

General Instructions:

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 - (i) **Section A** : Q. No. 1 contains 10 multiple choice type of questions carrying 1 mark each.
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 - (iv) **Section D** : Q. No. 15 to No. 26 contains 12 short answer type questions carrying 3 marks each.
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i.e. (a) / (b) / (c) / (d) etc. only first attempt will be considered for evaluation.

SECTION - A

Q.1. Select and write the correct answer:

[10]

- (i) The K.E. of a body is 3 J and its M.I. is 6 kg m^2 . Then its angular momentum will be
 (a) $3 \text{ kg m}^2/\text{s}$ (b) $6 \text{ kg m}^2/\text{s}$ (c) $4 \text{ kg m}^2/\text{s}$ (d) $5 \text{ kg m}^2/\text{s}$
- (ii) The coefficient of absorption and coefficient of transmission are 0.50 and 0.25 respectively. If 200 calories of radiant heat is incident on the surface of the body, the quantity of heat reflected will be
 (a) 140 cal (b) 150 cal (c) 50 cal (d) 200 cal
- (iii) What is the value of shunt resistance that allows 20% of the main current through a galvanometer of 99Ω ?
 (a) 20.75Ω (b) 24.75Ω (c) 28.75Ω (d) 30.75Ω
- (iv) The direction of induced emf due to changing magnetic flux is given by
 (a) Coulomb (b) Newton (c) Faraday (d) Lenz
- (v) When a charged capacitor is allowed to discharge through a non resistive inductor, electrical oscillations of constant amplitude and frequency are produced. These oscillations are called
 (a) LC oscillations (b) RC oscillations (c) FC oscillations (d) RF oscillations
- (vi) The successive lines in a given series come closer and closer and ultimately reach the values of $\lambda = \dots$ in the limit $m \rightarrow \infty$ for different values of n
 (a) $\frac{n}{R}$ (b) $\frac{R}{n}$ (c) $\frac{R}{n^2}$ (d) $\frac{n^2}{R}$

- (vii) Which gate can act as building block for the digital circuits?

- (a) OR (b) AND (c) NOT (d) NAND

- (viii) The expression of time period of angular SHM is

- (a) $2\pi/\sqrt{\text{Angular velocity per unit angular displacement}}$
- (b) $2\pi/\sqrt{\text{Angular acceleration per unit angular displacement}}$
- (c) $\sqrt{\text{Angular velocity per unit angular displacement}}/2\pi$
- (d) $\sqrt{\text{Angular acceleration per unit angular displacement}}/2\pi$

- (ix) For an isothermal process, which of the following quantities are non zero?

- (a) ΔU and ΔT (b) Q and W (c) ΔU and W (d) ΔU and Q

- (x) The SI unit and dimensions of Reynolds number respectively are

- (a) Poise, $[L^0 M^0 T^0]$ (b) Ns/m^2 , $[L^1 M^1 T^1]$ (c) No unit, $[L^0 M^0 T^0]$ (d) No unit, $[L^1 M^1 T^1]$

Q.2. Answer the following:

[08]

- (i) Which method of biasing is used for operating transistor as an amplifier?
- (ii) A pair of adjacent coils has a mutual inductance of 1.5 H. If the current at one coil changes from 0 to 20 A in 0.5 sec, what is the change of flux linked with the other coil?
- (iii) State Wien's displacement law.
- (iv) Define beat frequency.
- (v) A beaker of radius 10 cm is filled with water. Calculate the force of surface tension on any diametrical line on its surface. Surface tension of water is 0.075 N/m

- (vi) State formula for workdone against electrostatic force while displacing charge $+q_0$ at distance r_1 towards charge $+Q$ at distance r_2 .
 (vii) What is meant by Toroid?
 (viii) State the value of Bohr Magnetron.

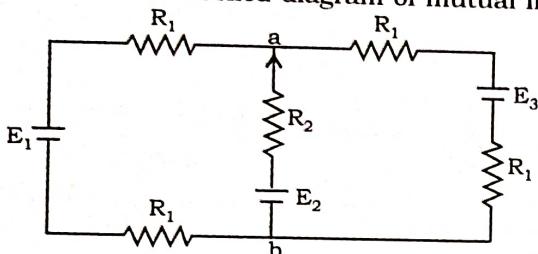
SECTION - B

[16]

Attempt any EIGHT of the following:

- Q.3. Explain the concept of lower limit and upper limit on the turning speed.
 Q.4. State any two limitations of Bohr's Model.
 Q.5. Draw a neat labelled diagram of mutual inductance of two coils.

Q.6.



For the circuit shown above, with $R_1 = 1.0 \Omega$, approx. $R_2 = 2.0 \Omega$, $E_1 = 2V$ and $E_2 = E_3 = 4V$. Calculate the approx. potential difference between the points 'a' and 'b'.

- Q.7. When do the two systems are said to be in thermal equilibrium?
 Q.8. An alternating voltage given by $e = 140 \sin 314.2 t$ is connected across a pure resistor of 50Ω . Find the frequency of the source.
 Q.9. Draw a neat labelled diagram for schematic of experiment set up for photo electric effect.
 Q.10. Length of 0.3 m wire vibrates in fundamental mode of frequency 480 Hz. Calculate the velocity of sound wave in air.
 Q.11. State any two factors affecting the angle of contact.
 Q.12. Calculate the energy radiated in one minute by a perfectly black sphere of radius 5 cm and maintained at $127^\circ C$. [Given: $\sigma = 5.7 \times 10^{-8} Jm^{-2}s^{-1}K^{-4}$]
 Q.13. What will happen if a parallel plate capacitor is filled with conducting slab?
 Q.14. A circular loop of radius 9.7 cm carries a current 2.3 A. Obtain the magnitude of the magnetic field at the centre of the loop.

SECTION - C

[24]

Attempt any EIGHT of the following:

- Q.15. Explain construction and working of moving coil galvanometer (MCG) with a neat labelled diagram.
 Q.16. Describe the input and output waveforms for full wave rectifier.
 Q.17. What should be the diameter of a soap bubble in order that the excess pressure inside it is 51.2 N/m^2 ?
 $[S.T. \text{ of soap solution} = 3.2 \times 10^{-2} \text{ N/m}]$
 Q.18. Calculate the de Broglie wavelength of bullet moving with the speed 90 m/s and having a mass 5 g.
 Q.19. Explain the term wave particle Duality of matter.
 Q.20. The length of a straight thin wire is 2 cm. It is uniformly charged with a positive charge of $3 \mu\text{C}$. Calculate
 (i) the charge density of the wire.
 (ii) the electric intensity due to the wire at a point 1.5 m away from the center of the wire.
 Q.21. What is series LCR resonant circuit? State the conditions for series resonance. Obtain an expression for resonant frequency.
 Q.22. With a neat labelled diagram, explain Ferry's perfectly blackbody.
 Q.23. State Lenz's law. Explain how Lenz's law is incorporated in Faraday's law?
 Q.24. The intensity of the light coming from one of the slits in Young's experiment is twice the intensity of the light coming from the other slit. What will be the approximate ratio of the intensities of the bright and dark fringes in the resulting interference pattern?
 Q.25. Obtain the balancing condition in case of a Wheatstone's network.

