# AAYTAN ACADEMY
Std 12 : Physics
SUPER REVISION SHEET (Most Imp Questions)

A   **Write the answer of the following questions. [Each carries 2 Marks]**   **[126]**

1. Write some important points for vector form of Coulomb's law.

2. Give characteristics of electric field lines.

3. Obtain the equation of electric field by dipole at a point on axis of dipole. ,

4. Obtain the equation of electric field by dipole at a point on equator of dipole. ,

5. Obtain the expression of torque acting on electric dipole in uniform external electric field. ,

6. Obtain the expression of electric field by a straight wire of infinite length and with linear charge density 'λ'. ,

7. Derive the formula for the electric potential due to an electric dipole at a point from it. Mention the electric potential on the axis and on the equator for that electric dipole.

8. What is parallel plate capacitor ? Obtain the formula for the capacitance of such a parallel plate capacitor and on which factors does the value of capacitance depend ?

9. Derive the equations of stored energy for series or parallel connection of many capacitors.

10. What is a parallel connection of capacitors ? Obtain the formula for the effective capacitance in the parallel combination of two different capacitors.

11. What is a series connection of capacitors ? Obtain the formula for the equivalent capacitance in the series combination of two different capacitors.

12. Write limitations of Ohm's law.

13. Draw resistivity $\rightarrow$ temperature ($\rho \rightarrow$ T) graph for metals, alloys and semiconductor.

14. Explain cell, emf and internal resistance. Derive relation between potential difference emf and internal resistance.

15. What is series connection of cell ? Derive equation of equivalent emf of two cells with emf ε_1 and ε_2 connected in series.

16. What is parallel connection of cell ? Obtain equation of equivalent emf of two cells connected in parallel.

17. Write and explain Kirchhoff's first law (Junction law).

18. Write and explain Kirchhoff's second law (Loop rule).

19. What is Wheatstone bridge ? Explain its principle.

20. Give the characteristics of magnetic field lines. ,

21. Derive the equation of torque on a magnetic needle in a uniform magnetic field.

22. Obtain the relation between magnetisation $(\overrightarrow{M})$ and magnetic intensity $(\overrightarrow{H})$ for a solenoid. Derive formula $\overrightarrow{B} = \mu_0(\overrightarrow{H} + \overrightarrow{M})$.

23. Explain ferromagnetism and ferromagnetic substance.

24. Derive the equation $\varepsilon = -Blv$ of a motional emf with the help of a suitable example.

25. Explain self induction and obtain equation of self induced emf in a coil.

26. Derive formula for mutual inductance for two very long coaxial solenoids. Also discuss reciprocity theorem.

27. Define an inductor. Derive equation of energy $U = \dfrac{1}{2}LI^2$ stored in inductor. ,

28. Discuss characteristic of induced emf in AC generator.

29. Obtain an equation of current for AC voltage applied to inductor and draw graph of V and I. ,

30. Define the power for AC circuit. Obtain an equation of average power for L-C-R series AC circuit and what is power factor ? Write its equation.

31. Write an equation of average power for L-C-R series AC circuit and discuss its various cases.

32. Using the equation of power for an ideal transformer, prove $\dfrac{i_p}{i_s} = \dfrac{\varepsilon_s}{\varepsilon_p} = \dfrac{N_s}{N_p}$.

33. Derive equation of missing term in Ampere circuital law. Write its definition and unit.

34. Write characteristics of electromagnetic waves. ,

35. Obtain mirror equation for the real image obtained by concave mirror.

36. Explain internal reflection and total internal reflection.

37. Obtain the equation of thin lens.

38. Obtain $\delta = i + e - A$ for equilateral prism.

39. Explain the minimum deviation angle for prism by graph of deviation angle versus incidence angle.

40. Obtain the equation of magnification for compound microscope.
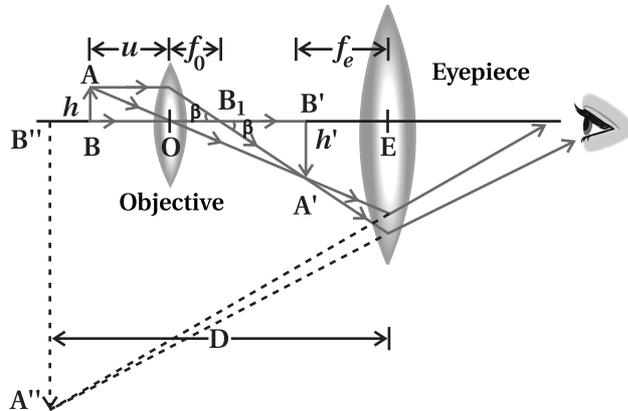
41. Derive the laws of refraction from the concept (Huygen's principle) of the wavefront.

