CHENNAI SAHODAYA SCHOOLS COMPLEX

COMMON EXAMINATION

CLASS: XII

SUBJECT: PHYSICS SUBJECT CODE: 042

CODE: C

MAXIMUM MARKS: 70 TIME ALLOWED: 3 HOURS

ROLL NO.: DATE: 27/01/2023

GENERAL INSTRUCTIONS

- This Question paper contains 11 printed pages.
- This Question paper contains 35 questions
- Write down the Question Number before attempting.
- An additional reading time of 15 minutes

1. There are 35 questions in all. All questions are compulsory
2. This question paper has five sections; Section A , Section B, Section C, Section D, and Section E. All the sections are compulsory.
3. Section A contains eighteen MCQ of 1 mark each, Section B contains seven questions of two marks each, Section C contains five questions of three marks each, Section D contains three long questions of five marks each and Section E contains two case study based questions of 4 marks each.
4. There is no overall choice however an internal choice has been provided in sections B, C, D and E. You have to attempt only one of the choices in such questions.
5. Use of calculators is not permitted.

SECTION A

1 Two point charges +16q and -4q are located at x=0 and x=L. The location of the point on the axis at which the resultant electric field due to these charges is zero is

i) 8L ii) 6L iii) 4L iv)2L

2. Given n resistors each of resistance R what is the ratio of maximum to minimum resistance?

i) $\frac{1}{n^2}$ ii) $\frac{n^2}{1}$ iii)$\frac{1}{n}$ iv) $\frac{n}{1}$

3. A beam of α particles projected along + X axis experiences a force due to magnetic field along the Y axis .The direction of magnetic field is along

i)-x axis ii) + y axis iii) + z axis iv) –z axis

4. In an ammeter 0.2% of the main current passes through the galvanometer. If the resistance of galvanometer is G, the resistance of ammeter will be

i) $\frac{1\ G}{499}$ ii) $\frac{499G}{500}$ iii)$\frac{1\ G}{500}$ iv) $\frac{500\ G}{499}$

5. The susceptibility of a magnetic material is -2.6x10^5.The magnetic material is

i) Ferromagnetic ii) paramagnetic iii) diamagnetic iv) none of the above

6. A short bar magnet of magnetic moment 0.4$\frac{Joule}{Tesla}$is placed in a uniform magnetic field of 0.16T.The magnet is in stable equilibrium when the potential energy is

i)-0.082 J ii) 0.064 J iii) -0.064 J iv) zero

7. In a series LCR circuit at resonance the current is equal to

i) $\frac{V}{R}$ ii) $\frac{V}{X_C}$ iii) $\frac{V}{X_{L-X_C}}$ iv) $\frac{V}{\sqrt{R^2+(XL-XC)^2}}$

8. The magnetic flux linked with a coil is given by $\varphi = 5t^2$ +3t+16 where $\varphi\ is\ in$ weber and t is in seconds. The induced emf in the coil at t=5 will be

i) 53 v ii) 43 v iii) 10v iv) 6V

9. In an ac circuit an alternating voltage e=200$\sqrt{2}$ sin $100t$ v is connected to a capacitor of capacitance 1μf.The RMS value of current in the circuit is

i) 10 mA ii) 100mA iii) 200mA iv) 20mA

10. The refracting angle of a prism is 30° and the refractive index of the material of the prism is $\sqrt{2}$.One of the refracting surfaces of the prism is made a mirror inwards. A beam of monochromatic light entering the prism from the other face will retrace its path after reflecting from the mirrored surface if its angle of incidence on the prism is

i) 45° ii)60° iii) 37° iv)30°

11. A microscope is focused on a mark on a piece of paper and then a slab of thickness3cm and refractive index 1.5 is placed over the mark. How should the microscope be moved to get the mark in focus again?