Q.26. Wavelengths of two notes in the air are $\left(\frac{70}{153}\right)$ m and $\left(\frac{70}{157}\right)$ m. Each of these notes produces 8 beats per second with a tuning fork of fixed frequency. Find the velocity of sound in the air and frequency of the tuning fork.

SECTION - D

[12]

Attempt any THREE of the following:

Q.27. Define magnetization. State its SI unit and dimensions. Derive the relation between magnetic field intensity (H) and magnetization (M) for a magnetic material placed in a magnetizing field.

Q.28. Light of wavelength 5000 \AA falls on a plane reflecting surface. What are the wavelength and frequency of the reflected light? For what angle of incidence is the reflected ray normal to the incident ray?
What are primary and secondary sources of light?

Q.29. Using differential equation of linear SHM, obtain the expression for velocity in SHM and acceleration in SHM.
A body of mass 1 kg is made to oscillate on a spring of force constant 16 N/m.

Calculate -

- (b) Angular frequency
- (c) Frequency of vibrations

Q.30. Distinguish between Isobaric and Isochoric thermodynamic process.
If a gas is compressed adiabatically by doing work of 150 J, what is the change in internal energy of the gas?

Q.31. Derive an expression for time period of a Conical pendulum. On what factors does the frequency of a Conical pendulum depends? Is it independent of some factors?



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SECTION - A**Q.1. Select and write the correct answer:**

[10]

- (i) A simple pendulum is suspended from the roof of a train. If the train is moving with an acceleration 49 cm/s^2 . Then the angle of inclination of the string about the vertical will be

(a) 20° (b) zero (c) 30° (d) 3°
- (ii) The Boolean expression for an exclusive OR gate is

(a) $A + B$ (b) $A \oplus B$ (c) $\overline{A + B}$ (d) $A \cdot B$
- (iii) What is the angular momentum of the electron in the third Bohr orbit in the hydrogen atom?

$$\left[\frac{h}{2\pi} = 1.055 \times 10^{-34} \text{ kg m}^2/\text{s} \right]$$

(a) $3.165 \times 10^{-34} \text{ kg m}^2/\text{s}$ (b) $3.165 \times 10^{34} \text{ kg m}^2/\text{s}$
 (c) $3.165 \times 10^{-24} \text{ kg m}^2/\text{s}$ (d) $3.165 \times 10^{24} \text{ kg m}^2/\text{s}$
- (iv) For which of the following does the centre of mass lie outside the body?

(a) Pencil (b) A shotput (c) A disc (d) A bangle
- (v) An ideal transformer has 100 turns in the primary and 250 turns in the secondary. The peak value of the ac is 28 V. The rms secondary voltage is nearest to

(a) 100 V (b) 70 V (c) 50 V (d) 40 V
- (vi) The magnetic dipole moment of current loop is independent of

(a) number of turns (b) area of loop
 (c) current in the loop (d) magnetic field in which it is lying
- (vii) The null point of a potentiometer wire will shift beyond the potentiometer wire if

(a) emf of driving cell is low (b) emf of accumulator is high
 (c) length of wire is small (d) length of wire is large
- (viii) A sonometer wire vibrates with three nodes and two antinodes. The corresponding mode of vibration is

(a) the first overtone (b) the second overtone
 (c) the third overtone (d) the fourth overtone
- (ix) Visible light comprises of wavelengths in the range

(a) 100 – 400 nm (b) 200 – 300 nm (c) 300 – 700 nm (d) 400 – 700 nm
- (x) The substance which allows heat radiations to pass through it is

(a) dry air (b) water vapour (c) iron (d) wood

Q.2. Answer the following:

[08]

- (i) What is meant by a surface film?
- (ii) A 100 mH inductor, a $25 \mu\text{F}$ capacitor and 15Ω resistor are connected in series to a 120 V, 50 Hz AC source. Calculate current at resonance.
- (iii) A gas receives an amount of heat equal to 110 J and performs 40 J of work. What is the change in internal energy of the gas?
- (iv) State the relation between the SI units volt and weber.
- (v) State the drawback of Thomson's model of atom.
- (vi) What should be the order of the size of an obstacle or aperture to produce diffraction of light?
- (vii) Define seconds pendulum.
- (viii) Capacitors are combined in which arrangement, when we require a large capacitance at small potentials?

SECTION - B**[16]**

- Attempt any EIGHT of the following:**
- Q.3. A toroid of 4000 turns has outer radius of 26 cm and inner radius of 25 cm. If the current in the wire is 10 A. calculate the magnetic field of the toroid.
- Q.4. The length of a straight thin wire is 2 m. It is uniformly charged with a positive charge of $3 \mu\text{C}$. If charge density of the wire is $1.5 \times 10^{-6} \text{ C/m}$ then calculate the electric intensity due to the wire at a point 1.5 m away from the centre of the wire.
- Q.5. State the zeroth law of thermodynamics. Give their schematic representation.
- Q.6. Draw neat labelled diagram of schematic of experimental set up for photoelectric effect.
- Q.7. Calculate the gyromagnetic ratio of electron (**Given:** $e = 1.6 \times 10^{-19} \text{ C}$, $m_e = 9.1 \times 10^{-31} \text{ kg}$)
- Q.8. Define phasor. Draw the diagram representing it.
- Q.9. A drop of radius $2 \times 10^{-5} \text{ m}$ and density $1.2 \times 10^3 \text{ kg/m}^3$ falls through air. The viscosity of air is $1.8 \times 10^{-5} \text{ Ns/m}^2$. Neglecting buoyancy due to air, calculate the terminal speed of the drop.
- Q.10. The wavelength of maximum emitted energy of a body at 700 K is $4.08 \mu\text{m}$. If the temperature of the body is raised to 1400 K. Calculate the maximum wavelength of emitted energy.
- Q.11. Why and where are eddy currents undesirable? How are they minimized?
- Q.12. Write a short note on Beats.
- Q.13. On what factors does the potential gradient of wire depend? What is the SI unit of potential gradient?
- Q.14. Draw neat labelled diagram of Huygen's progress of a plane wavefront and progress of a spherical wavefront.

SECTION - C**[24]**

- Attempt any EIGHT of the following:**
- Q.15. A circular race course track has a radius of 500 m and is banked to 10° . If the coefficient of friction between tyres of vehicle and the road surface is 0.25. Compute -
 (i) the maximum speed to avoid slipping.
 (ii) the optimum speed to avoid wear and tear of the tyres. ($g = 9.8 \text{ m/s}^2$)
- Q.16. The photoelectric work function of a metal is 3 eV. Find the maximum kinetic energy and maximum speed of photoelectrons when radiation of wavelength 4000 \AA is incident on the metal surface.
- Q.17. What is meant by the term impedance?
 The total impedance of a circuit decreases when a capacitor is added in series with L and R. Explain why.
- Q.18. In Young's double slit experiment the ratio of the intensities at the maxima and minima in the interference pattern is 36 : 16. What is the ratio of the widths of the two slits?
- Q.19. A resistance of 3Ω is connected to the secondary coil of 60 turns of an ideal transformer. Calculate the current (peak value) in the resistor, if the primary has 1200 turns and is connected to 240 volt (peak) ac supply. Assume that all the magnetic flux in the primary coil passes through the secondary coil and that there are no other losses.
- Q.20. Two parallel SHMs are given by
 $X_1 = 20 \sin(8\pi t)$ and $X_2 = 10 \sin[8\pi t + \pi/6]$
 Find the resultant amplitude and initial phase of resultant SHM
- Q.21. State and prove theorem of parallel axes about moment of inertia.
- Q.22. Explain with neat circuit diagram, how you will determine the unknown resistance by using a meter-bridge.
- Q.23. Define magnetic intensity. Explain magnetization of a material.
- Q.24. Define resonance. Give any four applications of resonance.
- Q.25. Obtain an expression for electric field intensity due to an infinitely long straight charged wire or charged conducting cylinder.
- Q.26. Explain Biot-Savart law.

