PHYSICS

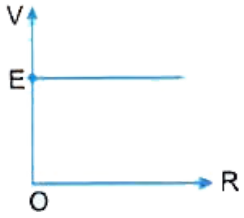
BOOKS - U-LIKE PHYSICS (HINGLISH)

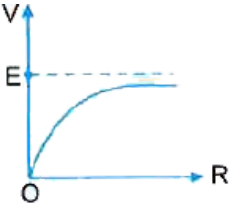
CBSE EXAMINATION PAPER 2020

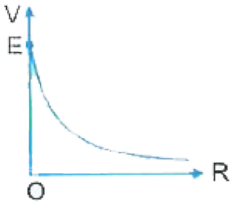
Section A Select The Most Appropriate Option From Those Given Below Each Quation

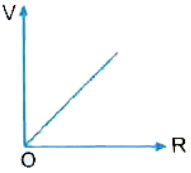
1. A cell of emf (E) and internal resistance r is connected across a variable external

resistance . R. The graph of terminal potential difference V as a function of R is

A. 

B. 

C. 

D. 

Answer: b

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2. A uniform wire of resistance 2R is bent in the form of a circle. The effective resistance between the ends of any diameter of the circle is

A. 2R

B. R

C. $\frac{R}{2}$

D. $\frac{R}{4}$

Answer: c

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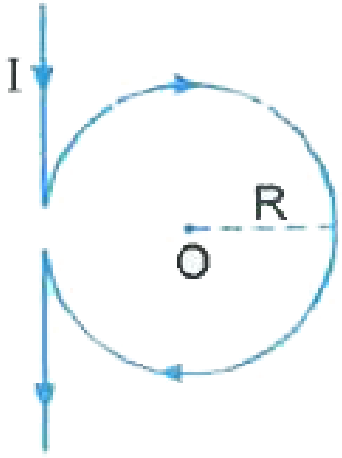
3. A current I flows through a long straight conductor which is bent into a circular loop of radius R in the middle as shown in the figure .



The magnitude of the net magnetic field at point O will be

A. Zero

B. $\frac{\mu_0 I}{2R}(1+\pi)$

C. $\frac{\mu_0 I}{4\pi R}$

D. $\frac{\mu_0 I}{2R}\left(1-\frac{1}{\pi}\right)$

Answer: d

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4. A circular loop of radius r, carrying a current I lines in y - z plane with its centre at the origin. The net magnetic flux through the loop is

A. directly proportional to r.

B. zero

C. inversely proportional to r.

D. directly proportional to I.

Answer: d

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5. The kinetic energy of a proton and that of an α - particle are 4 eV and 1 eV , respectively . The ratio of the de - Broglie wavelengths associated with them , will be

A. $2:1$

B. $1:1$

C. $1:2$

D. $4:1$

Answer: b

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6. A photocell connected in an electrical circuit is placed at a distance 'd' from a source of light . As a result , current I flows in the circuit . What will be the current in the circuit when the distance is reduced to ' $\frac{d}{2}$?

A. I

B. 2I

C. 4I

D. I/2

Answer: c

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7. A current of 10 A is flowing from east to west in a long straight wire kept on a horizontal table. The magnetic field developed at a distance of 10 cm due north on the table is

A. 2×10^{-5} T , acting downwards.

B. 2×10^{-5} T , acting upwards.

C. 4×10^{-5} T , acting downwards.

D. 4×10^{-5} T , acting upwards.

Answer: a

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8. When a wave undergoes reflection at an interface from rarer to denser medium , adhoc change in its phase is

A. $\frac{\pi}{2}$

B. 0

C. π

D. $\frac{\pi}{4}$

Answer: a

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9. Paschen series of atomic spectrum of hydrogen gas lies in

A. infrared region.

B. ultraviolet region.

C. visible region.

D. partly in ultraviolet and partly in visible region.

Answer: a

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10. In the α - particle scattering experiment , the shape of the trajectory of the scattered α - particles depend upon

A. only on impact parameter.

B. only on the source of α - particles.

C. both impact parameter and source of α - particles.

D. impact parameter and the screen material of the detector.

Answer: a

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Section A Fill In The Blanks With Appropriate Answer

1. Torqure acting on an electric dipole in an electric field is maximum when the angle between the electric field and the dipole moment is .....

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2. A proton released from rest in an electric field , will start moving towards a region of .....potential in the field.

View Text Solution

3. To minimise the percentage error in the determination of unknown resistance of a conductor in meter bridge experiment , the balance point is adjusted near.....of the wire.

View Text Solution

4. In potentiometer , a long uniform wire is used to .....potential gradient along the wire .

View Text Solution

5. Unpolarised light of intensity I_0 is incident on two crossed polaroids. The intensity of

light transmitted by the combination will be ..... .

View Text Solution

6. Name the particle emitted spontaneously in the following nuclear reaction.

$^{32}_{15}P \rightarrow {}^{32}_{16}S + \overrightarrow{v} + \ldots\ldots\ldots .$

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Section A Answer The Following

1. The work done in moving a charge particle between two points in a uniform electric field, does not depend on the path followed by the particle . Why ?

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2. Define 'magnetic declination' at a place on earth.

View Text Solution

3. An a.c. source with variable frequency is connected to a parallel plate capacitor . How will the displacement current be affected with the decrease in frequency of the source ?

View Text Solution

4. An astronomical telescope may be a refracting type or a reflecting type. Which of the two produces image of better quality ? Justify your answer.

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5. Can a slab of p - type semiconductor be physically joined to another n type semiconductor slab to form p -n junction ? Justify your answer.

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6. In a p - n junction diode the forward bias resistance is low as compared to the reverse bias resistance. Give reason.

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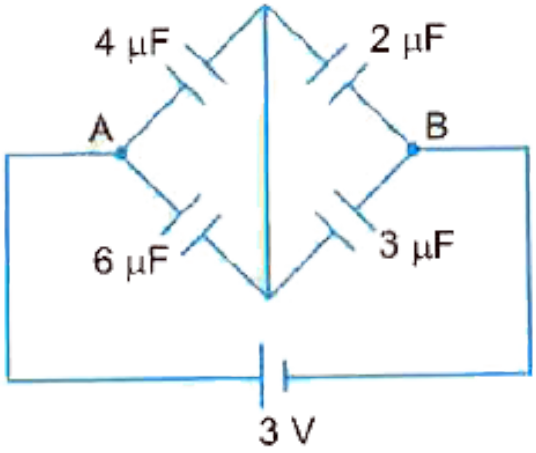
Section B

1. Find the total charge stored in the network of capacitors connected between A and B as shown in figure.



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2. A hollow conducting sphere of inner radius r_1 and outer radius r_2 has a charge Q on its surface. A point charge - q is also placed at the centre of the sphere .

