find the resistance?



- 4.2 Ω
 - 4200 Ω
 - 1 Ω
 - 0.1 Ω
9. The value of magnetic intensity remaining even after removing the magnetic field is said as

- Hysteresis loop
- Retentivity
- Coercivity
- Magnetic induction

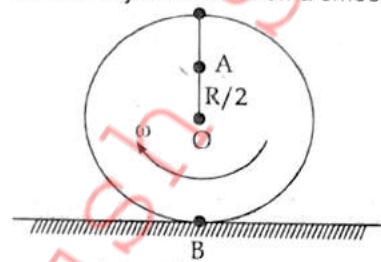
10. An AC circuit contains resistance 4 Ω and capacitor 3 F. Then, the impedance of circuit is
 - 5 Ω
 - 4 Ω
 - 3 Ω
 - 7 Ω
11. The continuous X-ray spectrum is produced when
 - electrons of the target atom jump from a higher to a lower orbit
 - the bombarding electrons knock out electron from inner shell
 - accelerated incident electrons get deflected by the nucleus
 - when transition of electrons takes place from K shell

Group B (Short Answer Questions)

Attempt all the questions.

[8×5=40]

1. A disc is rotating with angular velocity ω about its axis without any translation on a smooth surface.



- Find direction and magnitude of velocity at points B and A. [2]
 - What is the role of friction at B? [1]
 - What is the condition of friction during perfect rolling? [2]
2. Find the time period of simple pendulum in the following conditions.
- If length of a simple pendulum is increased by 4 times its original length, will its time period change? If yes, by how much? [2]
 - If the length of a second's pendulum is increased further by 20 percent, will it lose or gain time? [1]
 - A pendulum clock is in an elevator that descends at constant velocity. Does it keep correct time? If the same clock is in free fall, does it keep correct time? [2]
3. Work done during thermodynamic processes can be measured using indicator diagram.
- What does the area enclosed by P-V diagram (or indicator diagram) signify? [2]
 - How is there work done in cyclic process? [1]
 - Draw indicator diagram for isochoric and isobaric process. [2]
4. In the given progressive wave,
-
- What is 'a' named? [1]
 - If the wave travels O to A in 2 s, find the frequency of the wave. [2]
 - For $a = \pi$, find the maximum particle velocity for given condition at (b). [2]
5. a. What are the applications of induction in single coil and in double coil? [2]
- b. Deduce the relation of self-inductances of two coils with the mutual inductance between them. [2]

- c. Why correction factor is needed in the relation given from (b). [1]

OR

Define the terms,

- a. Positive Thomson effect [1]
 b. Negative Thomson effect [4]
 c. Thermopile [3]

6. In a current carrying circular conductor,

- a. What is the magnetic field at a point of the axis of conductor? [1]
 b. What would be the magnetic field at the center and axis distance $\frac{a}{2}$ from the center, where a is the radius of the circle? [2]
 c. Why the perpendicular components of the field on axis is not considered in the calculation of net magnetic field? [2]

7. Einstein's photoelectric equation is a landmark in photoelectric effect. Explain

- a. How it explains the conservation of energy. [3]
 b. The importance of alkali metals in the generation of solar energy. [2]

OR

Electron revolves through a specified orbit around the nucleus of an atom.

- a. Write the formula for radius of n^{th} orbit of hydrogen like atom. [2]
 b. Draw the nature of graph between (i) r and n (ii) r and n^2 [2]
 c. Find the relation of radius of hydrogen like atom with atomic number Z . [1]

8. Explain the production of x-rays in terms of

- a. Reverse photoelectric effect [2]
 b. Conservation of energy [2]
 c. Low efficiency mechanism [1]

Group C (Long Answer Questions) [3×8=24]

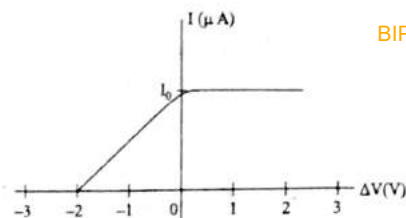
1. a. What is polarization by reflection? [2]
 b. Show that: $\mu = \tan \theta_p$, where μ =refractive index of the medium, θ_p = angle of polarization or polarizing angle. [2]
 c. Prove that, reflected rays and refracted rays are normal to each other when the light is incident at the angle of polarization. [2]

OR

The speed of sound derived from Newton's formula was corrected by Laplace to determine the correct value of speed of sound.

