Guess Paper – 2014
Class – XII
Subject –Physics

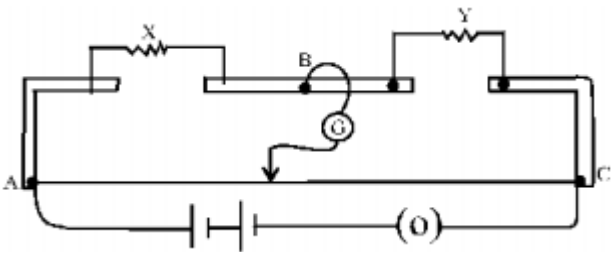
IMPORTANT STEP FOR REVISION :- REVISE NCERT BOOK COMPLETELY, GIVE THE STRESS ON EXAMPLE AND EXERCISE QUESTIONS , SOLVE HOTS QUESTION FROM TOGETHER BOOK.

LONG TYPE QUESTIONS FROM THE PREVIOUS PAPER OF CBSE BOARD EXAM.

1. Define electric field intensity at a point. Derive an expression for the electric field intensity at a point on the axial line of a short dipole.
2. Show that the potential on the equatorial line of an electric dipole is zero
3. What is an electric dipole? Derive an expression for the torque acting on an electric dipole, when held in a uniform electric field. Hence, define the dipole moment.
4. State Gauss theorem in electrostatics. Using this theorem, derive an expression for the electric field intensity due to an infinite plane sheet of charge of charge density σ
5. Show mathematically that for any point out side the shell, the field due to a uniformly charged thin spherical shell is the same as if the entire charge of the shell is concentrated at the centre.
6. Apply gauss theorem to find electric field intensity at a point due to an infinitely long thin, uniformly charged straight wire.
7. Define the capacitance of a capacitor. Give its S.I unit for a parallel plate capacitor, prove that the total energy stored in a capacitor is ½ cv^2 and hence derive expression for the energy density of the capacitor.
8. Derive an expression for the capacitance of a parallel plate capacitor when the space between the plates is partially filled with a dielectric medium of dielectric constant k.
9. Obtain the equivalent capacitance of the network in figure shown below. For a 300V supply determine the charge and voltage across each capacitor.

10. Give the principle of working of a Van –De – Graff generator. With the help of a labeled diagram describe its construction and working. How is the leakage of charge minimized from the generator?
11. Establish a relation between drift velocity of an electron in a conductor of cross section A carrying current I and concentration 'n' of free electrons per unit volume of conductor.
12. Define the term resistivity and write its S.I unit. Derive the expressions for (i) resistance (ii) the resistivity of a conductor in terms of number density of free electrons and relaxation time.
13. Draw a circuit diagram for a meter bridge two determine the unknown resistance of a resistor why are the connections between the resistors of a meter bridge made of thick copper strips? Find the shift in the balance point of a meter bridge, when the two resistors in the two gaps are interchanged.

14. With the help of a circuit diagram explain how the internal resistance of a cell can be determine by using a potentiometer? Write the formula used?
15. Show graphically the variation of resistivity with temperature for
    (i) Metals (ii) alloys (iii) semi conductors (iv) non conductor (carbon)
16. Why is potentiometer preferred over voltmeter to measure the emf of a cell? The potentiometer wire AB shown in the fig. is 400 cm long. Where should the free end of a galvanometer be connected so that the galvanometer shows zero deflection.



1. Derive the relation between the focal length of a convex lens in terms of the radii of curvature of the two surfaces and refractive index of its material. A convex lens of focal length 40 cm and a concave lens of focal length 25 cm are kept in contact with each other. What is the value of power of this combination?
2. State the essential condition for diffraction of light to take place. Use Huygen's principle to explain diffraction of light due to a narrow single slit and the formation of a pattern of fringes obtained on the screen. Sketch the pattern of fringes formed due to diffraction at a single slit showing variation of intensity with angle.
3. State Huygens' principle. Using the geometrical construction of secondary wavelets, explain the refraction of a plane wave front incident at a plane surface. Hence verify laws of reflection and refraction.
4. With the help of a ray diagram, show the formation of image of a point object by refraction of light at a spherical surface separating two media of refractive indices n_1 and n_2 ($n_2 > n_1$) respectively. Using this diagram, derive the relation.