SECTION - D**Attempt any THREE of the following:****[12]**

- Q.27.** Explain working of a transistor as an amplifier in detail with the help of proper diagram.
- Q.28.** A soap film is formed when a rectangular wire frame of area $2\text{ cm} \times 2\text{ cm}$ is dipped in a soap solution and taken out. If the area of the film is increased to $3\text{ cm} \times 3\text{ cm}$, calculate the workdone in the process.
[Surface tension of the soap film is $3 \times 10^{-2}\text{ N/m}$]
What is capillarity? Give some application of capillarity.
- Q.29.** Obtain an expression for the radius of n^{th} Bohr orbit and show that the radius is proportional to square of the principal quantum number.
How long will it take for a radioactive sample to reduce 1% of its original activity?
(Half life of the sample is 5.3 years)
- Q.30.** When a gas is heated its temperature increases. Explain this phenomenon based on kinetic theory of gases.
The difference between two molar specific heats of a gas is $8000\text{ J kg}^{-1}\text{ K}^{-1}$. If the ratio of the two specific heats is 1.65, calculate the two molar specific heats.
- Q.31.** Explain the cyclic process with a heat labelled PV diagram.
Why is there a change in the energy of a gas when its volume changes?



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SECTION - A**Q.1. Select and write the correct answer:**

[10]

- (i) As the electron revolves in the second Bohr orbit of the hydrogen atom, the corresponding current is (about) 1.3×10^{-4} A. If the area of the orbit is (about) 1.4×10^{-19} m², what is the (approximate) equivalent magnetic moment?
 (a) 1.82×10^{-23} Am² (b) 1.82×10^{-15} A-m² (c) 2.82×10^{-23} Am² (d) 2.82×10^{-15} A-m²
- (ii) In a common-base configuration the transistor has an emitter current of 10 mA and collector current of 9.8 mA; the value of the base current is
 (a) 0.1 mA (b) 0.2 mA (c) 0.3 mA (d) 0.4 mA
- (iii) The relation between relative permeability and magnetic susceptibility is given by
 (a) $\chi_m = \mu_r + 1$ (b) $\chi_m = -\mu_r - 1$ (c) $\mu_r = 1 - \chi_m$ (d) $\mu_r = 1 + \chi_m$
- (iv) The internal energy of one mole of argon at 300 K is (R = 8.314 J/mol.K)
 (a) 3541 J (b) 3741 J (c) 3941 J (d) 4041 J
- (v) The ratio of kinetic energy to the total energy of an electron in a Bohr orbit of the hydrogen atom is
 (a) 1 : 1 (b) 1 : -1 (c) 2 : -1 (d) 1 : -2
- (vi) In series LCR circuit, at resonance, phase difference between current and emf of source is
 (a) π rad (b) $\frac{\pi}{2}$ rad (c) $\frac{\pi}{4}$ rad (d) zero rad
- (vii) Henry is equivalent to
 (a) ampere/second (b) ampere-second (c) ohm/second (d) ohm-second
- (viii) For polyatomic molecule having 'F' vibrational modes, the ratio of two specific heats, $\frac{C_p}{C_v}$ is,
 (a) $\frac{1+F}{2+F}$ (b) $\frac{2+F}{3+F}$ (c) $\frac{4+F}{3+F}$ (d) $\frac{5+F}{4+F}$
- (ix) The magnitude of centripetal force cannot be expressed as,
 (a) $m r \omega^2$ (b) $\frac{4\pi^2 m r}{T^2}$ (c) $m v \omega$ (d) $m w/\omega$
- (x) In which of the following substance, surface tension increases with increase in temperature?
 (a) Copper (b) Molton copper (c) Iron (d) Molton iron

Q.2. Answer the following:

[08]

- (i) A metal rod of resistance of 15Ω is moved to the right at a constant speed 60 cm/s along two parallel conducting rails 2 cm apart and shorted at one end. A magnetic field of magnitude 0.35 T points into the page. Calculate the induced emf.
- (ii) The maximum velocity of a particle performing SHM is 6.28 cm/s. If the length of its path is 8 cm, calculate the period.
- (iii) A gate has following truth table. State the name of the gate.

P	Q	Y
0	0	0
1	0	0
0	1	0
1	1	1

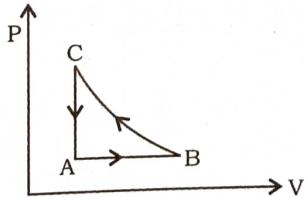
- (iv) What is Lorentz force?
 (v) What is mean by fluid?
 (vi) How is the heat defined?
 (vii) Define the diathermanous substance.
 (viii) In relation $I = MK^2$, K stands for what?

SECTION - B

- Q.3.** Explain Thomson's model of atom. [16]
Q.4. State Faraday's law of electromagnetic induction.
Q.5. A drop of water of radius 6 mm breaks into number of droplets each of radius 1 mm. How many droplets will be formed?
Q.6. The peak value of AC through a resistor of $100\ \Omega$ is 2 A. If the frequency of AC is 50 Hz, find the heat produced in the resistor in one cycle.
Q.7. Define end correction. State any two limitations of end correction.
Q.8. If the total energy of radiation of frequency 10^{14} Hz is 6.63 J, calculate the number of photons in the radiation.
Q.9. Compare the rate of emission of heat by a black body at 327°C with the rate of emission of heat of same body at 27°C .
Q.10. Find the angular speed of revolution of earth required so that the body on its surface, at equator would feel no weight. ($R = 6400\ \text{km}$, $g = 9.8\ \text{m/s}^2$)
Q.11. Draw a neat labelled diagram to determine the resistance of a galvanometer by using a meter bridge.
Q.12. Magnetic fields lines can be entirely confined within the core of a toroid, but not within a straight solenoid. Why?
Q.13. When water boils, why does its temperature remains constant?
Q.14. State Gauss's law what is a Gaussian surface?

SECTION - C

- Attempt any EIGHT of the following:** [24]
- Q.15.** What is transformer? Explain step up and step down transformer.
Q.16. Find the shortest wavelength in Paschen series if, the longest wavelength in Balmer series is $6563\text{ }^\circ\text{A}$.
Q.17. Consider the cyclic process ABCA on a sample of 2.0 mol of an ideal gas as shown in following figure, the temperatures of the gas at A and B are 300 K and 500 K respectively. A total of 1200 J heat is withdrawn from the sample in the process. Find the workdone by the gas in part BC. Take $R = 8.3\ \text{J/mol-K}$.