- a. What thermodynamic process did Laplace assume to overcome the discrepancy of Newton's formula? What mechanism occur in gas during the propagation of sound? Describe. [3]
 b. Derive the expression for Laplace correction of speed of sound. [3]
 c. At what temperature the speed of sound is increased by 50% than that at 27°C ? [2]

2. The figure below is the current versus potential difference graph for a photoelectric-effect experiment with an unknown metal. Assuming, classical physics provides the correct description of the photoelectric effect, how would the graph look if,



BIPOs Notes

- a. The light was replaced by an equally intense light with shorter wavelength? Draw it. [2]
 b. The metal was replaced by a different metal with smaller work function? Draw it. [2]
 c. The photoelectric work function of potassium is 2 eV and the surface is illuminated with radiation of wavelength 350 nm . What potential difference have to be applied between a potassium surface and the collecting electrode in order just to prevent collection of electrons? What would be the kinetic energy of the electrons? [4]
3. Hysteresis property of magnetic substance is useful to make the permanent and strong magnets.
- a. Describe the formation of hysteresis loop in ferromagnetic substance. [3]
 b. Explain the nature of hysteresis loop given by soft iron and steel. What do these loops signify? [2]
 c. Explain the coercivity and retentivity of hysteresis loop with appropriate diagram. [3]

OR

In resonant series L-C-R circuit, the current across the circuit is maximum at a certain frequency.

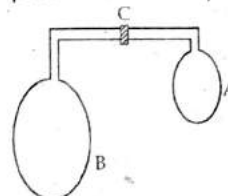
- a. Find the condition of resonance L-C-R circuit. [3]
 b. Deduce condition of minimum current in L-C-R circuit. What this circuit called? [2]
 c. Construct the graphs and phasors for (i) inductive dominance (ii) capacitive dominance and (iii) resonance condition in this combination. [3]

6

Group A (Multiple Choice Questions)

Tick the correct answer. [11×1=11]

1. The pendulum of clock is made of brass. If the clock keeps correct time at 20°C , how many seconds per day will it lose at 35°C : ($\alpha_{\text{brass}} = 2 \times 10^{-5} \text{ }^\circ\text{C}^{-1}$)
 a. 12.3 secs b. 36.9 secs
 c. 24.6 secs d. 49.2 secs
2. The figure shows two soap bubble A and B connected with each other by a thin tube with piston C initially closed. The piston C is now opened then



- a. B increases in size and size of A decreases
 b. A increases in size and size of B decreases
 c. Both A and B attain equal size
 d. Both A and B contract