(a) What is the surface charge density on the (i) inner and (ii) outer surface of the sphere ?

(b) Use Gauss' law of electrostatics to obtain the expression for the electric field at a point lying outside the sphere.

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Section C

1. An infinitely thin straight wire has uniform linear charge density λ . Obtain the expression. For the electric field (E) at a point lying at a distance x from the wire, using Gauss' law.

(b) Show graphically the variation of this electric field E as a function of distance x from the wire .

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2. (a) Explain the principle of working of a potentiometer.

(b) In a potentiometer, a standard source of emf 5 V and negligible internal resistance maintains a steady current through the potentiometer wire of length wire of length 10 m. Two primary cells of emf E_1 and E_2 are joined together in a series with (i) same polarity and (ii) opposite polarity. The combination is connected to the

potentiometer circuit in each case. The balancing length of the wire in the two cases are found to be 700 cm and 100 m , respectively . Find the values of emf of the two cells.

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3. (a) Differentiate between self inductance and mutual inductance.

(b) The mutual inductance of two coaxial coils is 2 H. The current in one coil is changed

uniformly from zero to 0.5 A in 100 ms. Find the :

(i) change in magnetic flux through the other coil.

(ii) emf induced in the other coil during the change.

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4. Explain with the help of a diagram , the working of a step - down transformer. Why is a laminated iron core used in a transformer ?

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5. Name the electro - magnetic waves with their frequency range, produced in

(a) some radioactive decay.

(b) sparks during electric welding.

(c) TV remote.

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6. Two coherent light waves of intensity $5 \times 10^{-2} Wm^{-2}$ each super - impose and

produce the interference pattern on a screen.

At a point where the path difference between the waves is $\frac{\lambda}{6}$, λ being wavelength of the wave, find the

(a) phase difference between the waves.

(b) resultant intensity at the point.

(c) resultant intensity in terms of the intensity at the maximum.

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7. Two objects P and Q when placed at different positions in front of a concave mirror of focal length 20 cm, form real images of equal size. Size object P is three times size of object Q. If the distance of P is 50 cm from the mirror. Find the distance of Q from the mirror.

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Section D

1. (a) Show that a current carrying solenoid behaves like a small bar magnet . Obtain the expression for the magnetic field at an external point lying on its axis.

(b) A steady current of 2 A flows through a circular coil having 5 turns of radius 7 cm. The coil lies in x - Y plane with its centre at the origin. Find hte magnitude and direction of the magnetic dipole moment of the coil.

View Text Solution

2. (a) Derive the experience for the forest acting between two long parallel current carrying conductors. Hence , defined 1 A current .

(b) A bar magnet of dipole moment 3 A m^2 . rests with its centre on a frictionless pivot. A force F is applied at right angles to the axis of the magnet , 10 cm from the pivot . It is observed that an external magnetic field of 0.25 T is required to hold the magnet in equilibrium at an angle of 30° with the field. Calculate the value of F.

How will the equilibrium be effected if F is withdrawn?

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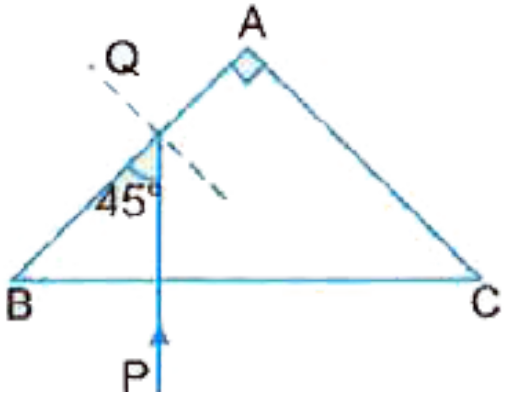
3. (a) Draw the ray diagram showing refraction of ray of light through a glass prism. Derive the expression for the refractive index n of the material of prism in terms of the angle A ray angle of minimum deviation δ_m

(b) A ray of light PQ enters an isosceles right angles prism ABC of refractive index 1.5 as

shown in figure .



(i) Trace the path of the ray through the prism

.

(ii) What will be the effect on the path of the ray if refractive index of the prism is 1.4 ?

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4. (a) Two thin lenses are placed coaxially in contact. Obtain the expression for the facal lengths of the lenses.

(b) A converging of refractive index 1.5 has power of 10 D. When it is completely immersed . In a liquid , it behaves as a diverging lens of focal length 50 cm. Find the refractive index of the liquid.

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5. (a) Derive the law of radioactive decay $N = N_0 e^{-\lambda t}$

(b) The half - life of $^{238}_{92}U$ undergoing α - decay is 4.5×10^9 years. Find its mean life.

(c) What fraction of the initial mass of a radioactive substance will decay in five half - life periods ?

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6. (a) State the postulates of Bohr's model of hydrogen atom and derive the expression for Bohr radius.

(b) Find the ratio of the longest and the shortest wavelengths amongst the spectral lines of Balmer series in the spectrum of hydrogen atom.

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Section A

1. Which of the following statements is not correct according to Rutherford model ?

A. Most of the space inside an atom is empty.

B. The electrons revolve around the nucleus under the influence of coulomb force acting on them.

C. Most part of the mass of the atom and its positive charge are concentrated at its centre.

D. The stability of atom was established by the model.

Answer:

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2. The resolving power of a telescope can be increased by increasing

A. wavelength of light

B. diameter of objective

C. length of the tube

D. focal length of eyepiece.

Answer:

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3. The magnetic dipole moment of acurrent carrying coil does not depend upon

A. number of turns of the coil

B. cross-sectional area of the coil

C. current flowing in the coil

D. material of the turns of the coil.

Answer: A::C

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4. If the net electric flux through a closed surface is zero, then we can infer

A. no net charge is enclosed by the surface

B. uniform electric field exists within the surface

C. electric potential varies from point to point inside the surface

D. charge is present inside the surface

Answer:

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5. A ray of light on passing through an equilateral glass prism, suffers a minimum deviation equal to the angle of the prism. The value of refractive index of the material of the prism is.....