42. Compare and contrast the interference and diffraction.

43. Obtain the conditions for constructive interference and destructive interference.

44. Explain Malus law and write it.

45. Define threshold frequency and on which factor threshold frequency depend ?

46. Write characteristic of photon.

47. Write de-Broglie hypothesis and derive equation of de-Broglie wavelength.

48. Write Einstein's explanation of photoelectric effect and derive Einstein's equation.

49. Describe Geiger-Marsden scattering experiment.

50. Explain Bohr's atomic model. State postulates of Bohr's theory.

51. Using Bohr's atomic model, derive an equation of the radius of the nth orbit of an electron.

52. Using the formula for the radius of nth orbit $r_n = \dfrac{n^2 h^2 \varepsilon_0}{\pi m Z e^2}$ derive an expression for the total energy of electron in n^{th} Bohr's orbit.

53. The total energy of electron $E_n = -\dfrac{Z^2 m e^4}{8 \varepsilon_0^2 n^2 h^2}$ in atom is based on which hypothesis ? When is that true ?

54. Explain the limitations of Bohr atomic model.

55. Describe the nuclear force and its charact-eristics.

56. What is nuclear fusion ? Explain giving its nuclear equations and write down the definition of thermonuclear fusion.

57. Explain the phenomenon of nuclear fission.

58. Write briefly on n-type semiconductor.

59. Write briefly on p-type semiconductor.

60. Explain the forward characteristics of the p-n junction diode by drawing circuit and graph.

61. Explain the reverse characteristics of p-n junction diode by circuit diagram with graph.

62. Explain the use of junction diode as a full wave rectifier by drawing circuit diagram and draw the

form of input and output waves.

63. Explain the use of the junction diode as a half wave rectifier by drawing a circuit and draw input and output waves.

**B** **Write the answer of the following questions. [Each carries 3 Marks]** **[90]**

64. If 10^9 electrons move out of a body to another body every second, how much time is required to get a total charge of 1 C on the other body ?

65. Consider the charges q, q and $-q$ placed at the vertices of an equilateral triangle as shown in figure. What is the force on each charge ?
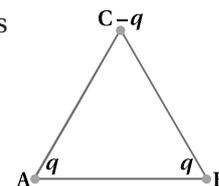
66. An electron falls through a distance of 1.5 cm in a uniform electric field of magnitude $2.0 \times 10^4 \text{NC}^{-1}$ figure (a). The direction of the field is reversed keeping its magnitude unchanged and a proton falls through the same distance figure (b). Compute the time of fall in each case. Contrast the situation with that of 'free fall under gravity'. ,
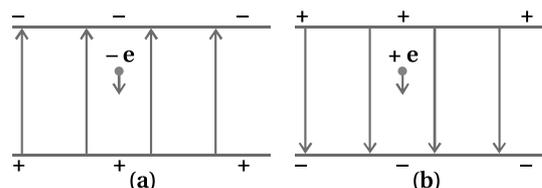
67. Two point charges q_1 and q_2, of magnitude $+10^{-8}$ C and -10^{-8} C, respectively, are placed 0.1 m apart. Calculate the electric fields at points A, B and C shown in figure.
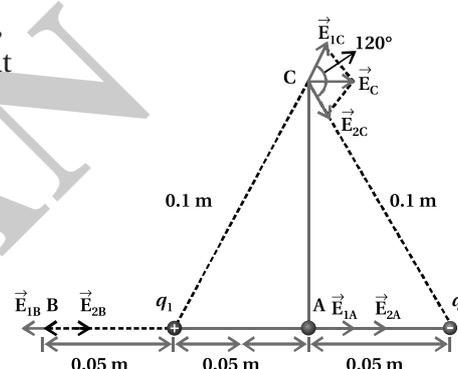
68. The electric field components in figure are $E_x = \alpha x^{1/2}$, $E_y = E_z = 0$ in which $\alpha = 800 \text{ N/C m}^{1/2}$. Calculate (a) the flux through the cube and (b) the charge within the cube. Assume that $a = 0.1$ m. [$\varepsilon_0 = 8.854 \times 10^{-12}$ $\text{C}^2 \text{N}^{-1} \text{m}^{-2}$] ,
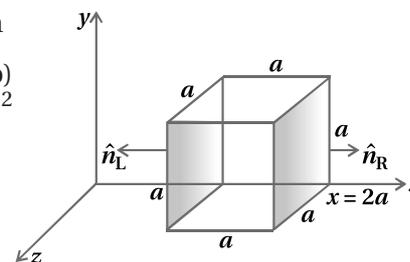
69. An electric field is uniform and in the positive x direction for positive x and uniform with the same magnitude but in the negative x direction for negative x. It is given that $\vec{E} = 200 \hat{i}$ N/C for $x > 0$ and $\vec{E} = -200 \hat{i}$ N/C for $x < 0$. A right circular cylinder of length 20 cm and radius 5 cm has its centre at the origin and its axis along the x-axis so that one face is at $x = +$ 10 cm and the other is at $x = -10$ cm as shown in figure. (a) What is the net outward flux through each flat face ? (b) What is the flux through the side of the cylinder ? (c) What is the net outward flux through the cylinder ? (d) What is the net charge inside the cylinder ? ,
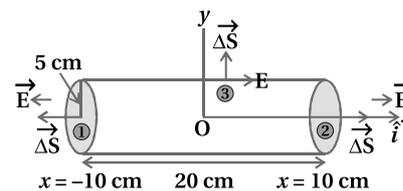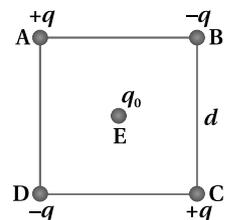
70. An early model for an atom considered it to have a positively charged point nucleus of charge Ze, surrounded by a uniform density of negative charge up to a radius R. The atom as a whole is neutral. For this model, what is the electric field at a distance r from the nucleus ?
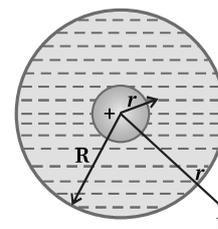
71. What is the force between two small charged spheres having charges of 2×10^{-7}C and 3×10^{-7}C placed 30 cm apart in air ? [$k = 9 \times 10^9 \text{Nm}^2 \text{C}^{-2}$]