$$\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$$

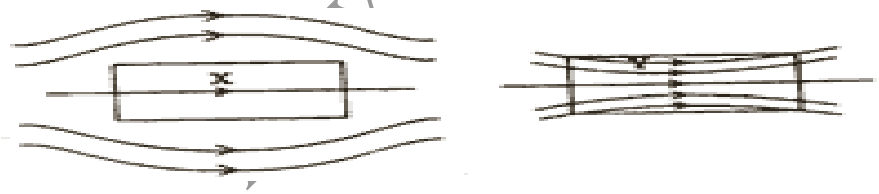
   What happens to the focal length of convex lens when it is immersed in water?
5. Define the term dipole moment of an electric dipole indicating its direction. Write its SI unit. An electric dipole is placed in a uniform electric field, Deduce the expression for the torque acting on it. In a particular situation, it has its dipole moment aligned with the electric field. Is the equilibrium stable or unstable?
6. Obtain the expression for the capacitance of a parallel plate capacitor. Three capacitors of capacitances C_1 , C_2 and C_3 are connected (i) in series, (ii) in parallel. Show that the energy stored in the series combination is the same as that in the parallel combination.
7. (a) Define the term magnetic inclination (Dip) and horizontal component of earth's magnetic field at a place. Establish the relationship between them with the help of a diagram.
   (b) Distinguish the magnetic properties of dia, para, and ferromagnetic substances in terms of (i) susceptibility (ii) magnetic permeability (iii) coercivity. Give one example of each.

8. Derive a mathematical expression for the force per unit length experienced by each of the two long current carrying conductors placed parallel to each other in air. Hence define one ampere of current. Explain why two parallel straight conductors carrying current in the opposite direction kept near each other in air repel?
9. With the help of a neat and labelled diagram, explain the underlying principle and working of a moving coil galvanometer. What is the function of: (i) uniform radial field (ii) soft iron core, in such a device? Write two factors on which the current sensitivity of a moving coil galvanometer depend.
10. Draw a neat and labelled diagram of a cyclotron. State the underlying principle and explain how a positively charged particle gets accelerated in this machine. Show mathematically that the cyclotron frequency does not depend upon the speed of the particle.
11. State the Biot - Savart law for the magnetic field due to a current carrying element. Use this law, obtain a formula for magnetic field (a) at the centre of a circular loop of radius R carrying a steady current I. Sketch the magnetic field lines for a current loop clearly indicating the direction of the field. OR (b) derive the expression for the magnetic field due to a current carrying circular loop of radius 'R', at a point which is at a distance 'x' from its centre along the axis of the loop.
12. Derive an expression for the torque acting on a loop of N turns, area A, carrying current i, when held in a uniform magnetic field. With the help of circuit, show how a moving coil galvanometer can be converted into an ammeter of given range. Write the necessary mathematical formula.
13. Derive the expression for the de Broglie wavelength of an electron moving under a potential difference of V volt. Describe Davisson and Germer experiment to establish the wave nature of electrons. Draw a labelled diagram of the apparatus used.
14. State the principle of working of p-n diode as a rectifier. Explain, with the help of a circuit diagram, the use of p-n diode as (a) a full wave rectifier (b) Half wave rectifier. Draw a sketch of the input and output waveforms.
15. State Bohr's postulates for an atom? Calculate energy of moving electron for n^{th} orbit? What is the significance of negative energy?
16. State Gauss' theorem in electrostatics. Using this theorem, derive the expression for the electric field intensity (a) at any point outside a uniformly charged thin spherical shell (b) at a point due to an infinitely long, thin, uniformly charged straight wire (c) at a point due to an infinite plane sheet of charge.
17. What is a phasor diagram? With its help, drive an expression for the impedance of an ac series L-c-R circuit. In series LCR circuit, voltage across an inductor, a capacitor and a resistor are 30v, 30v and 60v respectively. What is the phase difference between the applied voltage and current in the circuit.

Short Type (3 marks)

1. *(a)* Draw a labelled ray diagram to show the formation of an image by a compound microscope. Write the expression for its magnifying power. *(b)* How does the resolving power of a compound microscope change, when (i) refractive index of the medium between the object and the objective lens increases; and (ii) wavelength of the radiation used is increased?
2. Which two main considerations are kept in mind while designing the 'objective' of an astronomical telescope? Obtain an expression for the angular magnifying power and the length of the tube of an astronomical telescope in its (a) normal adjustment' position.
3. Give the principle of working of a Van de Graff generator. With the help of a labelled diagram, describe its construction and working. How is the leakage of charge minimised from the generator?