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6. According to Bohr's atomic model, the circumference of the electron orbit is always an multiple of de-Broglie wavelength.

View Text Solution

7. In β-decay, the parent and daughter nuclei have the same number of

View Text Solution

8. The number of turns of a solenoid are doubled without changing its length and area of cross-section. The self-inductance of the solenoid will become .....times.

View Text Solution

9. Laminated iron sheets are used to minimise currents in the core of a transformer.

View Text Solution

10. The magnetic field lines are by a diamagnetic substance.

View Text Solution

11. Why cannot we use Si and Ge in fabrication of visible LEDs ?

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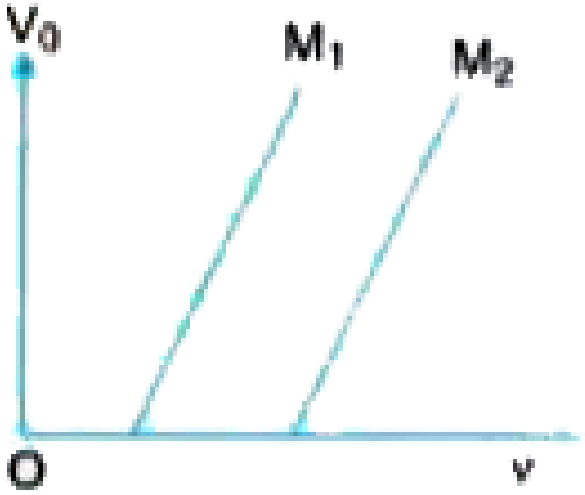
12. The variation of the stopping potential (V_0) with the frequency (v) of the light incident on two different photosensitive surfaces M_1 and M_2 is shown in the figure. Identify the surfaces which has greater value

of the work function.



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13. How does an increase in doping concentration affect the width of depletion layer of a p-n junction diode?

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14. The nuclear radius of ${}^{27}_{13}Al$ is 3.6 fermi. Find the nuclear radius of ${}^{64}_{29}Cu$.

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15. A proton and an electron have equal speeds. Find the ratio of de-Broglie wavelengths associated with them.

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16. How is displacement current produced between the plates of a parallel plate capacitor during charging ?

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17. The relationship between Brewester angle θ and the speed of light 'v' in

A. v tan θ=c

B. c tan θ =v

C. $v \sin \theta = c$

D. $c \sin \theta = v$

Answer: A::C

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18. Photo diodes are used to detect

A. radio waves.

B. gamma rays.

C. IR rays.

D. optical signals.

Answer: A::C

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19. The selectivity of a series LCR a.c. circuit is large, when

A. L is large and R is large.

B. L is small and R is small.

C. L is large and R is small.

D. L= R.

Answer: A::B::C::D

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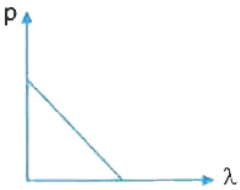
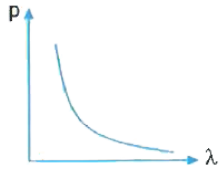
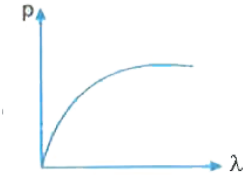
20. The graph showing the correct variation of linear momentum (p) of a charge particle with its de-Broglie wavelength (λ) is

A.



B. 

C. 

D. 

Answer: B

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21. The wavelength and intensity of light emitted by a LED depend upon

A. forward bias and energy gap of the semiconductor.

B. energy gap of the semiconductor and reverse bias.

C. energy gap only.

D. forward bias only.

Answer: A::B::C::D

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22. A charge particle after being accelerated through a potential difference V enters in a uniform magnetic field and moves in a circle of radius r. If V is doubled, the radius of the circle will become

A. 2r

B. $\sqrt{2r}$

C. 4 r

D. $\frac{r}{\sqrt{2}}$

Answer: B

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23. The electric flux through a closed Gaussian surface depends upon

A. net charge enclosed and permittivity of the medium.

B. net charge enclosed, permittivity of the medium and the size of the Gaussian

surface.

C. et charge enclosed only.

D. permittivity of the medium only.

Answer: A::C::D

View Text Solution

24. If photons of frequency v are incident on the surfaces of metals. A and B of threshold frequencies $\frac{v}{2}$ and $\frac{v}{3}$ respectively, the ratio of

the maximum kinetic energy of electrons emitted from A to that from B is

A. $2:3$

B. $3:4$

C. $1:3$

D. $\sqrt{3}:\sqrt{2}$

Answer: B::C

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25. The power factor of a series LCR circuit at resonance will be

A. 1

B. 0

C. $\frac{1}{2}$

D. $\frac{1}{\sqrt{2}}$

Answer: A

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26. A biconcave lens of power P vertically splits into two identical plano concave parts. The power of each part will be

A. 2P

B. $\frac{P}{2}$

C. P

D. $\frac{P}{\sqrt{2}}$

Answer: B

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27. The physical quantity having SI unit N C^{-1} m is _____ .

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28. A copper wire of non-uniform area of cross-section is connected to a d.c. battery. The physical quantity which remains constant along the wire is

View Text Solution

29. A point charge is placed at the centre of a hollow conducting sphere of internal radius ' and outer radius '2r. The ratio of the surface charge density of the inner surface to that of the outer surface will be _____ .

View Text Solution

30. The _____ a property of materials C, Si and Ge depends upon the energy gap between their conduction and valence bands.

View Text Solution

31. The ability of a junction diode to _____ an alternating voltage is based on the fact that it allows current current to pass only when it is forward biased .

View Text Solution

32. Define the term 'current sensitivity' of a moving coil galvanometer.

View Text Solution

33. Depict the fields diagram of an electromagnetic wave propagating along positive x-axis with its electric field along y-axis.

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34. Write the conditions on path difference under which (i) constructive (ii) destructive interference occur in Young's double-slit experiment.

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35. Plot a graph showing varñation of induced e.m.f. with the rate of change of current flowing through a coil.

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36. A series combination of an inductor (L), capacitor (C) and a resistor (R) is connected across an ac source of emf of peak value E_0 and angular frequency (ω). Plot a graph to

show variation of impedance of the circuit with angular frequency (ω).