i) 2cm upward ii) 1cm upward iii) 4.5cm upward iv) 1 cm downward,

12. In Youngs double slit experiment the fringe width is found to be 0.4mm. If the whole apparatus is immersed in water of refractive index 4/3 without disturbing the geometrical arrangement the new fringe width will be

i) 0.3mm ii) 0.4mm iii) 0.53mm iv) 540 microns

13. A heavy particle initially at rest splits spontaneously into two particles of masses m_1 and $m_2$having non zero velocities .The ratio of debroglie wavelengths associated with the particle is

i) $\frac{m_1}{m_2}$ ii) m_2/m_1 iii) 1 iv) $\frac{\sqrt{m_2}}{\sqrt{m_1}}$

14. A certain metallic surface is illuminated with monochromatic light of wavelengthλ. The stopping potential for photoelectric current for this light is $3V_0$. If the same surface is illuminated with light of wavelength 2λ the stopping potential is V_0. The threshold wavelength for this surface for photoelectric effect is

i) 4λ, $ii)\frac{\lambda}{4}$ iii) $\frac{\lambda}{6}$ iv) 6λ

15. In a forward biased pn junction there is a characteristic voltage upto which current increases very slowly (almost negligibly). The value of this voltage for germanium diode is

i) 0.6 v ii) 0.2 v iii) 1.12 v iv) 0.72 v

16.Two statements are given –one labelled assertion (A) and the other labelled reason (R).Select the correct answer to these questions from the codes(a), (b), (c) and (d) as given below

a) Both A and R are true and R is the correct explanation of A
b) Both A and R are true and R is not the correct explanation of A
c) A is true but R is false
d) A is false and R is also false

ASSERTION: A charge moving in a circular orbit can produce electromagnetic waves

REASON: The source of electromagnetic waves should be accelerated motion

17. Two statements are given –one labelled assertion(A) and the other labelled reason (R).Select the correct answer to these questions from the codes(a) ,(b) ,(c) and (d) as given below

    a) Both A and R are true and R is the correct explanation of A
    b) Both A and R are true and R is not the correct explanation of A
    c) A is true but R is false
    d) A is false and R is also false

    ASSERTION: In a pn junction in equilibrium there is no net current

    REASON: At equilibrium diffusion current exceeds drift current

18. Two statements are given –one labelled assertion (A) and the other labelled reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below

    a) Both A and R are true and R is the correct explanation of A
    b) Both A and R are true and R is not the correct explanation of A
    c) A is true but R is false
    d) A is false and R is also false

ASSERTION: Energy band structure of a semiconductor is affected by doping and conductivity is greatly improved

REASON: Additional energy states exist due to donor impurities and acceptor impurities and with a small supply of energy conduction electrons can be shifted to, these states

SECTION B

19. A $4\mu f$ capacitor is charged by a 200V 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 state situation?

20. A straight wire of length $\frac{\pi}{2}$ m is bent into a circular shape .If the wire were to carry a current of 5A calculate the magnetic field due to it before bending at a point distant 0.01 times the radius of the circle formed from it. Also calculate the magnetic field at the centre of the circular loop formed for the same value of current

OR

To convert a given galvanometer into a voltmeter of ranges 2V, V and V/2 resistances R_1 ,R_2 and R_3 ohm respectively are required to be connected in series with the galvanometer. Obtain the relationship betweenR_1 ,R_2 and R_3

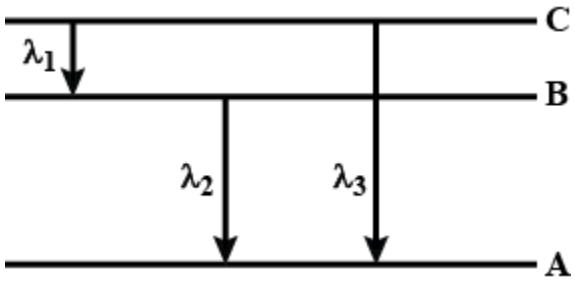
21. A slit of width 0.6mm is illuminated by a beam of light consisting of wavelengths 600nm and 480nm.The diffraction pattern is observed on a screen 1m from the slit. Find

    i) The distance of the second bright fringe from the central maximum pertaining to light of 600nm

    ii) The least distance from the central maximum at which bright fringes due to both wavelengths coincide

22. Lights of wavelengths 430nm, 450nm and 660nm are incident on a metal surface whose threshold wavelength is 600nm.In which case / cases will photoemission take place and why? Calculate the threshold frequency of the metal surface

23. Use the energy level diagram shown below to obtain the relation between three wavelengths λ_1 ,λ_2 and λ_3 emitted due to the transition of electron from the energy states Cand B

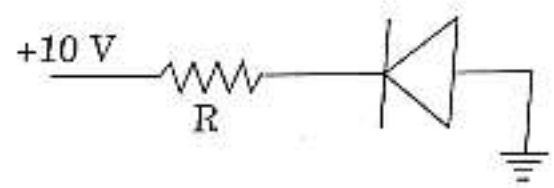


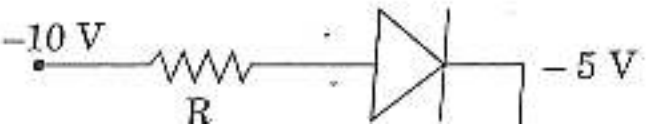
24. a) Mention the two important process involved in pn junction formation

    b) Draw the circuit arrangement for studying the V-I characteristics of a diode in forward bias

    Also draw the V-I characteristics.