72. Four point charges q_A = 2 μC, q_B = −5 μC, q_C = 2 μC, and q_D = −5 μC are located at the corners of a square ABCD of side 10 cm. What is the force on a charge of 1 μC placed at the centre of the square ?

73. Two point charges q_A = 3 μC and q_B = −3 μC are located 20 cm apart in vacuum.
    (a) What is the electric field at the midpoint O of the line AB joining the two charges ?
    (b) If a negative test charge of magnitude 1.5×10^{-9} C is placed at this point, what is the force experienced by the test charge ?

74. A system has two charges q_A = 2.5×10^{-7} C and q_B = -2.5×10^{-7} C located at points A:(0, 0, −15 cm) and B:(0, 0, +15 cm), respectively. What are the total charge and electric dipole moment of the system ?

75. (a) Two insulated charged copper spheres A and B have their centres separated by a distance of 50 cm. What is the mutual force of electrostatic repulsion if the charge on each is 6.5×10^{-7} C ? The radii of A and B are negligible compared to the distance of separation.
    (b) What is the force of repulsion if each sphere is charged double the above amount, and the distance between them is halved ?

76. Consider a uniform electric field, $\vec{E}$ = $3 \times 10^3 \ \hat{i}$ N/C.
    (a) What is the flux of this field through a square of 10 cm on a side whose plane is parallel to the yz plane ?
    (b) What is the flux through the same square if the normal to its plane makes a 60° angle with the X-axis ?

77. Two large, thin metal plates are parallel and close to each other. On their inner faces, the plates have surface charge densities of opposite signs and of magnitude 17.0×10^{-22} C/m². What is $\vec{E}$:
    (a) in the outer region of the first plate, (b) in the outer region of the second plate, and
    (c) between the plates ?

78. Two charges 3×10^{-8} C and -2×10^{-8} C are located 15 cm apart. At what point on the line joining the two charges is the electric potential zero ? Take the potential at infinity to be zero.

79. Four charges are arranged at the corners of a square ABCD of side d as show in figure.
    (a) Find the work required to put together this arrangement. (b) A charge q_0 is brought to the centre E of the square the four charges being held fixed at its corners. How much extra work is needed to do this ? ,

80. (a) Determine the electrostatic potential energy of a system consisting of two charges 7 μC and −2 μC (and with no external field) placed at (−9 cm, 0, 0) and (9 cm, 0, 0) respectively.
    (b) How much work is required to separate the two charges infinitely away from each other ?
    (c) Suppose that the same system of charge is now placed in an external electric field $E = A\left(\dfrac{1}{r^2}\right)$; A = 9×10^5 NC^{-1} m². What would the electrostatic energy of the configuration be ?

81. A slab of material of dielectrical constant K has the same area as the plates of a parallel-plate capacitor but has a thickness $\left(\dfrac{3}{4}\right)d$, where d is the separation of the plates. How is the capacitance changed when the slab is inserted between the plates ?