4. Define the term 'resolving power' of an astronomical telescope. How does it get affected on (a) increasing the aperture of the objective lens? (b) Increasing the wavelength of the light used? Justify your answer in each case.
5. State the principle of potentiometer. Draw a circuit diagram used to compare the e.m.f. of two primary cells. Write the formula used. How can the sensitivity of a potentiometer be increased?
6. What is meant by 'drift velocity of free electrons'? Derive Ohm's law on the basis of the theory of electron.
7. Explain, with the help of a schematic diagram, the principle and working of a Light Emitting Diode. What criterion is kept in mind while choosing the semiconductor material for such a device? Write any two advantages of Light Emitting Diode over conventional incandescent lamps.
8. Write any four characteristics of electromagnetic waves. Give two uses each of (a) Radio-waves (b) Micro-waves.
9. State the laws of radioactive decay. Establish a mathematical relation between half-life period and disintegration constant of a radioactive nucleus.
10. How is the mutual inductance of a pair of coils affected when (a) separation between the coils is increased? (b) the number of turns of each coil is increased ? (c) a thin iron sheet is placed between the two coils, other factors remaining the same? Explain your answer in each case.
11. What are eddy currents. How are these produced? In what sense are eddy currents considered undesirable in a transformer and how are these reduced in such a device?
12. On the basis of the energy band diagrams distinguish between metals, insulators and semiconductors.
13. An electric dipole is held in a uniform electric field. (a) Using suitable diagram, show that it does not undergo any translatory motion and (ii) derive an expression for the torque acting on it and specify its direction.
14. What is Wheatstone bridge? Deduce the condition for which Wheatstone bridge is balanced.
15. A uniform magnetic field gets modified as shown below, when two specimens X and Y are placed in it.



(a) Identify the two specimens X and Y (b) State the reason for the behaviour of the field lines in X and Y.

16. A pure inductor is connected across an a.c. source. Show mathematically that the current in it lags behind the applied emf by a phase angle of π/2. What is its inductive reactance? Draw a graph showing the variation of inductive reactance with the frequency of the a.c. source.
17. Distinguish between analogue and digital communication. Write any two modulation techniques employed for the digital data. Describe briefly any one of the techniques used.
18. Define the terms threshold frequency and stopping potential in relation to the phenomenon of photoelectric effect. How is the photoelectric current affected on increasing the (i) frequency (ii) intensity of the incident radiations and why?
19. Draw a schematic diagram of a single optical fibre structure. On what principle does such a device work? Explain the mechanism of propagation of light signal through an optical fibre.
20. (a) Draw the block diagram of a communication system. (b) What is meant by 'detection' of a modulated carrier wave? Describe briefly the essential steps for detection.
21. Give reasons for the following :

(a) Astronomers prefer to use telescopes with large objective diameters to observe astronomical objects.
(b) Two identical but independent monochromatic sources of light cannot be coherent.
(c) The value of the Brewster angle for a transparent medium is different for lights of different colours.

Short Type (2 marks)

