Sub.Code : 1021'H'

NEB - GRADE XII
2082 (2025)
Physics

(For the regular and partial general stream's students whose first two digits of registration number starts from 78 , 79, 80 and 81)

Multiple Choice Questions

Attempt all the questions.

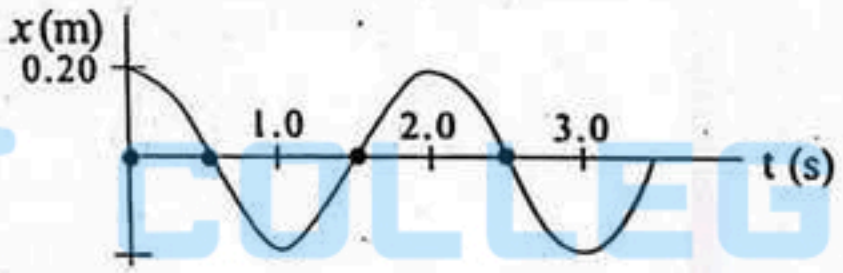
Group 'A'

Rewrite the correct option of each question in your answer sheet.[11×1=11]

1. What is the difference between moment of inertia of a rod about an axis passing through its one end and through its centre perpendicular to its length ?

   (A) $\frac{ML^2}{3}$ (B) $\frac{ML^2}{4}$ (C) $\frac{ML^2}{6}$ (D) $\frac{ML^2}{12}$

2. For an oscillating object, the displacement versus time curve shown in figure. What is the velocity of the object in the mean position ?



   (A) 0.2πm/s (B) 0.4πm/s (C) 2πm/s (D) 4πm/s

3. Two spherical rain drops of equal size are falling vertically downward with terminal` velocity of 0.15m/s. What would be the terminal velocity if these drops were combined to form a larger drop ?

   (A) 0.15 m/s (B) 0.24 m/s (C) 0.31 m/s (D) 0.48 m/s

4. What happens in an adiabatic process ?

   (A) Volume remains constant
   (B) Pressure remains constant
   (C) Temperature remains constant
   (D) The system is insulated from the surroundings

5. The efficiency of Carnot engine operating between steam point and ice point is

   (A) 26.8% (B) 50% (C) 73.2% (D) 100%

Contd...

6. Which of the following is an example of transverse wave ?
   (A) Sound wave in air
   (B) Waves inside the water
   (C) Wave produced in the stem of vibrating tuning fork
   (D) Wave produced in the stretched string
7. Which one of the following phenomena is not explained by Huygen's construction of wave front ?
   (A) refraction (B) reflection (C) polarization (D) diffraction
8. The magnetic field intensity at the center of a circular coil of radius R and carrying current I is

   (A) $\frac{\mu_0 I}{R}$ (B) $\frac{\mu_0 I}{2R}$

   (C) $\frac{\mu_0 I}{2\pi R}$ (D) $\frac{2\mu_0 I}{R}$
9. If χ is the magnetic susceptibility of a material then its relative permeability (μ_r) is

   (A) $\chi + 1$ (B) $\chi - 1$ (C) $\frac{1}{\chi}$ (D) $1+\chi^2$
10. A square coil of area 10^{-2} m^2 is placed perpendicular to a uniform magnetic field of intensity 10^3 T. What is the magnetic flux through the coil ?
    (A) 100 Weber (B) 10 Weber
    (C) 10^{-3} Weber (D) 10^{-5} Weber
11. What is the point where the Seismic waves start called ?
    A) Epicenter B) Metacenter
    C) Hypocenter D) Seismic center

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Candidates are required to give their answers in their own words as far as practicable. The figures in the margin indicate full marks.

Time: 3 hrs. **Full Marks: 75**

Attempt all the questions.

Group 'A'

Question No. 1 to 11 (Multiple Choice Questions) will be provided after 30 minutes of starting examination. Rewrite its (MCQ) correct option (answer) in the same answer sheet.