- Q.18.** A circular loop of radius 9.7 cm carries a current 2.3 A. Obtain the magnetic field
 (a) at the centre of the loop and
 (b) at a distance of 9.7 cm from the centre of the loop but on the axis.
Q.19. Explain the phenomenon of surface tension on the basis of molecular theory.
Q.20. In an interference experiment with the distance between the slit and the screen is 1m and the separation between the two virtual images of the slit as 0.5 cm, an interference pattern is obtained with a light of wavelength $3500\text{ }^\circ\text{A}$. Find the distance between 5th and 10th bright bands on the same side of central bright band.
Q.21. When a plate of magnetic material of size $10\ \text{cm} \times 0.5\ \text{cm} \times 0.2\ \text{cm}$ (length, breadth and thickness respectively) is located in 'magnetising field of $0.5 \times 10^4\ \text{Am}^{-1}$ then mangetic moment of $5\ \text{Am}^2$ is induced in it. Find out magnetic induction in rod.
Q.22. What is a junction transistor? What are its two types? Draw circuit symbols of each transistors.
Q.23. Obtain an expression relating the torque with angular acceleration for a rigid body.

- Q.24.** Show that in an AC circuit containing a pure inductor the voltage is ahead of current by $\frac{\pi}{2}$ rad in phase.
- Q.25.** With a neat labelled diagram describe the apparatus to study the characteristics of photoelectric effect.
- Q.26.** Prove the relation between pressure of the gas and speed of its molecules.

SECTION - D

Attempt any THREE of the following:

[12]

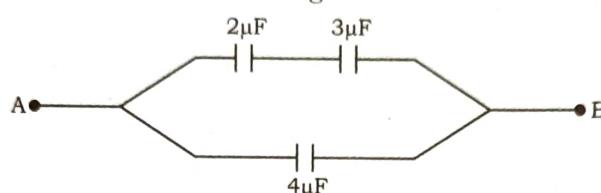
- Q.27.** What are harmonics and overtones?

A steel wire has a length of 12.0 m and a mass of 2.10 kg. What should be the tension in the wire so that speed of a transverse wave on the wire equals the speed of sound in dry air? (Speed of sound at $20^{\circ}\text{C} = 343 \text{ m/s}$).

- Q.28.** Define ideal simple pendulum. Deduce an expression for period of simple pendulum. Hence state the factors on which its period depends.

- Q.29.** What is a dielectric? State its two types. Give two examples in each case.

Three capacitors are connected as shown in the figure below.



Calculate the effective capacitance between A and B.

- Q.30.** What is meant by coherent sources? Explain the two methods for obtaining coherent sources in the laboratory.

- Q.31.** How do you calculate the shunt required to increase the range and times?

A galvanometer carries a maximum current of 15 mA, when a voltage of 75 mV is applied to it. How to convert this into a voltmeter to read upto 150 volt and into an ammeter to read upto 25 A?



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SECTION - A**Q.1. Select and write the correct answer:**

- [10]
- (i) A body of mass 'm' performs uniform circular motion along a circular path of radius 'r' velocity 'v'. If its angular momentum is L, then the centripetal force acting on it is -
- (a) $\frac{mL^2}{r^2}$ (b) $\frac{L^2}{mr}$ (c) $\frac{L^2}{mr^2}$ (d) $\frac{L^2}{mr^3}$
- (ii) The frequency of revolution of the electron in the second Bohr orbit of the hydrogen atom is 8.158×10^{14} Hz. What is the frequency of revolution of the electron in the fourth Bohr orbit of the hydrogen atom?
- (a) 1.012×10^{14} Hz (b) 1.012×10^{-14} Hz (c) 1.012×10^{10} Hz (d) 1.012×10^{-10} Hz
- (iii) Which property of light does not change when it travels from one medium to another?
- (a) Velocity (b) Wavelength (c) Frequency (d) Amplitude
- (iv) The internal energy change in a system that has absorbed 2 kcal of heat and done 500 J of work is
- (a) 8900 J (b) 6400 J (c) 5400 J (d) 7900 J
- (v) If the difference between the principal specific heats of nitrogen is 300 J/kg K and ratio of specific heat is 1.4 then C_v will be
- (a) 1500 J/kg K (b) 250 J/kg K (c) 750 J/kg K (d) 150 J/kg K
- (vi) The dimensions of coefficient of viscosity are
- (a) $[M^{-1} L^1 T^{-2}]$ (b) $[M^{-1} L^0 T^{-2}]$ (c) $[M L T^{-2}]$ (d) $[M L^{-1} T^{-1}]$
- (vii) An ideal voltmeter has
- (a) high resistance (b) low resistance (c) infinite resistance (d) zero resistance
- (viii) The power factor of LCR circuit is

(a) $\frac{R}{Z}$ (b) $\frac{Z}{R}$ (c) $R \times Z$ (d) $\frac{1}{ZR}$

(ix) Match the two columns in correct sequence

	Common units of capacitance	Their Value
(i)	1 pF	(a) $10^{-6} f$
(ii)	1 μF	(b) $10^{-12} f$
(iii)	1 nF	(c) $10^{-9} f$

- (a) (i - b), (ii - c), (iii - a) (b) (i - c), (ii - b), (iii - a)
(c) (i - b), (ii - a), (iii - c) (d) (i - a), (ii - b), (iii - c)

- (x) The magnetic dipole moment of current loop is independent of
- (a) number of turns (b) area of loop
(c) current in the loop (d) magnetic field in which it is lying

Q.2. Answer the following:

- (i) A ceiling fan having moment of inertia 2 kg m^2 attains its maximum frequency of 60 rpm in 2π seconds. Calculate its power rating.
- (ii) A plane wavefront of light of wavelength 5500 \AA is incident on two slits in a screen perpendicular to the direction of light rays. If the total separation of 10 bright fringes on a screen 2 m away is 2 cm. Find the distance between the slits.
- (iii) What is the minimum angular momentum of the electron in an hydrogen atom?

- (iv) What is the internal resistance of the cell?
- (v) Can a perfect black body be realized in practice?
- (vi) What is meant by angle of contact?
- (vii) What is mechanical equilibrium?
- (viii) Define radius vector.

SECTION - B

[16]

- Q.3.** Attempt any EIGHT of the following:
 A 100 mH inductor, a $25 \mu\text{F}$ capacitor and a 15Ω resistance are connected in series to a 120 V, 50 Hz AC source. Calculate:-
 (i) Impedance of the circuit at resonance
 (ii) Current at resonance.
- Q.4.** An iron rod is placed parallel to magnetic field of intensity 2000 A/m . The magnetic flux through the rod is $6 \times 10^{-4} \text{ Wb}$ and its cross sectional area is 3 cm^2 . Calculate the magnetic permeability of the rod in Wb/A-m .
- Q.5.** A progressive wave is $y = 12 \sin(5t - 4x)$ where all the quantities in SI unit. On this wave how far away are the two points having a phase difference of 90° ?
- Q.6.** One mole of an ideal gas is initially kept in a cylinder with a movable frictionless and massless piston at pressure of 1.0 mPa and temperature 27°C . It is then expanded till its volume is doubled. How much work is done if the expansion is isobaric?
- Q.7.** Draw a neat labelled diagram of Radiant power of a blackbody per unit range of wavelength as function of wavelength.
- Q.8.** What is logic gate? Draw the schematic symbol of NOT and NOR gate.
- Q.9.** Two soap bubbles have radii in the ratio 4:3. What is the ratio of workdone to blow these bubbles?
- Q.10.** What is meant by dual nature of matter?
- Q.11.** Explain why it is necessary to use cylindrically concave pole pieces in construction of moving coil galvanometer.
- Q.12.** Write a note on zero potential.
- Q.13.** What is wavefront? What is the shape of the wavefront at a point far away from the source of light?
- Q.14.** Obtain the differential equation of linear simple harmonic motion.