82. (a) A 900 pF capacitor is charged by 100 V battery (From figure (a)). How much electrostatic energy is stored by the capacitor ? (b) The capacitor is disconnected from the battery and connected to another 900 pF capacitor (From figure (b)). What is the electrostatic energy stored by the system ? ,
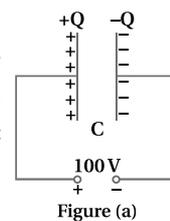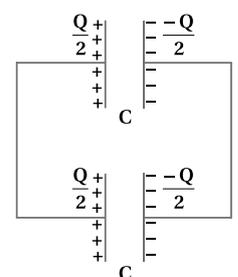
83. Two charges 5×10^{-8} C and -3×10^{-8} C are located 16 cm apart. At what point(s) on the line joining the two charges is the electric potential zero ? Take the potential at infinity to be zero.

84. A spherical conductor of radius 12 cm has a charge of 1.6×10^{-7} C distributed uniformly on its surface. What is the electric field (a) inside the sphere. (b) just outside the sphere. (c) at a point 18 cm from the centre of the sphere ?

85. Explain what would happen if in the capacitor given in exercise no. 8a 3 mm thick mica sheet (of dielectric constant = 6) were inserted between the plates, (a) while the voltage supply remained connected. (b) after the supply was disconnected.

86. A 600 pF capacitor is charged by a 200V supply. It is then disconnected from the supply and is connected to another uncharged 600 pF capacitor. How much electrostatic energy is lost in the process ? ,

87. An electric toaster uses nichrome for its heating element. When a negligibly small current passes through it, its resistance at room temperature (27.0 °C) is found to be75.3Ω. When the toaster is connected to a230V supply, the current settles, after a few seconds, to a steady value of 2.68A. What is the steady temperature of the nichrome element ?The temperature coefficient of resistance of nichrome averaged over the temperature range involved, is 1.70×10^{-4} °C^{-1}.

88. The resistance of the platinum wire of a platinum resistance thermometer at the ice point is 5 Ω and at steam point is 5.39 Ω. When the thermometer is inserted in a hot bath, the resistance of the platinum wire is 5.795 Ω. Calculate the temperature of the bath.
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89. Determine the current in each branch of the network shown in figure.
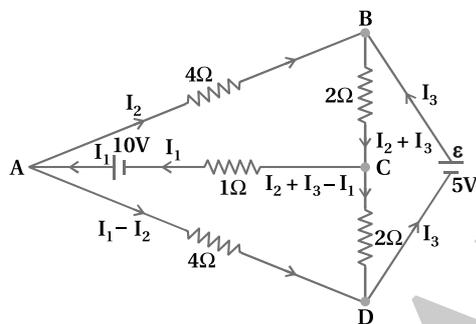
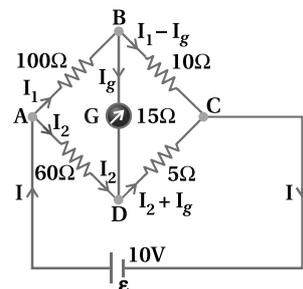90. The four arms of a Wheatstone bridge figure have the following resistances :
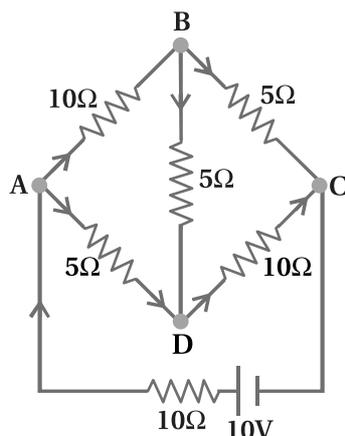
AB = 100 Ω, BC = 10 Ω, CD = 5 Ω and DA = 60 Ω

A galvanometer of 15 Ω resistance is connected across BD.

Calculate the current through the galvanometer when a

potential difference of10 V is maintained across AC.

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91. Determine the current in each branch of the network shown in figure.

92. The number density of free electrons in a copper conductor estimated in Example 1 is 8.5×10^{28} m^{-3}. How long does an electron take to drift from one end of a wire 3.0 m long to its other end ? The area of cross-section of the wire is 2.0×10^{-6} m^2 and it is carrying a current of 3.0 A.

93. A storage battery of emf 8.0 V and internal resistance 0.5 Ω is being charged by a 120 V dc supply using a series resistor of 15.5 Ω. What is the terminal voltage of the battery during charging ? What is the purpose of having a series resistor in the charging circuit ?
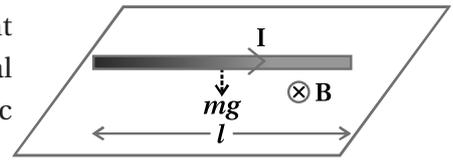
**A**　**Write the answer of the following questions. [Each carries 3 Marks]**　　　**[195]**

1.　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 (figure). What is the magnitude of the magnetic field ?