Group 'B'

Short answer questions. [8×5=40]

12. a) A ballet dancer sometimes stretches and sometimes folds her arms during her performance, why ? Justify. [2]
    b) Establish a relation between torque and moment of inertia for a rigid body. [2]
    c) Why do we prefer a wrench of longer arm over a wrench of shorter arm ? [1]

Or

    a) Show that the total energy of the particles executing SHM is constant. [3]
    b) Draw a graph showing the variation of potential energy of particle in SHM with displacement. [1]
    c) The time period of simple pendulum on the surface of earth is T. What will be its time period on the Moon's surface ? [1]

13. a) Define laminar flow and turbulent flow of liquid. [2]
    b) Water flows steadily through a horizontal pipe of non-uniform cross section. If the pressure of water is 4×10^4 Nm^{-2} at a point where the velocity of flow is 2 m/s and cross section is $200cm^2$. Calculate the pressure at a point where cross section reduces to $50cm^2$. (density of water = $1000kg/m^3$) [3]

14. a) A Carnot's engine has 25% efficiency with a sink at 9^0C. By how many degrees should the temperature of the source be increased in order to raise the efficiency to 50% ? [3]

Contd...

b) State first law of thermodynamics. Does it follow the principle of conservation of energy ? Explain. [2]

15. a) Discuss the effect of temperature and pressure on velocity of sound in a gas. [2]

b) A train is approaching a cliff at 10m/s. The driver sounds a whistle of frequency 600Hz. What will be the frequency of echo as heard by the driver ? (Velocity of sound in air = $340ms^{-1}$) [3]

16. a) State the two Kirchhoff's laws of electrical circuit. [2]

b) Obtain an expression for the balanced condition of Wheatstone bridge using Kirchhoff's laws. [3]

17. a) State Lenz's law. [1]

b) Plot a graph to show the variation of induced emf in a coil rotating in a uniform magnetic field with time. [1]

c) Derive an expression for the energy stored in an inductor. [3]

18. a) Write the symbol and truth table of NAND gate. [2]

b) Explain the full wave rectification using two P-N junction diodes. [3]

19. a) An oil drop of mass 3×10^{-11}g and of radius 2×10^{-4}cm carries 10 excess electrons. What is its terminal velocity when

i) falling in a region in which there is no electric field ? [1]

ii) falling in an electric field of 3×10^{5} Vm^{-1} directed downward ? [1]

(Viscosity of air = 1.8×10^{-5} NSm^{-2})

b) In Thomson's method for determining specific charge of an electron, why is the electric field kept perpendicular to magnetic field ? Justify. [2]

c) What is the use of X-rays in Millikan's oil drop experiment ? [1]

Or

a) Define decay constant and half life. [2]

b) Derive the equation : $N = N_o e^{-\lambda t}$ for radioactive process where symbols have there usual meanings. [3]

Group 'C'

Long answer questions: [3×8=24]

20. a) What are stationary waves ? Prove that the distance between two consecutive nodes in it is equal to half of the wavelength. [3]

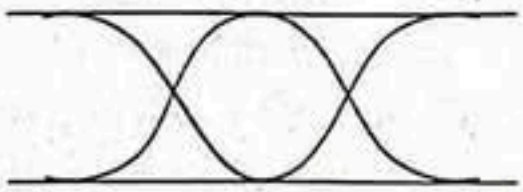
Contd...

b) Guitar string of length 1.5m is made of steel of density 7800 kg/m³ and Young's modulus 2×10^{11} N/m². It produces an elastic strain of 1% in the string. Calculate [3]

i) stress developed in the string.

ii) frequency of second mode of vibration.

c) The given figure shows standing wave formed in an open organ pipe.



i) Which mode of vibration is shown ? [1]

ii) Obtain the frequency of vibration for this mode. [1]