3. Two drops of water having same radius moving in air downwards with constant velocity v . If the drops coalesced, what will be the new velocity:
- $2^{1/3}v$
 - $(2^{2/3} - 1)v$
 - $2^{2/3}v$
 - $(2^{1/3} - 1)v$
4. The temperature of n moles of an ideal gas changes by dT when it undergoes an isochoric process. The change in internal energy of the gas during the process is equal to..
- $nC_p dT$
 - $nC_v dT$
 - $nRdT$
 - $(C_p - C_v)dT$
5. Seventy calories of heat is required to raise the temperature of 2 moles of an ideal gas at constant pressure from 30°C to 35°C . The amount of heat required to raise the temperature of the same gas through the same range at constant volume is equal to
- 30 cal
 - 70 cal
 - 50 cal
 - 90 cal
6. Which is not true?
- Velocity of sound do not change with pressure
 - Velocity of sound is directly proportional to absolute temperature
 - Velocity of sound depends upon elasticity of medium
 - All
7. A source of sound is moving away from a stationary observer with a speed equal to the speed of sound. The apparent frequency heard by the observer will be
- n^2
 - $2n$
 - $\frac{n}{2}$
 - None
8. Kirchoff's first law is based on
- Conservation of charge
 - Conservation of momentum
 - Conservation of voltage
 - None
9. The substances which when placed in external magnetic field are feebly magnetized in opposite direction to that of the magnetizing field are
- Paramagnetic substance
 - Diamagnetic substance
 - Ferromagnetic substance
 - Both (a) and (b)
10. An A.C. having angular frequency 1000 rad/sec is passed through a capacitor of $1 \mu\text{F}$, then capacitive reactance is ...
- 100Ω
 - 500Ω
 - 200Ω
 - 1000Ω
11. X-rays are
- Fluorescence wave
 - Deflected in electric and magnetic field
 - Not deflected in electric and magnetic field
 - Highly penetrating

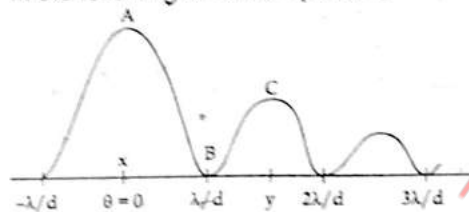
Group B (Short Answer Questions)

Attempt all the questions.

[8×5=40]

1. Adiabatic process is useful in the construction of heat engines.
- How this process does work, since there is no heat exchange in the system? [2]
 - How do you distinguish isothermal and adiabatic curve in same PV plane? [2]

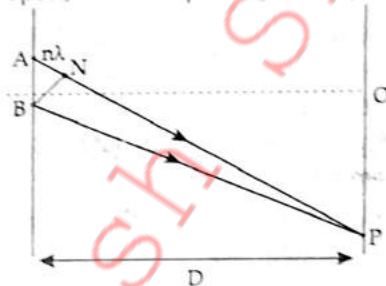
- c. What type of work is performed in adiabatic expansion, positive or negative? [1]
2. In the following diffraction pattern,



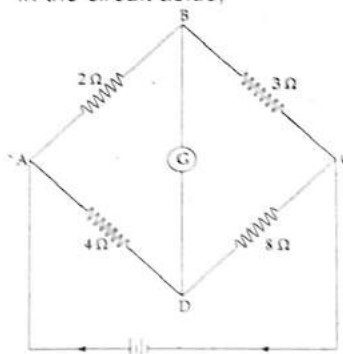
- Name the order of maximum or minimum at A, B and C. [1]
- What is the linear distance and angular distance between x and y . [2]
- What difference is there in the angular position and intensity in every successive maximum? [2]

OR

Analyze the given figure and answer the following questions. In the figure, A and B are slits and are d distance apart, AN is the path difference.



- What type of fringe is obtained, bright or dark at point P, if $n = 2$? [2]
 - What type of fringe would be obtained immediately after P? [2]
 - Find the distance OP in the given figure. [1]
3. In the oscillation of springs, consider the following conditions and give answers.
- Two identical springs of force constant k each are connected in parallel. What will be the equivalent spring constant [1]
 - What could be the time period of vibrating spring in the space? [2]
 - What is the acceleration of vibrating spring at mean position and extreme position? [2]
- 4.
- What makes water-proof rain coat water proof? [2]
 - By which phenomenon, the water rises from roots to leaves of plants? [1]
 - Why is the tip of the nib of a fountain pen split? [2]
5. In the circuit aside,

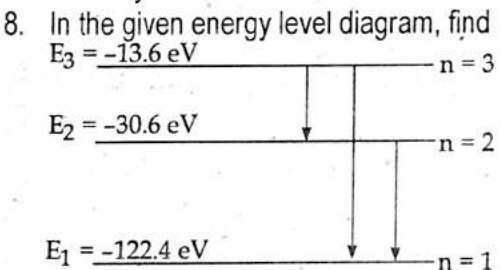


- Does the circuit have balanced condition? [1]
- What could be the value at 3Ω resistor to make the circuit balanced? [2]
- If the 8Ω resistor is changed to 12Ω , what would be the resistance across 4Ω resistor? [2]

OR

When a charge particle moves in a uniform magnetic field, it experience a force, called the Lorentz force.