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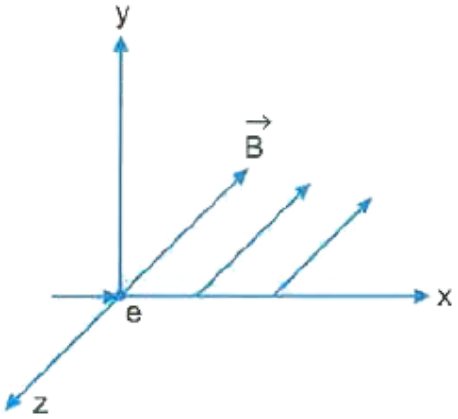
37. An electron moves along +x direction. It enters into a region of uniform magnetic field B directed along - z direction as shown in figure. Draw the shape of trajectory followed

by the electron after entering the field.



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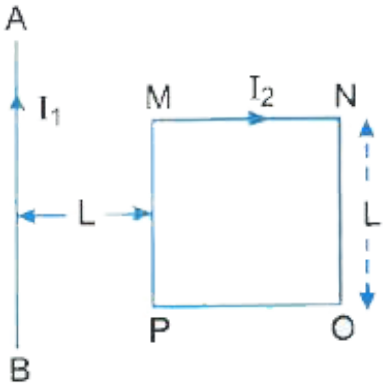
38. A square shaped current carrying loop MNOP is placed near a straight long current carrying wire AB as shown in the figure. The wire and the loop lie in the same plane. If the

loop experiences a net force F towards the wire, find the magnitude of the force on the side 'NO" of the loop.



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Section A Select The Most Appropriate Option

1. A cell of internal resistance r connected across an external resistance R can supply maximum current when

A. $R = r$

B. $R > r$

C. $R = \frac{r}{2}$

D. $R = 0$

Answer: d

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2. In a current carrying conductor, the ratio of the electric field and the current density at a point is called

A. resistivity

B. conductivity

C. resistance

D. mobility

Answer: a

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3. An electron is released from rest in a region of uniform electric and magnetic fields acting parallel to each other. The electron will

A. move in a straight line.

B. move in a circle.

C. ramain stationary.

D. move in a helical path.

Answer: a

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4. Above Curie temperature, a

A. ferromagnetic material becomes diamagnetic.

B. ferromagnetic material becomes paramagnetic.

C. paramagnetic material becomes ferromagnetic.

D. paramagnetic material becomes diamagnetic.

Answer: b

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5. Displacement current exists only when

A. electric field is changing.

B. magnetic field is changing.

C. electric field is not changing.

D. magnetic field is not changing.

Answer: a

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6. Electromagnetic waves used as a diagnostic tool in medicine are

A. X-rays.

B. ultraviolet rays.

C. infrared radiation.

D. ultrasonic waves.

Answer: a

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7. At equilibrium, in a p-n junction diode the net current is

A. due to diffusion of majority charge carriers.

B. due to drift of minority charge carriers.

C. zero as diffusion and drift currents are equal and opposite.

D. zero as no charge carriers cross the junction.

Answer: c

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8. In an n-type semiconductor, the donor energy level lies

A. at the centre of the energy gap.

B. just below the conduction band.

C. just above the valance band.

D. in the conduction band.

Answer: b

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9. When two nuclei $(A \leq 10)$ fuse together to form a heavier nucleus, the

A. binding energy per uncleon increases.

B. binding energy per uncleon decreases.

C. binding energy per nucleon does not change.

D. total binding energy decreases.

Answer: a

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10. In β^1 decay, a

A. neutron converts into a proton emitting antineutrino.

B. neutron converts into a proton emitting neutrino.

C. proton converts into a neutron emitting antineutrino.

D. proton converts into a neutron emitting neutrino.

Answer: a

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Section A Fill In The Blanks With Appropriate Answer

1. If the electric flux entering and leaving a closed surface in air are ϕ_1 and ϕ_2 respectively, the net electric charge enclosed within the surface is _____ .

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2. In Young's double-slit experiment, the path difference between two interfering waves at a

point on the screen is $\frac{5\lambda}{2}$, λ being wavelength of the light used. The _____ dark fringe will lie at this point.

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3. If one of the slits in Young's double-slit experiment is fully closed, the new pattern has _____ central maximum in angular size.

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4. For a higher resolving power of a compound microscope, the wavelength of light used should be _____ .

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5. Unpolarised light passes from a rarer into a denser medium. If the reflected and the refracted rays are mutually perpendicular, the reflected light is linearly polarised _____ to the plane of incidence.

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6. Out of red, blue and yellow lights, the scattering of _____ light is maximum.

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Section A Answer The Following

1. What is the impedance of a capacitor of capacitance C in an ac circuit using source of frequency n Hz?

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2. What is the value of impedance of a resonant series LCR circuit?

View Text Solution

3. A conducting rod of length l is kept parallel to a uniform magnetic field $\overrightarrow{B}$. It is moved along the magnetic field with a velocity $\overrightarrow{v}$.

What is the value of emf induced in the conductor?

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4. Draw the graph showing variation of the value of the induced emf as a function of rate of change of current flowing through an ideal inductor.

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5. What is the wavelength of a photon of energy 3.3×10^{-19} J?

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6. Define the term 'threshold frequency' in photoelectric emission.

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Section B

1. Two long straight parallel wires A and B separated by a distance d, carry equal current I flowing in same direction as shown in the figure.

(a) Find the magnetic field at a point P situated between them at a distance x from one wire.

(b) Show graphically the variation of the magnetic field with distance x for $0 < x < d$.

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2. Using Bohr's atomic model, derive the expression for the radius of nth orbit of the revolviting electron in a hydrogen atom.

View Text Solution

3. (a) Write two maln observations of photoelectric effect experiment which could only be explained by Einstein's photoelectric equation.

(b) Draw a graph showing variation of

photocurrent with the anode potential of a photocell.

View Text Solution

4. Define wavefront of a travelling wave. Using Huygens principle, obtain the law of refraction at a plane interface when light passes from rarer to a denser medium.

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5. Using lens maker's formula, derive the thin less formula $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ for a biconevex lens.

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6. Explain the principle of working of a meter bridge. Draw the circuit diagram for determination of an unknown resistance using it.

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7. Explain the terms 'depletion layer' and 'potential barrier' in a p-n junction diode. How are the (a) width of depletion layer, and (b) value of potential barrier affected when the p-n junction is forward biased ?

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8. N small conducting liquid droplets, each of radius r, are charged to a potential V each. These droplets coalesce to form a single large

drop without any charge leakage. Find the potential of the large drop.