SECTION - C

[24]

- Q.15.** Attempt any EIGHT of the following:
 Why is the P-V curve for an adiabatic process steeper than that for an isothermal process? Explain formation of clouds at high altitude.
- Q.16.** State any two advantages of full wave rectifier. Explain Ripple factor.
- Q.17.** Derive an expression for electrostatic potential due to system of charges.
- Q.18.** Explain the term inductive reactance.
- Q.19.** A charged particle travels with a velocity \vec{v} through a uniform magnetic field \vec{B} as shown in the following figures in three different situations. What is the direction of the magnetic force \vec{f}_m due to the magnetic field, on the particle?

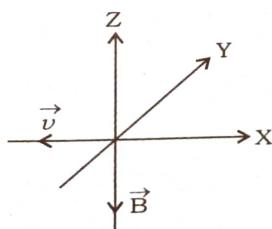


Figure (a)

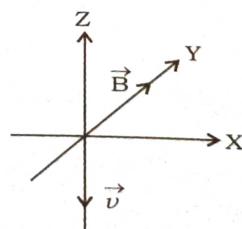


Figure (b)

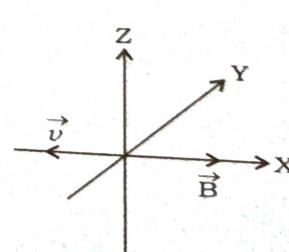


Figure (c)

- Q.20.** Explain what do you understand by interference of light.
- Q.21.** The energy of a photon is 2 eV. Find its frequency and wavelength.
- Q.22.** A plane coil of 10 turns is tightly wound around a solenoid of diameter 2 cm having 400 turns per centimeter. The relative permeability of the core is 800. Calculate the mutual inductance.

- Q.23.** A metal cube has side of length 1 m losses all its energy at rate of 3000 watts. If the emissivity is 0.4, find its temperature. ($\sigma = 5.67 \times 10^{-8} \text{ J/m}^2\text{s K}^4$)
- Q.24.** When the length of a simple pendulum is decreased by 20 cm, the period changes by 10%. Find the original length of the pendulum.
- Q.25.** Define magnetization. State its formula, SI unit and dimension. What is the magnetic susceptibility of a medium?
- Q.26.** A spherical drop of oil falls at a constant speed of 4 cm/s in steady air. Calculate the radius of the drop. The Density of the oil is 0.9 gm/cm³, density of air is 1.0 gm/cm³ and the coefficient of viscosity of air is 1.8×10^{-4} poise. ($g = 980 \text{ cm/s}^2$)

SECTION - D

Attempt any THREE of the following:

[12]

- Q.27.** Explain the statement: atomic spectrum is a signature of element.
How long will it take for a radioactive sample to reduce to 1% of its original activity.
(Half life of the sample is 5.3 years)
- Q.28.** Two batteries with emf 12 V and 13 V are connected in parallel across a load resistor of 10Ω . The internal resistance of the two batteries are 1Ω and 2Ω respectively. What is the voltage across the load lies between?
In a Wheatstones meter bridge experiment the null point is obtained in middle one third portion of wire. Why is it recommended? Define potential gradient.
- Q.29.** A metre gauge train is moving at 72 km/hr along a curve railway track of radius of curvature 500 m. Find the elevation of the outer rail above the inner rail so that there is no side thrust on the outer rail. ($g = 10 \text{ m/s}^2$)
Prove the theorem of perpendicular axes about moment of inertia.
- Q.30.** With neat labelled diagram, explain the three lowest modes of vibration of the air column in a pipe closed at one end.
- Q.31.** Find an expression for the power expended in pulling a conducting loop out of a magnetic field.



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 - (iv) **Section D :** Q. No. 15 to No. 26 contains 12 short answer type questions carrying **3 marks each.**
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- (3) Figure to the right indicate full marks.
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i.e. (a) / (b) / (c) / (d) etc. only first attempt will be considered for evaluation.

SECTION - A**[10]****Q.1. Select and write the correct answer:**

- (i) The nucleus contains all the positive charge of the atom and also _____ of its mass.
 - (a) 90.9%
 - (b) 99.9%
 - (c) 80.9%
 - (d) 79.9%
- (ii) According to right hand rule, the direction of magnetic induction if current is directed in anticlockwise direction is
 - (a) perpendicular and inwards.
 - (b) perpendicular and outwards.
 - (c) same as current.
 - (d) opposite to that of current.
- (iii) The Conical projection in Ferry's blackbody is
 - (a) used to support the sphere.
 - (b) used to transmit incident radiation to outer sphere.
 - (c) used to prevent reflected radiation to escape outside.
 - (d) used for all of the above purposes.
- (iv) In a series LCR circuit the phase difference between the voltage and the current is 45° , then the power factor will be
 - (a) 0.607
 - (b) 0.707
 - (c) 0.808
 - (d) 1
- (v) The maximum radiant power of the sun is at wavelength 500 nm. The Wien displacement law constant is 2.898×10^{-3} mK. Estimate the temperature of the surface of the Sun. Assume the Sun to be a blackbody
 - (a) 5796 K
 - (b) 6796 K
 - (c) 7796 K
 - (d) 4796 K
- (vi) Four resistances $10\ \Omega$, $10\ \Omega$, $10\ \Omega$ and $15\ \Omega$ form a Wheatstone's network. What shunt is required across $15\ \Omega$ resistor to balance the bridge
 - (a) $10\ \Omega$
 - (b) $15\ \Omega$
 - (c) $20\ \Omega$
 - (d) $30\ \Omega$
- (vii) In which of the following devices, the eddy current effect is not used?
 - (a) Electromagnet
 - (b) induction furnace
 - (c) Electric heater
 - (d) Magnetic breaking in train
- (viii) For constructive interference the phase difference between two waves should be
 - (a) $0, \frac{\pi}{2}, \pi, \dots$
 - (b) $0, 2\pi, 4\pi, \dots$
 - (c) $\pi, 3\pi, 5\pi, \dots$
 - (d) $\frac{\pi}{4}, \frac{\pi}{2}, \frac{3\pi}{4}, \dots$
- (ix) In which of the following processes, heat is neither absorbed nor released by a system?
 - (a) isobaric
 - (b) isochoric
 - (c) isothermal
 - (d) adiabatic
- (x) A sonometer wire is vibrating in second overtone. The number of nodes and antinodes formed respectively are
 - (a) 2, 3
 - (b) 3, 4
 - (c) 4, 3
 - (d) 3, 2

Q.2. Answer the following:**[108]**

- (i) For a transistor $I_C = 15\text{ mA}$, $I_B = 0.5\text{ mA}$. Find the value of current amplification factor.
- (ii) A body of mass m tied to a spring performs SHM with period 2 seconds. If the mass is increased by $3m$, what will be the period of SHM?
- (iii) Which material are used in making magnetic compass needle?
- (iv) The expression $p = \frac{E}{c}$ defines the momentum of a photon. Can this expression be used for momentum of an electron or proton?