- a. What is the vector representation of Lorentz force? [1]
 - b. Represent graphically the direction of \vec{F} , \vec{B} and \vec{v} . [2]
 - c. The direction of force from Fleming's left hand rule is for which nature of charge, positive or negative? [2]
6. Alternating current (a.c.) is the function of time.
- a. Write the equation that represents the time dependent current. [1]
 - b. Draw the current versus time graph. [2]
 - c. What is the necessity of root mean square calculation to find the mean value of time dependent current? [2]
7. There are several factors associated in photoelectric emission, work function of metals, the orbit through which the electron revolves and what energy it provides to the electron.
- a. Why alkali metals are preferred for the photoelectric emission? [1]
 - b. Why don't free electrons in a metal emit out spontaneously? Why is external energy (light or heat) required to eject them out? [2]
 - c. Why do different metals have different work functions? [2]



- a. The largest possible energy emission in given condition. [1]
- b. The longest wavelength of emitted photon. [1]
- c. From which atom, the energy levels have been taken. [3]

Group C (Long Answer Questions) [3×8=24]

1. Pressure amplitude and displacement amplitude are the different physical parameters.
- a. What is pressure amplitude? [2]
 - b. Define the intensity of sound and prove that $I = \frac{1}{2} \rho v a^2 \omega^2$ where the symbols have their usual meaning. [3]

- c. The intensity level from a loud speaker is 100 dB at a distance of 10 m. What is its intensity level at a distance of 100 m? [3]

OR

A plane progressive simple harmonic sound wave of angular frequency 680 rads^{-1} moves with speed 340 ms^{-1} in the direction which makes equal angle with each x, y, and z axis. The oscillations of the particle in the medium is located at the positions $(\sqrt{3}, \sqrt{3}, \sqrt{3}) \text{ m}$ and $(2\sqrt{3}, 2\sqrt{3}, 2\sqrt{3}) \text{ m}$.

- a. Write the appropriate relation of phase difference and path difference, and then find the path difference. [3]
 - b. Find the phase difference of these two points. [2]
 - c. Write the appropriate progressive wave equation. [3]
2. Figures (i) and (ii) show two U-shaped wires placed in the same uniform magnetic field. If a conducting bar is slid along the wire in the directions shown, with same velocity v , the current induced in figure (i) is counter-clockwise. If the parallel lengths of the wire are separated by $2L$ in Fig. (i) and by L in Fig. (ii) (a) Is the magnetic field into or out of the page? (b) Is the current induced in Fig. (ii) clockwise or counter-clockwise? (c) Is the emf induced in the Fig. (i) is larger, smaller than or the same as in Fig. (ii). [8]

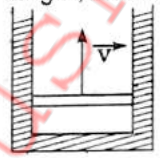


Fig. (i)

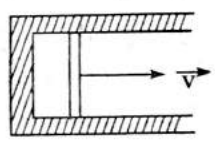


Fig. (ii)

3. The isotope $^{90}_{38}\text{Sr}$ undergoes β^- decay with a half-life of 28 years.
- a. What nucleus is produced by this decay? [2]
 - b. If a nuclear power plant is contaminated with ^{90}Sr , how long will it take for the radiation level to decrease to 1.0% of its initial value? [3]

OR

Sodium has a work function of 2 eV. Calculate the maximum energy and speed of the emitted electrons when sodium is illuminated by a radiation of 150 nm. What is the threshold frequency of radiation for which electrons are emitted from sodium surface?

Created by BHAKHATRI