1. Name the reaction which takes place when a slow neutron beam strikes $_{92}U^{235}$ nuclei. Write the nuclear reaction involved.
2. Define the terms 'Magnetic Dip' and 'Magnetic Declination' with the help of relevant diagrams.
3. Define 'electric line of force' and give its important properties.
4. State the condition under which the phenomenon of resonance occurs in a series LCR circuit. Plot a graph showing variation of current with frequency of a.c. source in a series LCR circuit.
5. How does the resistivity of (i) a conductor and (ii) a semiconductor vary with temperature? Give reason for each case.
6. Explain how the width of depletion layer in a p-n junction diode changes when the junction is (i) forward biased (ii) reverse biased.
7. Define resolving power of a compound microscope. How does the resolving power of a compound microscope change when (i) refractive index of the medium between the object and objective lens increases? (ii) Wavelength of the radiation used is increased?
8. Write the relation for the force acting on a charge carrier q moving with a velocity through a magnetic field in vector notation. Using this relation, deduce the conditions under which this force will be (i) maximum (ii) minimum.
9. You are given 'a' resistors, each of resistance 'r'. These are first connected to get minimum possible resistance. In the second case, these are again connected differently to get maximum possible resistance. Compute the ratio between the minimum and maximum values of resistance so obtained.
10. Draw a circuit diagram using a metre bridge and write the necessary mathematical relation used to determine the value of an unknown resistance. Why cannot such an arrangement be used for measuring very low resistances?
11. What does the term LOS communication mean? Name the types of waves that are used for this communication. Which of the two-height of transmitting antenna and height of receiving antenna can affect the range over which this mode of communication remains effective?
12. Draw a ray diagram to show the refraction of light through a glass prism. Hence obtain the relation for the angle of deviation in terms of the angle of incidence, angle of emergence and the angle of the prism.
13. We do not choose to transmit an audio signal by just directly converting it to an e.m. wave of the same frequency. Give two reasons for the same.
14. State Bohr's postulate for the 'permitted orbits' for the electron in a hydrogen atom. Use this postulate to prove that the circumference of the nth permitted orbit for the electron can 'contain' exactly n wave lengths of the de Broglie wavelength associated with the electron in that orbit.
15. What is photoelectric effect? Drive Einstein's photoelectric equation.
16. Explain the essential difference between interference and diffraction.
17. What is the basic difference between the atom or molecule of a diamagnetic and a paramagnetic material? Why are elements with even atomic number more likely to be diamagnetic?

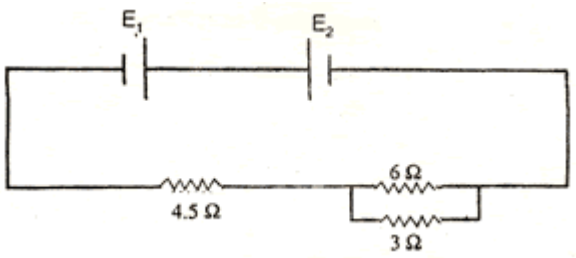
Numerical Problems

1. The output of an OR gate is connected to both the inputs of a NAND gate. Draw the logic circuit of this combination of gates and write its truth table.
2. A convex lens of refractive index 1.5 has a focal length of 18 cm in air. Calculate the change in its focal length when it is immersed in water of refractive index 1.33.
3. Two point charges and are separated by a distance of 1 m in air. Calculate at what point on the line joining the two charges is the electric potential zero.
4. A voltage of 30 V is applied across a carbon resistor with first, second and third rings of blue, black and yellow colours respectively. Calculate the value of current, in mA, through the resistor.
5. Calculate the current drawn by the primary of a transformer which steps down 200 V to 20 V to operate a device of resistance. Assume the efficiency of the transformer to be 80%.
6. An a.c. voltage of 100 V, 50 Hz is connected across a 20 ohm resistor and mH inductor in series. Calculate (i) impedance of the circuit, (ii) rms current in the circuit
7. In an ammeter (consisting of a galvanometer and a shunt), 0.5% of the main current passes through the galvanometer. Resistance of the galvanometer coil is G. Calculate the resistance of the shunt in terms of galvanometer resistance, G.
8. An electric bulb B and a parallel plate capacitor C are connected in series to the a.c. mains as shown in the given figure. The bulb glows with some brightness. How will the glow of the bulb be affected on introducing a dielectric slab between the plates of the capacitor? Give reasons in support of your answer.
9. The output of a 2-input NOR gate is fed to a NOT gate. Draw the logic circuit of this combination of gates and write the truth table for the output of the combination for all inputs.
10. The electric field and electric potential at any point due to a point charge kept in air is 20 N/C and 10 J/C respectively. Compute the magnitude of this charge.
11. Draw and explain the output waveform across the load resistor R, if the input waveform is as shown in the given figure.

12.

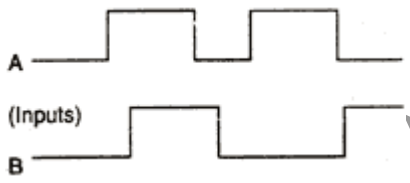
13.

14. Two cells E_1 and E_2 in the given circuit diagram have an emf of 5 V and 9 V and internal resistance of 0.3Ω and 1.2Ω respectively.

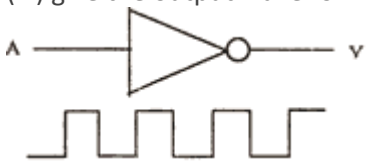


Calculate the value of current flowing through the resistance of 3Ω.