- (v) State Faraday's first law of electromagnetic induction.
- (vi) State the principle of a Capacitor.
- (vii) Draw P-V diagram for positive work at constant pressure.
- (viii) State any one demerits of Huygen's wave theory of light.

SECTION - B

Attempt any EIGHT of the following:

[16]

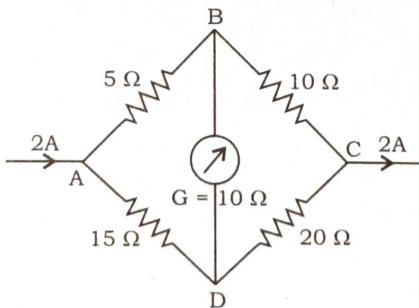
- Q.3.** At the instant, the current through a coil is 0.2 A, the energy stored in its magnetic field is 6 mJ. What is the self inductance of the coil?
- Q.4.** Calculate the value of the capacity in picofarad, which will make 101.4 microhenry inductance to oscillate with frequency of one megahertz?
- Q.5.** State the difficulties faced by Rutherford's atomic model.
- Q.6.** Obtain expression for magnetic field at a distance r from straight current conducting wire using Ampere's law.
- Q.7.** A motor cyclist (to be treated as a point mass) is to undertake horizontal circles inside the cylindrical wall of a well of inner radius 4 m. Coefficient of static friction between the tyres and the wall is 0.4. Calculate the minimum speed and frequency necessary to perform this stunt. ($g = 10 \text{ m/s}^2$)
- Q.8.** When 20 kcal heat is supplied to a system, the external workdone is 20,000 J. Find the increase in integral energy of the system (in joule). ($J = 4200 \text{ J/kcal}$)
- Q.9.** A tuning fork with frequency 800 Hz produces resonance in a resonance column tube with upper end open and lower end closed by water surface. Successive resonance are observed at lengths 9.75 cm, 31.25 cm and 52.75 cm. Calculate the speed of sound in air.
- Q.10.** Derive an expression for effective capacitance of three capacitors connected in parallel.
- Q.11.** What is post office box? Explain how does it work.
- Q.12.** Draw a neat labelled diagram of Fraunhofer diffraction.
- Q.13.** State (i) Stefan's Boltzmann law of radiation
(ii) Kirchhoff's law of heat radiation.
- Q.14.** Define radius of gyration? Explain its physical significance.

SECTION - C

Attempt any EIGHT of the following:

[24]

- Q.15.** Derive an expression that relates the angular momentum with the angular velocity of a rotating rigid body.
- Q.16.** Explain classification of thermodynamic system.
- Q.17.** What is end correction? State the cause of end correction. How is it estimated?
- Q.18.** Determine the linear momentum of the electron in the second Bohr orbit of a hydrogen atom. Hence determine the linear momentum in the third Bohr orbit.
- Q.19.** Determine the current flowing through the galvanometer shown in the figure below.



- Q.20.** In Young's double slit experiment using monochromatic light of wavelength λ , the intensity of light at a point on the screen where the path difference is λ is I . What is the intensity of light at a point where the path difference is $\lambda/3$?
- Q.21.** Define admittance. The total impedance of a circuit decreases when a capacitor is added in series with L and R. Explain why?
- Q.22.** A 100 watt filament lamp loses all its power by radiation when it is heated to a temperature of 2500 K. If the diameter of the filament is 0.2 mm and the surface emissivity of the filament is 0.5, Find the length of the filament ($\sigma = 5.67 \times 10^{-8} \text{ W/m}^2\text{K}^4$)

- Q.23. A capillary tube of radius 5×10^{-4} m is immersed in a beaker filled with mercury. The mercury level inside the tube is found to be 8×10^{-3} m below the level of reservoir. Determine the angle of contact between mercury and glass. Surface tension of mercury is 0.465 N/m and its density is $13.6 \times 10^3 \text{ kg/m}^3$. ($g = 9.8 \text{ m/s}^2$)
- Q.24. Explain the phenomenon of mutual induction.
- Q.25. Draw a neat labelled diagram of a suspended coil type moving coil galvanometer. What is the advantage of a radial magnetic field in a moving coil galvanometer and how is it produced?
- Q.26. Derive an expression for electric potential due to a point charge. Show graphical variation of electric field (or electric force) and electric potential due to a single charge at a distance r .

SECTION - D

[12]

- Q.27. Draw a neat circuit diagram of a transistor CE amplifier and explain its working.
- Q.28. Can we get photoemission with an intense beam of radio waves? Is photoemission possible at all frequencies? The wavelength and intensity of the incident light is 4000 \AA and 0.1 W respectively. What is the minimum change in the light energy? What is the number of incident photons?
- Q.29. Derive the quantity for Bohr magneton and also state its value.
Rowland ring of mean radius 15 cm has 3500 turns of wire wound on a Ferromagnetic core of relative permeability 800. What is the magnetic field B in the core for a magnetizing current of 1.2 A ?
- Q.30. Why do molecules of a liquid in the surface film possess extra energy?
A beaker of radius 10 cm is filled with water. Calculate the force of surface tension on any diametrical line on its surface. Surface tension of water is 0.075 N/m .
- Q.31. Draw the graph in which variation of KE, PE and TE with displacement?
Deduce the expressions for kinetic energy and potential energy of a particle executing SHM. Hence obtain an expression for total energy of a particle performing SHM and show that the total energy is conserved.



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i.e. (a) / (b) / (c) / (d) etc. only first attempt will be considered for evaluation.

SECTION - A**[10]****Q.1. Select and write the correct answer:**

- (i) Linear momentum of an electron in Bohrs orbit of H-atom (Principal Quantum number n) is proportional to

(a) $\frac{1}{n}$	(b) $\frac{1}{n^2}$	(c) n	(d) n^2
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- (ii) If the frequency of the input voltage 50 Hz is applied to a full wave rectifier, what will be the output frequency?

(a) 25 Hz	(b) 50 Hz	(c) 100 Hz	(d) 150 Hz
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- (iii) The angular displacement of a particle in 6 sec on a circle with angular velocity $\frac{\pi}{3}$ rad/sec. is

(a) π rad	(b) 2π rad	(c) 3π rad	(d) $\pi/2$ rad
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- (iv) The relation between relative permeability (μ_r) and magnetic susceptibility (χ_m) is

(a) $\mu_r = 1 - \chi_m$	(b) $\mu_r = 1 + \chi_m$	(c) $\chi_m = \mu_r + 1$	(d) $\chi_m = \mu_r$
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- (v) If $a = 0.72$ and $t = 0.04$, then the value of r is

(a) 0.02	(b) 0.08	(c) 0.24	(d) 0.4
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- (vi) is the source of energy for stars.