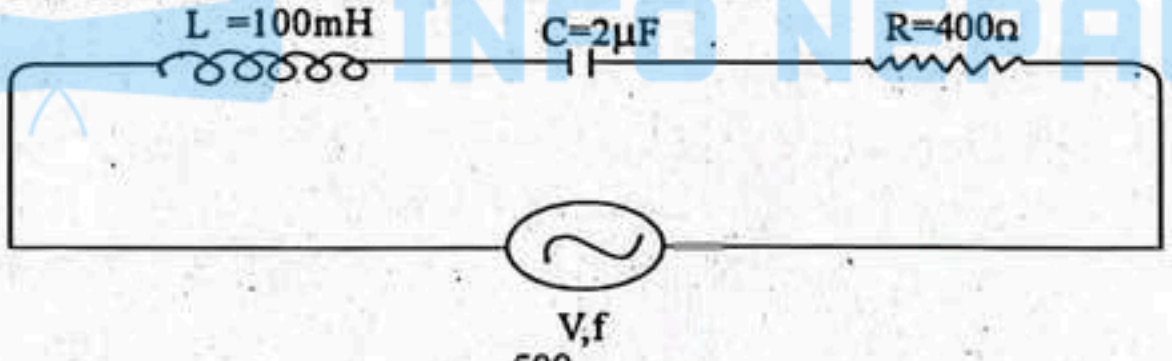
Or

a) Prove that bright and dark fringes are equally spaced in Young's double slit experiment. [3]

b) A parallel beam of monochromatic light is incident on diffraction grating having 500 lines/mm to get second order maxima at 30°. Calculate the wavelength of light used. [3]

c) State and prove Brewster's law. [2]

21. a) The figure below shows a series LCR circuit.



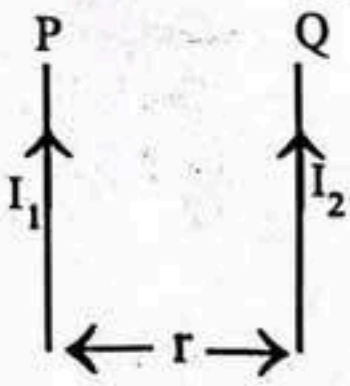
If the frequency of an ac source is $\frac{500}{\pi}$ Hz then,

i) Calculate the phase angle between current and voltage. [2]

ii) Which one leads in phase, current or voltage ? Justify. [1]

b) What is meant by impedance of an ac circuit ? [1]

c) Two parallel wire P and Q carrying currents I_1 and I_2 are placed in the air at a distance r apart as shown in figure.



i) Obtain an expression for the magnitude of force per unit length between them. [2]

ii) What is the nature of force in this case ? [1]

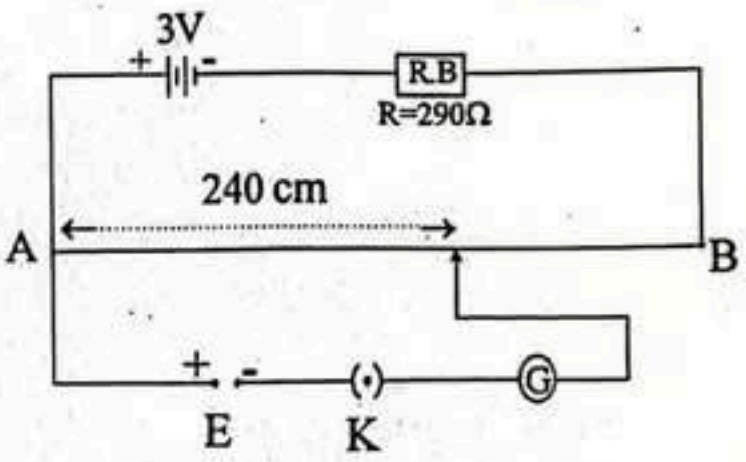
iii) What will be the force per unit length between two wires if distance between wires is halved, keeping all other quantities constant ? [1]

Contd...

Or

a) Explain the variation of thermoelectric emf with the temperature of the hot junction of a thermocouple. [3]

b) A potentiometer circuit is shown in figure.
If the total length of potentiometer wire is 4m and has resistance 10Ω and the balance point is obtained at a length of 240cm, calculate the value of unknown emf E. [3]



c) Use ampere's circuital law to find the magnetic field due to a straight current carrying conductor. [2]

22. a) Define threshold wavelength. [1]

b) A metal has a work function of 2eV. Calculate the maximum speed of the emitted photoelectrons when it is illuminated by radiation of wavelength 150nm. What is the least frequency of the radiation for which electrons are emitted ?
(Given : Planck's constant h = 6.62×10^{-34} Js, m = 9.1×10^{-31} Kg, e = 1.6×10^{-19} C) [3]

c) State Heisenberg's Uncertainty principle. [1]

d) Obtain an expression for velocity of an electron in n^{th} orbit of hydrogen atom. [3]

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