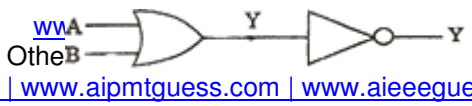
15. Two capacitors of capacitance of 6μF and 12μF are connected in series with a battery. The voltage across the 6μF capacitor is 2 V. Compute the total battery voltage.
16. A parallel plate capacitor with air between the plates has a capacitance of 8 pF. The separation between the pates is now reduced by half and the space between them is filled with a medium of dielectric constant 5. Calculate the value of capacitance of the capacitor in the second case.
17. A 4μF capacitor is charged by a 200 V supply. The supply is then disconnected and the charged capacitor is connected to another uncharged 2 μF capacitor. How much electrostatic energy of the first capacitor is lost in the process of attaining the steady situation?
18. Find the wavelength of electromagnetic waves of frequency 5×10^{19}Hz in free space.
19. A compound microscope with an objective of 1.0 cm focal length and an eye-piece of 2.0 cm focal length has a tube length of 20 cm. Calculate the magnifying power of the microscope, if the final image is formed at the near point of the eye.
20. The magnifying power of an astronomical telescope in the normal adjustment position is 100. The distance between the objective and the eye-piece is 101 cm. Calculate the focal lengths of the objective and of the eye-piece.
21. An electric dipole of length 4 cm, when placed with its axis making an angle of 60^0 with a uniform electric field experiences a torque 4√3 Nm. Calculate the (i) magnitude of the electric field. (ii) potential energy of the dipole, if the dipole has charges of ±8nC.
22. A TV tower has a height of 400 m at a given place. Calculate coverage range, if the radius of the earth is 6400 km.
23. Give the logic symbol for an OR gate. Draw the output wave form for input wave forms A and B for this gate.



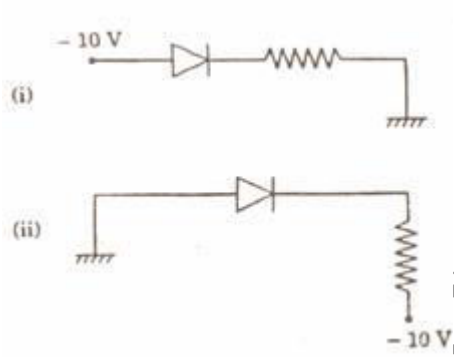
24. In the figure below, circuit symbol of a logic gate and input wave from is shown.
(i) Name the logic gate,
(ii) write its truth table and
(iii) give the output wave form.



25. Two point charges q_A= +3μc and q_B= -3μc are located 20 cm apart in vacuum, (i) Find the electric field at the mid -point of the line AB joining the two charges, (ii) If a negative test charge of magnitude **1.5×10^{-9} C** is placed at the centre, find the force experienced by the test charge.
26. Name the gate obtained from the combination of gates shown in the figure. Draw its logic symbol. Write the truth table of the combination.

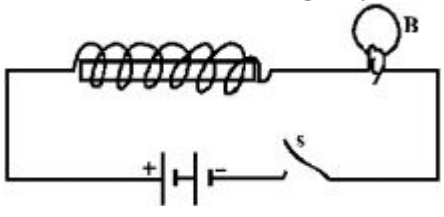


27. Draw a circuit diagram for use of NPN transistor as an amplifier in common emitter configuration. The input resistance of a transistor is1000Ω. On changing its base current by 10μA, the collector current increases by 2 m A. If a load resistance of 5 kΩ is used in the circuit, calculate: (i) the current gain (ii) voltage gain of the amplifier.
28. When an inductor L and a resistor R in series are connected across a 12 V, 50Hz supply, a current of 0.5 A flows in the circuit. The current differs in phase from applied voltage by π/3 radian. Calculate the value of R.
29. Two cells of emf 1.5 V and 2 V and internal resistance 1 ohm and 2 ohm respectively are connected in parallel to pass a current in the same direction through an external resistance of 5 ohm. (i) Draw the circuit diagram. (ii) Using Kirchhoff's laws, calculate the current through each branch of the circuit and potential difference across the 5 ohm resistor.
30. A galvanometer with a coil of resistance 120 ohm shows full scale deflection for a current of 2.5 mA. How will you convert the galvanometer into an ammeter of range 0 to 7.5 A? Determine the net resistance of the ammeter. When an ammeter is put in a circuit, does it read slightly less or more than the actual current in the original circuit? Justify your answer.
31. Explain, with the help of a circuit diagram, how the thickness of depletion layer in a p-n junction diode changes when it is forward biased. In the following circuits which one of the two diodes is forward biased and which is reverse biased?