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9. Define activity of a sample of a radioactive substance. The value of the disintegration constant of a radioactive substance is $0.0693h^{-1}$. Find the time after which the activity of a sample of this substance reduces to one-half that of its present value.

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10. Derive the expression for the torque acting on an electric dipole, when it is held in a uniform electric field. Identify the orientation of the dipole in the electric field, in which it attains stable equilibrium.

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11. Obtain the expression for the energy stored in a capacitor connected across a dc battery. Hence define energy density of the capacitor.

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12. Gamma rays and radio waves travel with the same velocity in free space. Distinguish between them in tems of their origin and the main application.

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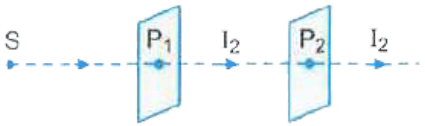
13. Light from a sodium lamp (S) passes through two polaroid sheets P_1 and P_2 as

shown in figure. What will be the effect on the intensity of the light transmitted (i) by P_1 and (ii) by P_2 on rotating polaroid P_1 about the direction of propagation of light ? Justify your answer in both cases.

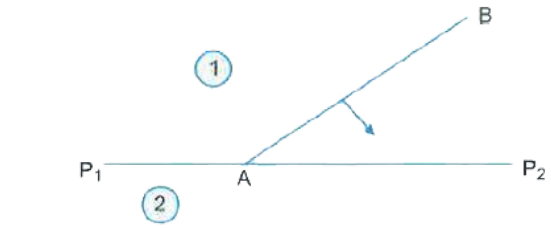


View Text Solution

14. Define the term 'wavefront of light'. A plane wave front AB propagating from denser medium (1) into a rarer medium (2) is incident

on the surface P_1P_2 separating the two media as shown in figure.

Using Huygen's principle, draw the secondary wavelets and obtain the refracted wavefront in the diagram.



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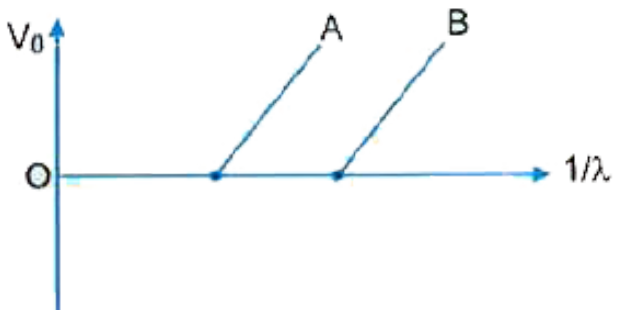
15. A heavy nucleus P of mass number 240 and binding energy 7.6 MeV per nucleon splits in

to two nuclei Q and R of mass numbers 110, 130 and binding energy per nucleon 8.5 MeV and 8.4 MeV, respectively. Calculate the energy released in the fission.

View Text Solution

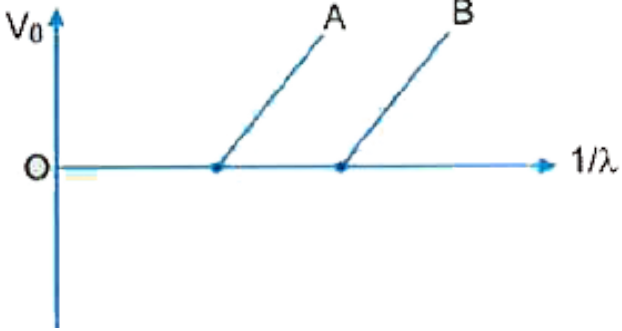
16. Figure shows the stopping potential (V_0) for the photo electron vers $\left(\frac{1}{\lambda}\right)$ graph, for two metals A and B, λ being the wavelength of incident light.



How is the value of Planck's constant determined from the graph ?

View Text Solution

17. Figure shows the stopping potential (V_0) for the photo electron vers $\left(\frac{1}{\lambda}\right)$ graph, for two metals A and B, λ being the wavelength of incident light.



If the distance between the light source and the surface of metal A is increased, how will the stopping potential for the electrons emitted from it be affected ? Justify your answer.

View Text Solution

18. Use Bohr's model of hydrogen atom to obtain the relationship between the angular momentum and t magnetic moment of the revolving electron.

View Text Solution

19. In a single slit diffraction experiment, the width of the slit is increased. How will the (i) size and (ii) intensity of central bright band be affected ? Justify your answer.

View Text Solution

20. Define the term 'mobility' of charge carriers in a current carrying conductor. Obtain the relation for mobility in terms of relaxation time.

View Text Solution

Section C

1. In a single-slit diffraction experiment, light of wavelength λ illuminates the slit of width 'a' and the diffraction pattern is observed on a screen.

(a) Show the intensity distribution in the pattern with the angular position θ.

(b) How are the intensity and angular width of central maxima affected when

(i) width of slit is increased, and

(ii) separation between slit and screen is decreased ?

View Text Solution

2. With the help of a simple diagram, explain the working of a silicon solar cell, giving all three basic processes involved. Draw its I-V characteristic.

View Text Solution

3. A resistor R and an inductor L are connected in series to a source $V = V_m \sin \omega t$. Find the

(a) peak value of the voltage drops across R

and across L,

(b) phase difference between the applied voltage and current. Which of them is ahead ?

View Text Solution

4. (a) Write the expression for the speed of light in a material medium of relative permittivity & and relative magnetic permeability μ_r.

(b) Write the wavelength range and name of the electromagnetic waves which are used in

(i) radar systems for aircraft navigation, and (a) earth satellites to observe the growth of the crops.

View Text Solution

5. (a) Two cells of emfe and € have their internal resistances ε_1 and ε_2 respectively. Deduce an expression for the equivalent emf and internal resistance of their parallel combination when connected across an external resistance R. Assume that the two

cells are supporting each other.

(b) In case the two cells are identical, each of emf e= 5V and internal resistance $r = 2\Omega$, calculate the voltage across the external resistance $R = 10\Omega$.

View Text Solution

6. (a) Write an expression of magnetic moment associated with a current (I) carrying circular coil of radius R having N turns.

(b) Consider the above mentioned coil placed

in YZ plane with its centre at the origin. Derive expression for the value of magnetic field due to it at point (x, 0, 0).

View Text Solution

7. (a) Define current sensitivity of a galvanometer. Write its expression.

(b) A galvanometer has resistance and shows full scale deflection for currently I_g.