(a) Chain reaction	(b) Nuclear fission	(c) Nuclear fusion	(d) Radioactivity
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- ★(vii) The power factor of LCR circuit is

(a) $R \times Z$	(b) $\frac{R}{Z}$	(c) $\frac{1}{ZR}$	(d) $\frac{Z}{R}$
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- (viii) Efficiency of transformer is the ratio of

(a) $\frac{\text{Output voltage}}{\text{Input voltage}}$	(b) $\frac{\text{Output power}}{\text{Input power}}$	(c) $\frac{\text{Output current}}{\text{Input current}}$	(d) $\frac{\text{Input power}}{\text{Output power}}$
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- (ix) The surface tension of boiling water is

(a) Zero	(b) Infinity	(c) 100°C	(d) 100°C times than 0°C
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- ★(x) The law of equipartition of energy is valid for

(a) high temperatures	(b) absolute zero temperature
(c) low temperatures	(d) temperature between -273K to -100K

[08]**Q.2. Answer the following:**

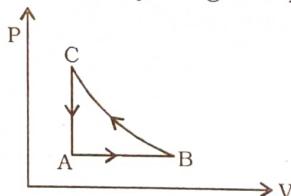
- (i) A pair of adjacent coil has a mutual inductance of 1.5 H. If the current at one coil changes from 0 to 20 A in 0.5 sec., what is the change of flux linked with the other coil?
- (ii) A particle executes S.H.M. of amplitude 3 cm. Its acceleration at extreme position is 27 cm/s^2 . Calculate its angular velocity.
- (iii) Draw the schematic symbol for NAND gate and write its Boolean expression.
- (iv) State dimensions of magnetic field.
- (v) Define velocity gradient.
- (vi) State Wien's displacement law.
- (vii) What is Isobaric process?
- (viii) Define 'Radius of Gyration'.

SECTION - B**Attempt any EIGHT of the following:****[16]**

- Q.3.** Draw a near labelled energy level diagram for hydrogen atom.
- Q.4.** What are eddy currents? State any two applications of eddy currents.
- Q.5.** A drop of water of radius 8 mm breaks into number of droplets each of radius 1 mm. How many droplets will be formed?
- Q.6.** Find the reactance of a coil of inductance 100 mH at a frequency of 50 Hz.
- Q.7.** Prove that for pipe closed at one end, the end correction is $e = \frac{n_2 l_2 - n_1 l_1}{n_1 - n_2}$
- Q.8.** Calculate the de Broglie wavelength associated with an electron moving with a speed of 5×10^6 m/s.
($m_e = 9.1 \times 10^{-31}$ kg)
- Q.9.** Calculate the energy radiated in one minute by a black body of surface area 100 cm^2 when it is maintained at 227°C .
- ★Q.10.** A motor cyclist rides in a vertical hollow sphere of radius 5 m. Find minimum angular speed required so that it does not loose contact with the sphere at the highest point. ($g = 9.8 \text{ m/s}^2$)
- Q.11.** State Kirchhoff's current law in electric circuit. Also state their sign conventions.
- Q.12.** Obtain an expression for magnetic field at a distance r from straight conductor carrying current using Ampere's law.
- Q.13.** Derive an expression for energy stored in a capacitor.
- Q.14.** State zeroth law of thermodynamics. State its significance.

SECTION - C**Attempt any EIGHT of the following:****[24]**

- Q.15.** Derive an expression for the total emf induced in a conducting rotating rod.
- Q.16.** Find the wavelength and wave number of the first member of the Balmer series in Hydrogen spectrum.
($R = 1.097 \times 10^7 \text{ m}^{-1}$)
- Q.17.** A rectangular coil of wire 50 turn each of area $6 \times 10^{-4} \text{ m}^2$ is freely suspended in a field of $3 \times 10^{-2} \text{ Wb/m}^2$. Calculate the current flowing through the coil when it deflects through 60° , when torsional constant is 3.82×10^{-6} SI unit.
- Q.18.** Consider the cyclic process ABCA on a sample of 2.0 mol of an ideal gas as shown in following fig. The temperature of the gas at A and B are 300 K and 500 K respectively. A total of 1200 J heat is withdrawn from the sample in this process. Find the work done by the gas in part BC. ($R = 8.3 \text{ J/mol K}$)



- Q.19.** Define surface tension. Obtain the relation between surface tension and surface energy.
- Q.20.** In a biprism experiment, the slit is illuminated by red light of wavelength 6400 \AA° and the crosswire of eyepiece is adjusted to the centre of 3^{rd} bright band. By using blue light it is found that 4^{th} bright band is at the centre of the cross wire. Calculate the wavelength of blue light.
- Q.21.** An electron in an atom is revolving around the nucleus in a circular orbit of radius 0.53 \AA° , with a speed of $2 \times 10^6 \text{ m/s}$. Find the resultant orbital magnetic moment and angular momentum of electron.
($e = 1.6 \times 10^{-19} \text{ C}$, $m = 9.1 \times 10^{-31} \text{ kg}$)
- Q.22.** With a neat circuit diagram, explain working of p-n junction diode as a half wave rectifier.
- Q.23.** State and explain the principle of conservation of angular momentum.
- ★Q.24.** Obtain an expression for average power dissipated in a pure resistive circuit.
- ★Q.25.** Describe construction and working of a photo cell with the help of neat diagram.
- Q.26.** At what temperature will the rms velocity of a gas be four times its value at STP?

SECTION - D**[12]**

- Q.27.** Define ideal simple pendulum. Derive an expression for period of simple pendulum. Hence state the factors on which its period depends.
- Q.28.** Show that only odd harmonics are present in the vibrations of air column in a pipe closed at one end. A violin string vibrates with fundamental frequency of 440 Hz. What are the frequencies of first and second overtone?
- Q.29.** Derive the relation between electric intensity and electric potential.
A parallel plate air condenser has a capacity of $20 \mu\text{F}$. What will be the new capacity if the distance between two plates is doubled?
- Q.30.** State advantages of a potentiometer over a voltmeter.
A resistance of 3Ω is connected in parallel to a galvanometer of resistance 297Ω . Find the fraction of current passing through the galvanometer.
- Q.31.** Explain reflection of light at a plane reflecting surface on the basis of Huygen's principle. Also state laws of reflection.



(Note : Questions marked by '★' are not included in the syllabus for the year 2021 - 22.