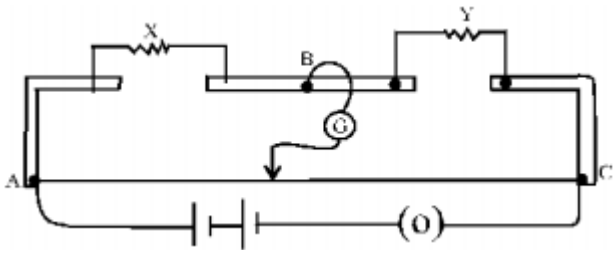


32. In a series R - C circuit, R= 30Ω, C= 0.25μF, V= 100 V and ω= 100 rad/second. Find the current in the circuit and calculate the voltage across the resistor and the capacitor.
    Is the algebraic sum of these voltages more than the source voltage? If yes, resolve the paradox.
33. In a double slit experiment with monochromatic light, fringes are obtained on a screen placed at some distance from the slits. If the screen is moved by 5 x 10^{-2} m towards the slits, the change in fringe width is 3x 10^{-5} m. If the distance between slits is 10^{-3} m, calculate the wavelength of light used.
34. Six resistors, each of value 4Ω are joined together in a circuit as shown in the figure. Calculate equivalent resistance across the points A and B. If a cell of emf 2V is connected across AB, compute the current through the arms AB and DF of the circuit.

35. The horizontal component of the earth's magnetic field at a given place is 0.4×10^{-4} Wb/m^2 and angle of dip is 30^0. Calculate the value of (i) vertical component, (ii) the total intensity if the earth's magnetic field.
36. Calculate the temperature at which the resistance of a conductor becomes 20% more than its resistance at 270C. The value of the temperature coefficient of resistance of the conductor is 2.0×10^{-4} /k.
37. A 8Ω resistance wire is bent at the middle by 180^0. Both the halves are twisted together. What is the new resistance?
38. A galvanometer with a coil of resistance 12Ω shows the full scale deflection for a current of 2.5 mA. How will you convert the galvanometer into (a) an ammeter of range 0 to 7.5A, (b) voltmeter of range 0 to 10v?
39. In a young's double slit experiment, the slit are separated by 0.28 mm and the screen is placed 1.4m 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.
40. A 25 µF capacitor, a 0.10 henry inductor and a 25 ohm resistor are connected in series with an a.c. source, whose emf is given by E= 310 sin314t volts (a) What is frequency of the emf? (b) What is impedance of the circuit? (c) What is the phase angle of the current by which it leads or lags the applied e.m.f? (d) what is expression for the instantaneous value of current in the circuit? (e) construct a phase diagram for these voltages.
41. 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 150g travelling at 30.0 m/s?
42. The half-life of $_{92}U^{238}$ undergoing α- decay is 4.5×10^9 years. What is the activity of 1g sample of $_{92}U^{238}$?
43. A regular hexagon of side 10 cm has a charge 5µc at each of its vertices. Calculate the potential at the centre of the hexagon.
44. Double convex lenses are to be manufactured from a glass of refractive index 1.55 with both faces of the same radius of curvature. What is the radius of curvature required if the focal length is to be 20 cm?
45. Three capacitors of capacitance 2pF, 3pF and 4pF are connected in parallel. (a) What is the total capacitance of the combination? (b) Determine the charge on each capacitor if the combination is connected to a 100V supply.
46. What is the focal length of a convex lens of focal length 30 cm in contact with a concave lens of focal length 20 cm? Is the system a converging or a diverging lens?
47. Fig. shows a light bulb (B) and iron cored inductor connected to a DC battery through a switch (S). (i) What will one observe when switch (S) is closed? (ii) How will the glow of the bulb change when the battery is replaced by an ac source of rms voltage equal to the voltage of DC battery? Justify your answer in each case.



48. The given figure shows the experimental set up of a metre bridge. The null point is found to be 60cm away from the end A with X and Y in position as shown.