2.　What is the radius of the path of an electron (mass 9×10^{-31} kg and charge 1.6×10^{-19} C) moving at a speed of 3×10^7 m/s in a magnetic field of 6×10^{-4} T perpendicular to it ? What is its frequency ? Calculate its energy in keV. ($1\,eV = 1.6 \times 10^{-19}$ J)

3.　Figure shows a long straight wire of a circular cross-section (radius a) carrying steady current I. The current I is uniformly distributed across this cross-section. Calculate the magnetic field in the region $r < a$ and $r > a$.
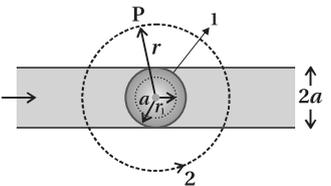
4.　A solenoid of length 0.5 m has a radius of 1 cm and is made up of 500 turns. It carries a current of 5A. What is the magnitude of the magnetic field inside the solenoid ?

5.　A 100 turn closely wound circular coil of radius 10 cm carries a current of 3.2 A.

　　(a)　What is the field at the centre of the coil ?

　　(b)　What is the magnetic moment of this coil ? The coil is placed in a vertical plane and is free to rotate about a horizontal axis which coincides with its diameter. A uniform magnetic field of 2T in the horizontal direction exists such that initially the axis of the coil is in the direction of the field. The coil rotates through an angle of 90° under the influence of the magnetic field.

　　(c)　What are the magnitudes of the torques on the coil in the initial and final position ?

　　(d)　What is the angular speed acquired by the coil when it has rotated by 90° ? The moment of inertia of the coil is $0.1\,kg\,m^2$. ,

6.　In the circuit, the current is to be measured. What is the value of the current if the ammeter as shown in figure.

　　(a)　If a galvanometer with a resistance $R_G = 60.00\,\Omega$.

　　(b)　If a galvanometer described in (a) but converted to an ammeter by a shunt resistance $r_s = 0.02\,\Omega$.

　　(c)　If an ideal ammeter with zero resistance ?
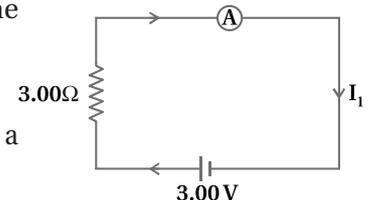
7.　What is the magnitude of magnetic force per unit length on a wire carrying a current of 8A and making an angle of 30° with the direction of a uniform magnetic field of 0.15 T ?

8.　Two long and parallel straight wires A and B carrying currents of 8.0 A and 5.0 A in the same direction are separated by a distance of 4.0 cm. Estimate the force on a 10 cm section of wire A.

9.　Two moving coil meters, M_1 and M_2 have the following particulars :

　　$R_1 = 10\,\Omega$, $N_1 = 30$, $A_1 = 3.6 \times 10^{-3}\,m^2$, $B_1 = 0.25$ T, $R_2 = 14\,\Omega$, $N_2 = 42$, $A_2 = 1.8 \times 10^{-3}\,m^2$, $B_2 = 0.50$ T (The spring constants are identical for the two meters). Determine the ratio of (a) current sensitivity and (b) voltage sensitivity of M_2 and M_1.

10.　A solenoid has a core of a material with relative permeability 400. The windings of the solenoid are insulated from the core and carry a current of 2A. If the number of turns is 1000 per metre, calculate (a) H, (b) M, (c) B and (d) the magnetising current I_m.

11.　A closely wound solenoid of 2000 turns and area of cross-section $1.6 \times 10^{-4}\,m^2$, carrying a current of 4.0 A, is suspended through its centre allowing it to turn in a horizontal plane.

　　What is the force and torque on the solenoid if a uniform horizontal magnetic field of 7.5×10^{-2} T

is set up at an angle of 30° with the axis of the solenoid ?

12. A bar magnet of magnetic moment $1.5\,JT^{-1}$ lies aligned with the direction of a uniform magnetic field of $0.22\,T$.

What is the amount of work required by an external torque to turn the magnet so as to align its magnetic moment: (i) normal to the field direction, (ii) opposite to the field direction ?

13. A short bar magnet has a magnetic moment of $0.48\,JT^{-1}$. Give the direction and magnitude of the magnetic field produced by the magnet at a distance of 10 cm from the centre of the magnet on

(a) the axis

(b) the equatorial lines (normal bisector) of the magnet. ,

14. A square loop of side 10 cm and resistance $0.5\,\Omega$ is placed vertically in the east-west plane. A uniform magnetic field of $0.10\,T$ is set up across the plane in the north-east direction. The magnetic field is decreased to zero in $0.70\,s$ at a steady rate. Determine the magnitudes of induced emf and current during this time-interval.