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SECTION - A**Q.1. Select and write the correct answer:****[10]**

- (i) A thin ring has mass 0.25 kg and radius 0.5 m. Its M.I. about an axis passing through its centre and perpendicular to its plane is

 (a) 0.0625 kg m^2 (b) 0.625 kg m^2 (c) 6.25 kg m^2 (d) 62.5 kg m^2
- (ii) Absorption of water by filter paper is due to

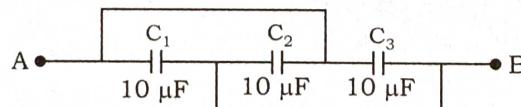
 (a) cohesion (b) capillarity (c) adhesion (d) elasticity
- (iii) The molar specific heat of an ideal gas at constant pressure and constant volume is C_p and C_v respectively. If R is the universal gas constant and the ratio C_p to C_v is γ then $C_v =$

 (a) $\frac{1-\gamma}{1+\gamma}$ (b) $\frac{1+\gamma}{1-\gamma}$ (c) $\frac{\gamma-1}{R}$ (d) $\frac{R}{\gamma-1}$
- ★(iv) The second law of thermodynamics deals with transfer of

 (a) workdone (b) energy (c) momentum (d) heat
- (v) A body of mass 1 kg is performing linear S.H.M. Its displacement x cm at time t sec is given by $x = 6 \sin \left(100t + \frac{\pi}{4} \right)$. Maximum K.E. of the body is

 (a) 36 J (b) 9 J (c) 27 J (d) 18 J
- (vi) One beat means that the intensity of sound should be

 (a) once maximum (b) once maximum and once minimum
 (c) once minimum (d) twice maximum and twice minimum
- (vii) The effective capacitor between A and B in the following circuit is



- (a) $\frac{10}{3} \mu\text{F}$ (b) $\frac{3}{10} \mu\text{F}$ (c) $30 \mu\text{F}$ (d) $\frac{1}{30} \mu\text{F}$

- (viii) Accuracy of potentiometer can be easily increased by

 (a) increasing resistance of wire (b) decreasing resistance of wire
 (c) increasing the length of wire (d) decreasing the length of wire
- ★(ix) Which of the following statement is correct for diamagnetic materials?

 (a) Susceptibility is negative and low (b) Susceptibility does not depend on temperature
 (c) $\mu_r < 1$ (d) All of above
- (x) Which logic gate corresponds to the truth table given below?

 (a) AND (b) OR (c) NAND (d) NOR

A	B	Y
0	0	1
0	1	1
1	0	1
1	1	0

9.2. Answer the following:

- (i) State SI unit and dimensions of surface energy.
 (ii) A gas in a closed container is heated with 10 J of energy, causing the lid of the container to rise 2 m with 3 N of force. What is the total change in energy of the system?
 (iii) What is Lorentz force?
 (iv) State Curie's law.
 (v) Two coils having self inductances $L_1 = 75 \text{ mH}$ and $L_2 = 55 \text{ mH}$ are coupled with each other. The coefficient of coupling (K) is 0.75. Calculate the mutual inductance (M) of the two coils.
 (vi) Define peak value of alternating signal.
 (vii) Define half life period.
 (viii) What is a ripple?

[08]

Attempt any EIGHT of the following:**SECTION - B**

- 9.3.** Distinguish between centripetal force and centrifugal force. [16]
9.4. State and explain Newton's law of viscosity.
9.5. Explain, on the basis of kinetic theory, how the pressure of gas changes if its volume is reduced at constant temperature.
9.6. A steam engine delivers $4.8 \times 10^8 \text{ J}$ of work per minute and services $1.2 \times 10^9 \text{ J}$ of heat per minute from its boiler. What is the percentage efficiency of the engine?
9.7. A proton is accelerated in a cyclotron in which the magnetic induction is 0.6 Wb/m^2 . Find the cyclotron frequency. (Given: $m_p = 1.673 \times 10^{-27} \text{ kg}$, $e = 1.6 \times 10^{-19} \text{ C}$)
9.8. Two sound waves travel at a speed of 330 m/s . If their frequencies are also identical and are equal to 540 Hz , what will be the phase difference between the waves at points 3.5 m from one source and 3 m from other if the sources are in phase?
9.9. One hundred twenty five small liquid drops, each carrying a charge of $0.5 \mu\text{C}$ and each of diameter 0.1 m form a bigger drop. Calculate the potential at the surface of the bigger drop.
9.10. Calculate the change in angular momentum of electron when it jumps from 3^{rd} orbit to 1^{st} orbit in hydrogen atom. (Take $h = 6.63 \times 10^{-34} \text{ Js}$)
9.11. Draw labelled circuit diagram of meter bridge to determine unknown resistance.
9.12. State Faraday's laws of electromagnetic induction.
9.13. Explain the theory of an AC circuit with resistor.
9.14. Define: (a) Threshold frequency
 (b) Work function

SECTION - C**Attempt any EIGHT of the following:**

- 9.15.** Derive an expression of excess pressure inside a liquid drop.
9.16. Explain the mechanism of a refrigerator with the help of a schematic diagram.
9.17. Show that all harmonics are present on a stretched string between two rigid supports.
9.18. In a double-slit arrangement the slits are separated by a distance equal to 100 times the wavelength of the light passing through the slits.
 (i) What is the angular separation between the central maximum and an adjacent maximum.
 (ii) What is the distance between these maxima on a screen 50 cm from the slits?
9.19. Describe construction and working of a van de Graaff generator.
9.20. Explain how a potentiometer is used to compare the emf of two cells by connecting the cells individually.
9.21. State principle of moving coil galvanometer. Explain construction of moving coil galvanometer with a neat labelled diagram.
9.22. A magnetic needle placed in uniform magnetic field has magnetic moment of $2 \times 10^{-2} \text{ Am}^2$ and moment of inertia of $7.2 \times 10^{-7} \text{ kg m}^2$. It performs 10 complete oscillations in 6 sec. What is the magnitude of the magnetic field?
9.23. A light bulb is rated 100 W for 220 V AC supply of 50 Hz . Calculate:
 (i) resistance of the bulb. (ii) the rms current through the bulb.

[24]

- Q.24.** In nuclear reactor, neutrons travel with energies of 5×10^{-21} J. Find their speed and wavelength.
(Take $m_n = 1.67 \times 10^{-27}$ kg)
- ★Q.25.** Determine the binding energy per nucleon of the Americium isotope $^{244}_{95}\text{Am}$, given the mass of $^{244}_{95}\text{Am}$ to be 244.06428 u.
- Q.26.** Explain working of a transistor as an amplifier in detail with the help of proper circuit diagram.

SECTION - D

[12]

Attempt any THREE of the following:

- Q.27.** Obtain an expression for angle of banking when a vehicle moves along a curved banked road neglecting friction.
The radius of curvature of road is 60 m. If angle of banking is 27° , find maximum speed with which vehicle can turn along this curve. ($g = 9.8 \text{ m/s}^2$)
- Q.28.** State and explain Stefan's law of radiation.
Energy is emitted from a hole in an electric furnace at the rate of 20 W, when the temperature of the furnace is 727°C . What is the area of the hole? ($\sigma = 5.7 \times 10^{-8} \text{ J/sm}^2 \text{ K}^4$)
- Q.29.** Obtain the differential equation of linear simple harmonic motion.
At what distance from the mean position is the speed of a particle performing SHM half its maximum speed.
(Given: Path length of SHM = 10 cm)
- Q.30.** Derive conditions for occurrence of dark and bright fringes on screen in Young's double slit interference experiment.
Define fringe width and derive formula for it.
- Q.31.** Show that the workdone in pulling a loop through the magnetic field appears as heat energy in the loop.



(Note : Questions marked by '★' are not included in the syllabus for the year 2021 - 22.