When a resistance of 15Ω is connected in series with 'Y', the null point is found to shift by 10cm towards the end A of the wire. Find the position of null point if a resistance of 30Ω were connected in parallel with 'Y'.

49. Why is a potentiometer preferred over a voltmeter for determining the emf of a cell? Two cells of emf E1 and E2 are connected together in two ways shown here.

The 'balance points' in a given potentiometer experiment for these two combinations of cells are found to be at 351.0cm and 70.2cm respectively. Calculate the ratio of the emfs of the two cells.

Q.1 How is the relative permeability (μ_r) of a material related to its susceptibility (χ_m) ? 1

Q.2 A metallic wire 1 m in length is moving normally across a field of 0.1 T with a speed of 5 ms^{-1}. Find the emf between the ends of the wire. 1

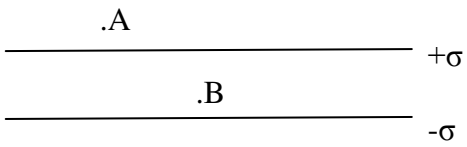
Q.3 For which frequency of light, the human eye is most sensitive ? 1

Q.4 If a plane glass slab is placed on letters of different colours, then red coloured letters appear more raised up. Why ? 1

Q.5 If the maximum kinetic energy of electrons emitted in a photo-cell is 5 eV, what is the stopping potential ?Q.6 Is the ionization energy of an isolated free atom different from the ionization energy for the atoms in a crystalline lattice ? 1

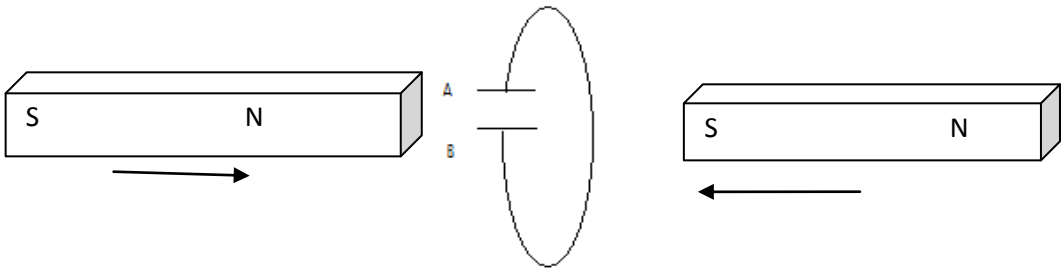
Q.7 What is the de Broglie wavelength (A^0) associated with an electron accelerated through a potential of 100 V ? 1

Q.8 Two plane sheets of charge densities +σ and – σ are kept in air as shown in Fig. what are the electric field intensities at points A and B ? 1



Q.9 What is the magnitude of magnetic force per unit length on a wire carrying a current of 8 A and making an angle of 30^0 with the direction of a uniform magnetic field of 0.15 T ? 2

Q.10 State Lenz's law. Predict the polarity of the capacitor in the situation described by fig.



Q.11 (i) Draw the graphs showing variation of inductive reactance and capacitive reactance with frequency of applied a.c. source.

(ii) Can the voltage drop across the inductor or the capacitor in a series LCR-circuit be greater than the applied voltage of the a.c. source ? Justify your answer. 2

Q.12 (i) Draw a circuit diagram of a common emitter amplifier using n-p-n transistor. Show input and output voltages graphically. 2

Q.13 (i) Give any one difference between FAX and Email systems of communication.

(ii) A carrier wave of peak voltage 12 V is used to transmit a message signal. What should be the peak voltage of the modulating signal in order to have a modulation index of 75% ? 2

Q.14 Name the following constituent radiations of electromagnetic spectrum which :

(i) produce intense heating effect. 2

(ii) is absorbed by the ozone layer in the atmosphere.

(iii) is used for studying crystal structure.

Q.15 State Gauss theorem and draw a graph between electric field due to an infinite plane charged sheet and distance. 2

Q.16 An infinite line charge produces a field of 9×10^4 NC^{-1} at a distance of 2 cm. Calculate the linear charge density. 2

Q.17 Define the term current density of a metallic conductor. Deduce the relation connecting 2 current density (J) and conductivity (σ) of the conductor, when an electric field E is applied to it.

Q.18 Explain why does a convex lens behave as a converging lens when immersed in water (μ=1.33) and as a diverging lens, when immersed in carbon disulphide (μ=1.6).