15. A circular coil of radius 10 cm, 500 turns and resistance $2\,\Omega$ is placed with its plane perpendicular to the horizontal component of the earth's magnetic field. It is rotated about its vertical diameter through 180° in $0.25\,s$. Estimate the magnitudes of the emf and current induced in the coil. Horizontal component of the earth's magnetic field at the place is $3.0 \times 10^{-5}\,T$.

16. A wheel with 10 metallic spokes each $0.5\,m$ long is rotated with a speed of 120 rev/min in a plane normal to the horizontal component of earth's magnetic field H_E at a place. If $H_E = 0.4\,G$ at the place, what is the induced emf between the axle and the rim of the wheel ? Note that $1\,G = 10^{-4}\,T$.

17. Kamla pedals a stationary bicycle. The pedals of the bicycle are attached to a 100 turn coil of area $0.10\,m^2$. The coil rotates at half a revolution per second and it is placed in a uniform magnetic field of $0.01\,T$ perpendicular to the axis of rotation of the coil. What is the maximum voltage generated in the coil ?

18. A long solenoid with 15 turns per cm has a small loop of area $2.0\,cm^2$ placed inside the solenoid normal to its axis. If the current carried by the solenoid changes steadily from $2.0\,A$ to $4.0\,A$ in $0.1\,s$, what is the induced emf in the loop while the current is changing ?

19. A rectangular wire loop of sides $8\,cm$ and $2\,cm$ with a small cut is moving out of a region of uniform magnetic field of magnitude $0.3\,T$ directed normal to the loop. What is the emf developed across the cut if the velocity of the loop is $1\,cm\,s^{-1}$ in a direction normal to the (a) longer side, (b) shorter side of the loop ? For how long does the induced voltage last in each case ?

20. A rectangular wire loop of sides $8\,cm$ and $2\,cm$ with a small cut is moving out of a region of uniform magnetic field of magnitude $0.3\,T$ directed normal to the loop. What is the emf developed across the cut if the velocity of the loop is $1\,cm\,s^{-1}$ in a direction normal to the shorter side of the loop ? For how long does the induced voltage last in each case ?

21. A $1.0\,m$ long metallic rod is rotated with an angular frequency of $400\,rad\,s^{-1}$ about an axis normal to the rod passing through its one end. The other end of the rod is in contact with a circular metallic ring. A constant and uniform magnetic field of $0.5\,T$ parallel to the axis exists everywhere. Calculate the emf developed between the centre and the ring.

22. A pair of adjacent coils has a mutual inductance of $1.5\,H$. If the current in one coil changes from 0 to $20\,A$ in $0.5\,s$, what is the change of flux linkage with the other coil ?

23. A light bulb is rated at $100\,W$ for a 220 V supply. Find

(a) resistance of the bulb; (b) peak voltage of the source; and (c) rms current through the bulb.

24. A pure inductor of 25.0 mH is connected to a source of 220V. Find the inductive reactance and rms current in the circuit if the frequency of the source is $50\,Hz$.

25. A resistor of $200\,\Omega$ and a capacitor of $15.0\,\mu F$ are connected in series to a 220V, 50 Hz ac source.

(a) Calculate the current in the circuit;

(b) Calculate the voltage (rms) across the resistor and the capacitor. Is the algebraic sum of these voltages more than the source voltage ? If yes, resolve the paradox.

26. A sinusoidal voltage of peak value 283V and frequency 50 Hz is applied to a series LCR circuit in

which $R = 3\,\Omega$, $L = 25.48\,mH$ and $C = 796\,\mu F$. Find

(a) the impedance of the circuit;

(b) the phase difference between the voltage across the source and the current;

(c) the power dissipated in the circuit; and

(d) the power factor.

27. Figure shows a series LCR circuit connected to a variable frequency 230V source. $L = 5.0\,H$, $C = 80\,\mu F$, $R = 40\,\Omega$

(a) Determine the source frequency which drives the circuit in resonance.

(b) Obtain the impedance of the circuit and the amplitude of current at the resonating frequency.

(c) Determine the rms potential drops across the three elements of the circuit. Show that the potential drop across the LC combination is zero at the resonating frequency.
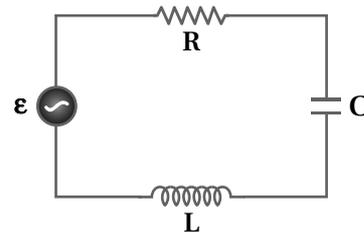
28. A 60 µF capacitor is connected to a 110V,60 Hz ac supply. Determine the rms value of the current in the circuit.

29. A plane electromagnetic wave of frequency 25 MHz travels in free space along the x-direction. At a particular point in space and time, $\vec{E} = 6.3\,\hat{j}\,{}^{V}\!/_{m}$. What is $\vec{B}$ at this point ?