(i) How can it be converted into an ammeter to measure current up to $I_0 \left(I_0 > I_g\right)$

(ii) What is the effective resistance of this ammeter ?

View Text Solution

8. The nucleus ${}_{92}^{235}Y$, initially at rest, decays into ${}_{90}^{213}X$ by emitting an α-particle

${}_{92}^{235}Y \rightarrow {}_{90}^{231}X$ + energy,

The binding energies per nucleon of the parent nucleus, the daughter nucleus and α-particle are 7.8 MeV, 7.835 MeV and 7.07 MeV, respectively. Assuming the daughter nucleus

to be formed in the unexcited state and neglecting its share in the energy of the reaction, find the speed of the emitted α-particle,

$[\text{Mass of particle} \quad = 6.68 \times 10^{-27} kg]$

View Text Solution

9. Differentiate between electrical resistance and resistivity of a conductor.

View Text Solution

10. Two metallic rods, each of length L, area of cross A_1 and A_z, having resistivities ρ_1 and ρ_2 are connected in parallel across a d.c. battery. Obtain the expression for the effective resistivity of this combination.

View Text Solution

11. Calculate the de-Broglie wavelength associated with the electron revolving in the first excited state of hydrogen atom. The

ground state energy of the hydrogen atom is -13.6 eV.

View Text Solution

12. Define the term decay constant of a radioactive substance.

View Text Solution

13. The half -life of $\frac{238}{92}$ U undergoing a decay is 4.5×10^9 years. Calculate the activity of 10 g

same of $\frac{238}{92}$ U.

View Text Solution

14. What is a solar cell ? Draw its V-I characteristics. Explain the three processes involved in its working.

View Text Solution

15. Draw the circuit diagram of a full wave rectifier. Explain its working showing its input

and output waveforms.

View Text Solution

16. An optical instrument uses a lens of power 100 D for objective lens and 50 D for its eyepiece. When the tube length is kept at 25 cm the final image is formed at infinity.

(a) Identify the optical instrument.

(b) Calculate the magnification produced by the instrument.

View Text Solution

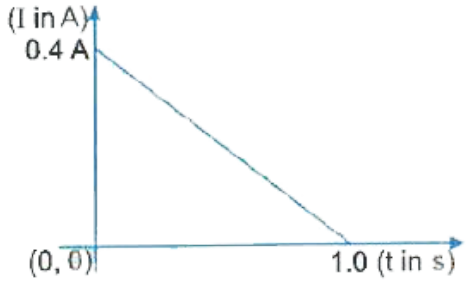
17. Two point charges q_1, and q_2 are kept at a distance of r_{12} in air. Deduce the expression for the electrostatic potential energy of this system.

View Text Solution

18. If an extermal electric field (E) is applied on the system, write the expression for the total energy of this system.

View Text Solution

19. When a conducting loop of resistance 10Ω and area 10 cm^2 is removed from an external magnetic field acting normally, the variation of induced current in the loop with time is shown in the figure.



Find the

(i) total charge passed through the loop.

(ii) change in magnetic flux through the loop.

(iii) magnitude of the magnetic field applied.

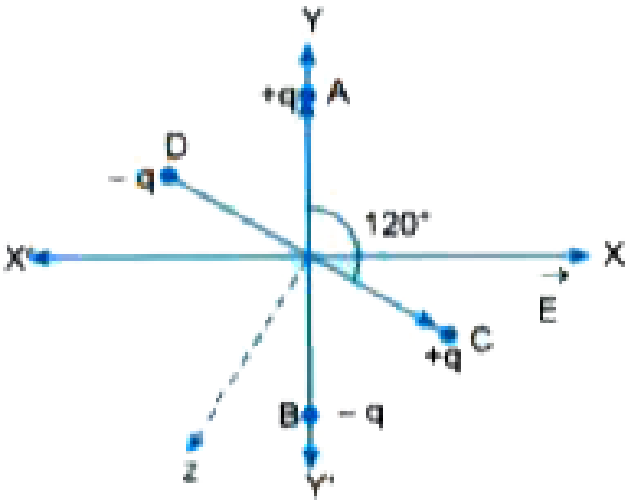
View Text Solution

20. Two small identical electric dipoles AB and CD, each of dipole moment $\vec{p}$ are kept at an angle of 120° to each other in an external electric field $\vec{E}$ pointing along the x-axis as shown in the figure. Find the

(a) dipole moment of the arrangement, and

(b) magnitude and direction of the net torque

acting on it.



View Text Solution

21. In the figure given below, find the

(a) equivalent capacitance of the network between points A and B.

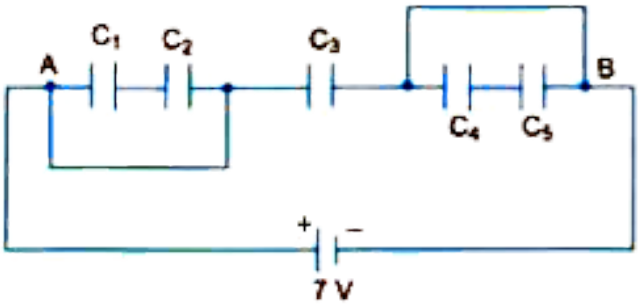
Given:

$C_1 = C_5 = 8\mu F, C_2 = C_3 = C_4 = 4\mu F.$

(b) maximum charge supplied by the battery,

and

(c) total energy stored in the network.



View Text Solution

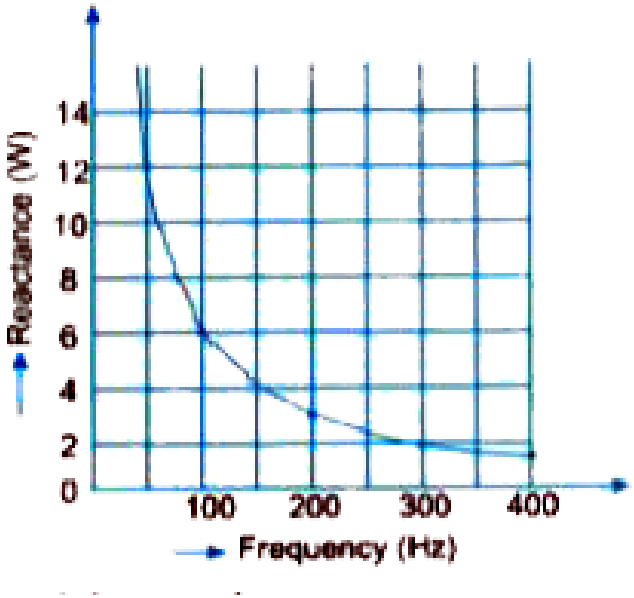
22. Derive the condition of balance for Wheatstone bridge.