Q.19 State the principle of metre bridge. With the help of circuit diagram, explain how will you find out an unknown resistance ? 3

Q.20 (i) State the principle of transformer. 3

(ii) Show that in the free oscillations of an LC circuit, the sum of energies stored in capacitor and the inductor is constant in time.

OR

(a) In India, domestic power supply is at 220 V, 50 Hz, while in USA it is 110 V, 50 Hz. Give one advantage and one disadvantage of 220 V supply over 110 V supply.

(b) In an a.c. circuit, R=4Ω , Z=5 Ω, V_{rms}=200 V and I_{rms} =1.5 A. Calculate the average power consumed over a full cycle.

Q.21 Explain, using Huygens' principle ,how diffraction is produced by a narrow slit which is illuminated by monochromatic light. Show that central maximum is twice as wide as the other maxima and the pattern becomes narrower as the width of the slit is increased. 3

Q.22 (i) State Brewster's law. (ii) A small telescope has an objective lens of focal length 144 cm and an eyepiece of focal length 6.0 cm. What is the magnifying power of the telescope ? What is the separation between the objective and the eyepiece ?

Q.23 What is the significance of Davisson and Germer experiment. Draw Davisson- Germer 3 electron diffraction arrangement. Where do we find the utility of the result of the experiment ?

Q.24 Draw a diagram to show the variation of binding energy per nucleon with mass number for different nuclei. State with reason why light nuclei usually undergo nuclear fusion. 3

Q.25 A 10 kg satellite circles earth once every 2 h in an orbit having a radius of 8000 km. Assuming that Bohr's angular momentum postulate applies to satellites just as it does to an electron in the hydrogen atom , find the quantum number of the orbit of the satellite. 3

Q.26 A ground receiver station is receiving a signal at (a) 5 MHz and (b) 100 MHz transmitted from a ground transmitter at a height of 300 m located at a distance of 100 km. Identify whether it is coming via space wave or sky wave propagation or satellite transponder. (Given the value of radius of the earth is 6400 km and maximum electron density, $N_{max}=10^{12}$ m^{-3}) 3

Q.27 Explain (i) forward biasing (ii) Reverse biasing of the p-n junction diode .With the help of a circuit diagram, explain the use of this device as a half-wave rectifier. 3

Q.28 A parallel plate capacitor, each with plate area A and separation d, is charged to a potential difference V. The battery used to charge it is then disconnected. A dielectric slab of thickness d and dielectric constant k is now placed between the plates. What change, if any, will take place in : (i) charge on plates, (ii) electric field intensity between the plates
(iii) capacitance of the capacitor. Justify your answer in each case. 5

OR

(a) State the principle of Van de Graaff generator and draw a labelled diagram of the generator.
(b) A parallel plate capacitor is to be designed with a voltage rating 1 kV, using a material of dielectric constant 3 and dielectric strength about 10^7 Vm^{-1}. For safety ,we would like the field never to exceed say 10% of the dielectric strength. What minimum area of the plates is required to have a capacitance of 50 pF ?

Q.29 (a) Derive an expression for the maximum force experienced by a straight conductor of length l, carrying current I and kept in a uniform magnetic field B.

(b) 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. What is the magnitude of the magnetic field

OR 5

(a) State the principle of cyclotron and draw labelled diagram.
(b) A cyclotron's oscillator frequency is 10 MHz .What should be the operating magnetic field for accelerating protons ? If the radius of the 'Dees' is 60 cm, what is the kinetic energy of the proton beam produced by the accelerator ? (e=1.60 x 10^{-19} C,
m_p=1.67 x 10^{-27} kg). Express your answer in units of MeV (1 MeV =1.602 x 10^{-13} J)

Q.30 Draw a labelled ray diagram of an astronomical telescope, forming the image at infinity.
An astronomical telescope uses two lenses powers 10 dioptre, 1 dioptre.
(i) State with reason, which lens is preferred as objective and eye-piece.
(ii) Calculate the magnifying power of the telescope ,if the final image is formed at the near point.
(iii) How do the light gathering power and resolving power of a telescope change, if the

aperture of the objective lens is doubled ?

OR 5

(a) An angular magnification (magnifying power) of 30 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 ?

(b) A myopic person has been using spectacles of power -1.0 dioptre for distant vision. During old age he also needs to use separate reading glass of power +2.0 dioptres. Explain what may have happened .

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