30. The magnetic field in a plane electromagnetic wave is given by

$B_y = (2 \times 10^{-7})T\sin(0.5 \times 10^3 x + 1.5 \times 10^{11} t)$.

(a) What is the wavelength and frequency of the wave ?

(b) Write an expression for the electric field.

31. In a plane electromagnetic wave, the electric field oscillates sinusoidally at a frequency of 2.0×10^{10} Hz and amplitude $48\,Vm^{-1}$.

(a) What is the wavelength of the wave ?

(b) What is the amplitude of the oscillating magnetic field ?

(c) Show that the average energy density of the E field equals the average energy density of the B field. ($c = 3 \times 10^8\,ms^{-1}$)

32. Suppose that the electric field amplitude of an electromagnetic wave is $E_0 = 120$ N/C and that its frequency is $\nu = 50.0$ MHz. (a) Determine, B_0, ω, k, and λ. (b) Find expressions for E and B.

33. An object is placed at (i) 10 cm, (ii) 5 cm in front of a concave mirror of radius of curvature 15 cm. Find the position, nature, and magnification of the image in each case.

34. (i) If f = 0.5 m for a glass lens, what is the power of the lens ? (ii) The radii of curvature of the faces of a double convex lens are 10 cm and 15 cm. Its focal length is 12 cm. What is the refractive index of glass ? (iii) A convex lens has 20 cm focal length in air. What is focal length in water ? (Refractive index of air-water = 1.33, refractive index for air-glass = 1.5.)

35. Find the position of the image formed by the lens combination given in the figure.
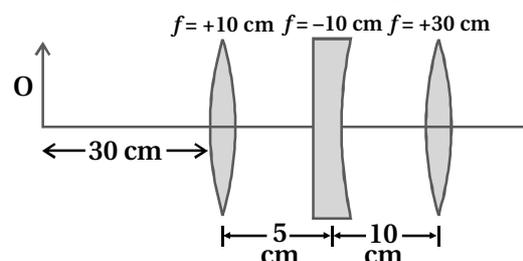
36. A small candle, 2.5 cm in size is placed at 27 cm in front of a concave mirror of radius of curvature 36 cm. At what distance from the mirror should a screen be placed in order to obtain a sharp image ? Describe the nature and size of the image. If the candle is moved closer to the mirror, how would

the screen have to be moved ?

37. A tank is filled with water to a height of 12.5 cm. The apparent depth of a needle lying at the bottom of the tank is measured by a microscope to be 9.4 cm. What is the refractive index of water ? If water is replaced by a liquid of refractive index 1.63 up to the same height, by what distance would the microscope have to be moved to focus on the needle again ?

38. A compound microscope consists of an objective lens of focal length 2.0 cm and an eyepiece of focal length 6.25 cm separated by a distance of 15 cm. How far from the objective should an object be placed in order to obtain the final image at (a) the least distance of distinct vision (25 cm), and (b) at infinity ? What is the magnifying power of the microscope in each case ?

39. A person with a normal near point (25 cm) using a compound microscope with objective of focal length 8.0 mm and an eyepiece of focal length 2.5 cm can bring an object placed at 9.0 mm from the objective in sharp focus. What is the separation between the two lenses ? Calculate the magnifying power of the microscope,

40. (a) A giant refracting telescope at an observatory has an objective lens of focal length 15 m. If an eyepiece of focal length 1.0 cm is used, what is the angular magnification of the telescope ?

   (b) If this telescope is used to view the moon, what is the diameter of the image of the moon formed by the objective lens ? The diameter of the moon is 3.48×10^6 m, and the radius of lunar orbit is 3.8×10^8 m.

41. A card sheet divided into squares each of size 1 mm^2 is being viewed at a distance of 9 cm through a magnifying glass (a converging lens of focal length 10 cm) held close to the eye.

   (a) What is the magnification produced by the lens ? How much is the area of each square in the virtual image ?

   (b) What is the angular magnification (magnifying power) of the lens ?

   (c) Is the magnification in (a) equal to the magnifying power in (b) ? Explain.

42. An angular magnification (magnifying power) of 30X is desired using an objective of focal length 1.25 cm and an eyepiece of focal length 5 cm. How will you set up the compound microscope ?

43. Discuss the intensity of transmitted light when a polaroid sheet is rotated between two crossed polaroids ?

44. Monochromatic light of wavelength 589 nm is incident from air on a water surface. What are the wavelength, frequency and speed of :

   (a) reflected, and

   (b) refracted light ? Refractive index of water is 1.33.

45. (a) The refractive index of glass is 1.5. What is the speed of light in glass ? (Speed of light in vacuum is 3.0×10^8 ms^{-1})

   (b) Is the speed of light in glass independent of the colour of light ? If not, which of the two colours red and violet travels slower in a glass prism ?