View Text Solution

23. Draw the circuit diagram of a metre bridge to explain how it is based on Wheatstone bridge.

View Text Solution

24. The figure shows the graphical variation of the rectance of a capacitor with frequency of acsource.



(a) Find the capacitance of the capacitor.

(b) An ideal inductor has the same reactance at 100 Hz frequency as the capacitor has at the

same frequency. Find the value of inductance of the inductor.

(c) Draw the graph showing the variation of the rectance of this inductor with frequency.

View Text Solution

25. What is the difference in the construction of an astronomical telescope and a compound microscope? The focal lengths of the objective and eyepiece of a compound microscope are 1.25cm and 5.0cm, respectively. Find the

position of the object relative to the objective in order to obtain an angular magnification of 30 when the final image is formed at the near point.

View Text Solution

26. The maximum kinetic energy of the photoelectrons emitted is doubled when the wavelength of light incident on the photosensitive surface changes from λ_1 to λ_2. Deduce expressions for the threshold

wavelength and work function for the metal surface in terms of λ_1 and λ_2.

View Text Solution

27. Differentiate between half-life and average life of a radioactive substance.

View Text Solution

28. A radioactive substance decays for an interval of time equal to its mean life. Find the

fraction of the amount of the substance which is left undecayed after this time interval.

View Text Solution

29. What is the function of a solar cell? Briefly explain its working and draw its I-V characteristic curve.

View Text Solution

Section D

1. (a) Derive the expression for the torque acting on the rectangular current carrying coll of a galvanometer. Why is the magnetic field made radial ?

(b) A α- particle is accelerated through a potential difference of 10 kV and moves along y-axis. It enters in a region of uniform magnetic field $B = 2 \times 10^{-3} T$ acting along y-axis. Find the radius of its path. $\left[\text{Take mass of } \alpha - \text{particle } = 6.4 \times 10^{-27} kg\right]$

View Text Solution

2. (a) With the help of a labelled digram, explain the working of a step-up transformer. Give reason to explain the following,

(i) The core of the transformer is laminated.

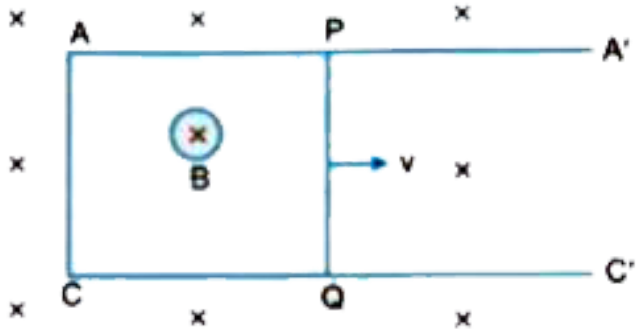
(ii) Thick copper wire is used in windings.

(b) A conducting rod PQ of length 20 cmn and resistance 0.1Ω rests on two smooth parallel rails of negligible resistance AA' and CC'. It can slide on the rails and the arrangement is positioned between the poles of a permanent magnet producing uniform magnetic field B=0.4T. The rails, the rod and the magnetic

field are in three mutually perpendicular directions as shown in the figure. If the ends A and C of the rails are short circuited, find the

(i) external force required to move the rod with uniform velocity v= 10 cm/s, and

(ii) power required to do so.



View Text Solution

3. (a) Draw the ray diagram of an astronomical telescope when the final images is formed at infinity. Write the expression for the resolving power of the telescope.

(b) An astronomical telescope has an objective lens of focal length 20m and eyepiece of focal length 1 cm.

(i) Find the angular magnification of the telescope.

(ii) If this telescope is used to view the Moon, find the diameter of the image formed by the objective lens. Given the diameter of the Moon

is $3.5 \times 10^6 m$ and the radius of lunar orbit is $3.8 \times 10^8 m$.

View Text Solution

4. An object is placed in front of a concave mirror. It is observed that a virtual image is formed. Draw the ray diagram to show the image formation and hence derive the morror equation $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$.

(b) An object is placed 30 cm is front of a plano-convex lens with its spherical surface of

radius of curvature 20cm. If the refractive index of the material of the lens 1.5, find the position and nature of the image formed.

View Text Solution

5. (a) Using Gauss law, derive expression for electric field due to a spherical shell a uniform charge distribution σ and radius R at a point lying at a distance r from the centre of shell, such that

(i) $O < r < R,$ and

(ii) $r > R$.

(b) An electric field is uniform and acts along +x direction in the region of positive x. It is also uniofrm with the same magnitude but acts in -x direction in the region of negative x. The value of the field is E= 200 N/C for $x > 0$ and $E = -200 N/C$ 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 flat face is at x =+ 10 cm and the other is at x=-10 cm.

Find :

(i) The net outward flux through the cylinder.

(ii) The net change present inside the cylinder.

View Text Solution

6. Find the expression for the potential energy of a system of two point charges q_1, and q_2 glocated at $\vec{r}_1$ and $\vec{r}_2$ respectively in an external electric field $\vec{E}$.

(b) Draw equipotential surfaces due to an isolated point charge (-q) and depict the electric field lines.

(c) Three point charges $+1\mu C, -1\mu C$ and $+2\mu C$ are initially infinite distance apart. Calculate the work done in assembling these charges at the vertices of an equilateral triangle of side 10 cm.

View Text Solution

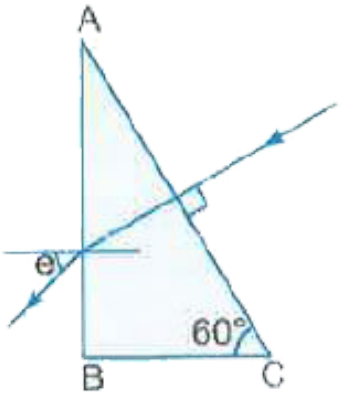
7. Define the term 'focal length ofa mirror. With the help of a ray diagram, obtain the

relation between its focal length and radius of curvature.

View Text Solution

8. Calculate the angle of emergence (e) of the ray of light incident normally on the face AC of a glass prism ABC of refractive index $\sqrt{3}$. How will the angle of emergence change qualitatively, if the ray of light emerges from the prism into a liquid of refractive index 1.3

instead of air ?



View Text Solution

9. Define the term 'resolving power of a telescope'. How will the resolving power be effected with the increase in

(i) Wavelength of light used . (ii) Diameter of the objective Lens justify your answers.

View Text Solution

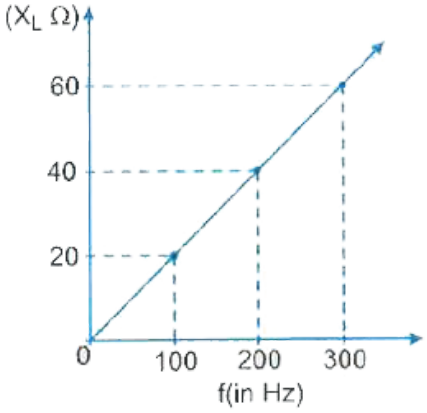
10. A screen is placed 80 cm from an object. The image of the object on the screen is formed by a convex lens placed between them at two different locations separated by a distance 20 cm. Determine the focal length of the lens.

View Text Solution

11. Show that an ideal inductor does not dissipate power in an ac circuit.

View Text Solution

12. The variation of inductive reactance (X_L) of an inductor with the frequency (f) of the a.c. source of 100 V and variable frequency is shown in the figure.



(i) Calculate the self-inductance of the inductor.

(ii) When this inductor is used in series with a capacitor of unknown value and a resistor of 10Ω at 300 s^{-1}, maximum power dissipation occurs in the circuit. Calculate the capacitance of the capacitor.

View Text Solution

13. A conductor of length T'is rotated about one of its ends at a constant angular speed 'ω' in a plane perpendicular to a uniform magnetic field B. Plot graphs to show variations of the emf induced across the ends of the conductor with (i) angular speed o and (ii) length of the conductor i.

View Text Solution

14. Two concentric circular loops of radius 1 cm and 20 cm are placed coaxially.

(i) Find mutual inductance of the arrangement

(ii) If the current passed through the outer loop is changed at a rate of 5 A/ms, find the emf induced in the inner loop. Assume the magnetic field on the inner loop to be uniform.

View Text Solution

15. Write two important characteristics of equipotential surfaces.

View Text Solution

16. A thin circular ring of radius r is charged uniformly so that its linear charge density becomes λ . Derive an expression for the electric field at a point P at a distance x from it along the axis of the ring. Hence, prove that at

large distances ($r >> r$), the ring behaves as a point charge.

View Text Solution

17. State Gauss's law on electrostatics and derive an expression for the electric field due to a long straight thin uniformly charged wire (linear charge density) at a point lying at a distance r from the wire.

View Text Solution

18. Use Gauss's law to show that due to uniformly charged spherical shell of radius R, the electric field at any point situated outside the shell at a distance r from its centre is equal to the electric field at the same point, when the entire charge on the shell were concentrated at its centre. Also plot the graph showing the variation of electric field with r, for $r \leq R$ and $r \geq R$.

View Text Solution

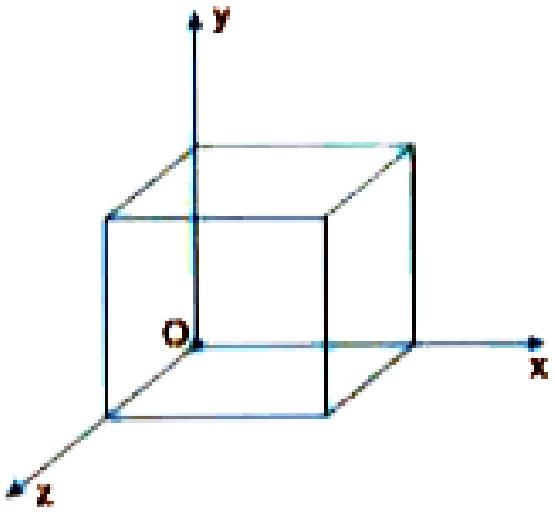
19. Two point charges of $+1\mu C$ and $+4\mu C$ are kept 30 cm apart. How far from the $+1\mu C$ charge on the line joining the two charges, will the net electric field be zero?

View Text Solution

20. Two point charges q_1 and q_2 are kept r distance apart in a uniform external electric field $\vec{E}$. Find the amount of work done in assembling this system of charges.

View Text Solution

21. A cube of side 20 cm is kept in a region as shown in the figure. An electric field $\vec{E}$ exists in the region such that the potential at a point is given by $V = 10x + 5$, where V is in volt and x is in m.



Find the

(i) electric field $\vec{E}$, and

(ii) total electric flux through the cube.

View Text Solution

22. A circular loop of radius R carries a current I. Obtain an expression for the magnetic field at a point on its axis at a distance x from its centre.

View Text Solution

23. A conducting rod of length 2 m is placed on a horizontal table in north-south direction. It carries a current of 5A from south to north. Find the direction and magnitude of the magnetic force acting on the rod. Given that the Earth's magnetic field at the place is $0.6 \times 10^{-4} T$ and angle of dip is $\frac{\pi}{6}$.

View Text Solution

24. Obtain the expression for the deflecting torque acting on the current carrying

rectangular coil of a galvanometer in a uniform magnetic field. Why is a radial magnetic field employed in the moving coil galvanometer?

View Text Solution

25. Particles of mass 1.6×10^{-27} kg and charge $1.6 \times 10^{-19} C$ are accelerated in a cyclotron of dee radius 40cm. It employs a magnetic field 0.4T. Find the kinetic energy (in

MeV) of the particle beam imparted by the accelerator.

View Text Solution

26. Derive lens maker's formula for a biconvex lens.

View Text Solution

27. A point object is placed at a distance of 12 cm on the principal axis of a convex lens of

focal length 10cm. A convex mirror is placed coaxially on the other side of the lens at a distance of 10cm. If the final image coincides with the object, sketch the ray diagram and find the focal length of the convex mirror.

View Text Solution

28. What is a wavefront? How does it propagate? Using Huygens' principle, explain reflection of a plane wavefront from a surface and verify the laws of reflection.

View Text Solution

29. A parallel beam of light of wavelength 500 nm falls on a narrow slit and the resulting diffraction pattern is obtained on a screen 1 m away. If the first minimum is formed at a distance of 2.5 mm from the centre of the screen, find the

(i) width of the slit, and

(ii) distance of first secondary maximum from the centre of the screen.

View Text Solution