46. In Young's double-slit experiment using monochromatic light of wavelength λ, the intensity of light at a point on the screen where path difference is λ, is K units. What is the intensity of light at a point where path difference is $\dfrac{\lambda}{3}$?

47. A beam of light consisting of two wavelengths, 650 nm and 520 nm, is used to obtain interference fringes in a Young's double-slit experiment.

   (a) Find the distance of the third bright fringe on the screen from the central maximum for wavelength 650 nm.

   (b) What is the least distance from the central maximum where the bright fringes due to both the wavelengths coincide ?

48. In a Young's double-slit experiment, the slits are separated by 0.28 mm and the screen is placed 1.4 m away. The distance between the central bright fringe and the fourth bright fringe is measured to be 1.2 cm. Determine the wavelength of light used in the experiment.

49. The work function of caesium is 2.14 eV. Find (a) the threshold frequency for caesium, and (b) the wavelength of the incident light if the photocurrent is brought to zero by a stopping potential of 0.60 V.

50. What is the de-Broglie wavelength associated with (a) an electron moving with a speed of 5.4×10^6 m/s, and (b) a ball of mass 150 g travelling at 30.0 m/s ?

51. The photoelectric cutoff voltage in a certain experiment is 1.5 V. What is the maximum kinetic energy of photoelectrons emitted ?

    (1) $c = 3 \times 10^8$ ms^{-1}, $m_e = 9.1 \times 10^{-31}$ kg

    (2) $h = 6.63 \times 10^{-34}$Js, $m_n = m_p = 1.67 \times 10^{-27}$ kg

    (3) $e = 1.6 \times 10^{-19}$ c, $k_B = 1.38 \times 10^{-23}$ JK^{-1}

52. Monochromatic light of wavelength 632.8 nm is produced by a helium-neon laser. The power emitted is 9.42 mW.

    (a) Find the energy and momentum of each photon in the light beam,

    (b) How many photons per second, on the average, arrive at a target irradiated by this beam ? (Assume the beam to have uniform cross-section which is less than the target area), and

    (c) How fast does a hydrogen atom have to travel in order to have the same momentum as that of the photon ?

53. Light of wavelength 488 nm is produced by an argon laser which is used in the photoelectric effect. When light from this spectral line is incident on the emitter, the stopping (cutoff) potential of photoelectrons is 0.38 V. Find the work function of the material from which the emitter is made.

54. Light of frequency 7.21×10^{14} Hz is incident on a metal surface. Electrons with a maximum speed of 6.0×10^5 m/s are ejected from the surface. What is the threshold frequency for photoemission of electrons ? ($h = 6.625 \times 10^{-34}$ Js, $e = 1.6 \times 10^{-19}$ C, $m = 9.1 \times 10^{-31}$ kg)

55. In a Geiger-Marsden experiment, what is the distance of closest approach to the nucleus of a 7.7 MeV α-particle before it comes momentarily to rest and reverses its direction ?

56. It is found experimentally that 13.6 eV energy is required to separate a hydrogen atom into a proton and an electron. Compute the orbital radius and the velocity of the electron in a hydrogen atom.

57. The ground state energy of hydrogen atom is – 13.6 eV. What are the kinetic and potential energies of the electron in this state ?

58. A hydrogen atom initially in the ground level absorbs a photon, which excites it to the $n = 4$ level. Determine the wavelength and frequency of photon.

59. (a) Using the Bohr's model calculate the speed of the electron in a hydrogen atom in the $n = 1, 2,$ and 3 levels. (b) Calculate the orbital period in each of these levels.

60. The radius of the innermost electron orbit of a hydrogen atom is 5.3×10^{-11} m. What are the radii of the $n = 2$ and $n = 3$ orbits ?

61. Given the mass of iron nucleus as 55.85 u and A = 56, find the nuclear density.

62. A given coin has a mass of 3.0 g. Calculate the nuclear energy that would be required to separate all the neutrons and protons from each other. For simplicity assume that the coin is entirely made of $^{63}_{29}$Cu atoms (of mass 62.92960 u).

63. How long can an electric lamp of 100 W be kept glowing by fusion of 2.0 kg of deuterium ? Take the fusion reaction as $^2_1$H + $^2_1$H $\rightarrow$ $^3_2$He + n + 3.27 MeV

64. The fission properties of $^{239}_{94}\text{Pu}$ are very similar to those of $^{235}_{92}\text{U}$. The average energy released per fission is 180 MeV. How much energy, in MeV, is released if all the atoms in 1 kg of pure $^{239}_{94}\text{Pu}$ undergo fission ?

65. From the relation $R = R_0 A^{1/3}$, where R_0 is a constant and A is the mass number of a nucleus, show that the nuclear matter density is nearly constant (i.e. independent of A).