25. State whether the given ideal diodes are forward biased or reverse biased

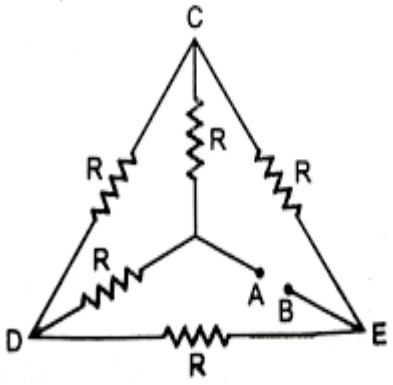
(i) 

(ii) 

SECTIONC

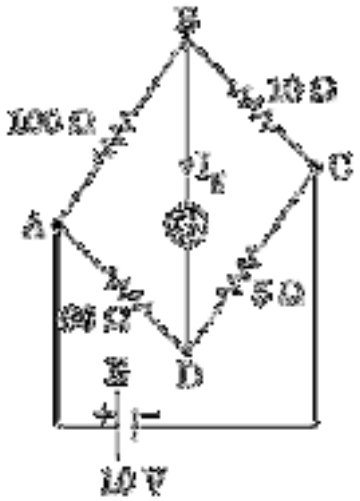
26. i) Calculate the equivalent resistance of the given electrical network between points A and B

ii) Also calculate the current through CD and ACB if a 10v D.C source is connected between A and Band the value of R is assumed as 2 Ω



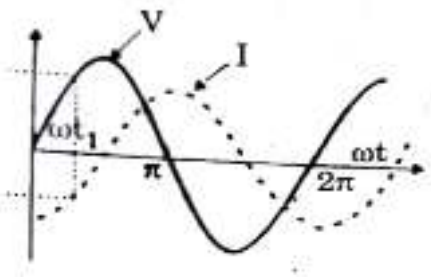
OR

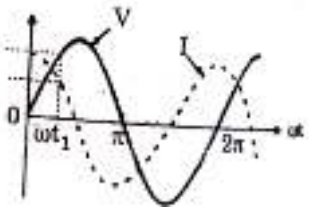
Using kirchoffs rules calculate the current (i_g) that flows through the galvanometer of resistance 15Ω in the circuit diagram shown in figure



27. a) For a series LCR circuit connected to a sinusoidal ac voltage source identify the graph that corresponds to $\omega > \frac{1}{\sqrt{LC}}$

Fig a) fig b)





b) Given below are two electric circuits A and B

Calculate the ratio of power factor of circuit B to the power factor of the circuit A.

28. In single slit diffraction explain why the maxima at $\theta = \left\lfloor n + \frac{1}{2} \right\rfloor \frac{\lambda}{a}$ becomes weaker and weaker as n increases. State two important differences between interference and diffraction pattern.

29 a) Determine from the given data whether the following reaction is exothermic or endothermic

$${}_1^1H + {}_1^3H \rightarrow {}_1^2H + {}_1^2H$$

Atomic masses: $m({}_1^2H)$=2.014102amu ,m$({}_1^3H)$=3.016049amu ,m(${}_1^1H$)=1.007825amu

b) What is the ratio of nuclear density of gold isotope ${}_{79}^{197}Au$ and silver isotope ${}_{47}^{107}Ag$.

30. i) Draw a graph of potential energy of a pair of nucleons as a function of nucleon separation. Indicate the region in which the nuclear force is i) attractive and ii) repulsive

ii) A photosensitive surface is illuminated with a beam of i) yellow light and ii) red light both of same intensity. In which case will I) photoelectrons have more E_k? II) More number of photoelectrons emitted?

Justify your answer in each case

SECTION D

31 a) Derive an expression for the electric field E due to a dipole of length 2a at a point distant r from the centre of the dipole on the axial line .

b) Draw a graph of E versus r for $r \gg a$

c) If this dipole were kept in a uniform external electric field E_O, diagrammatically represent the position of the dipole in stable and unstable equilibrium and write the expressions for the torque acting on the dipole in the two cases

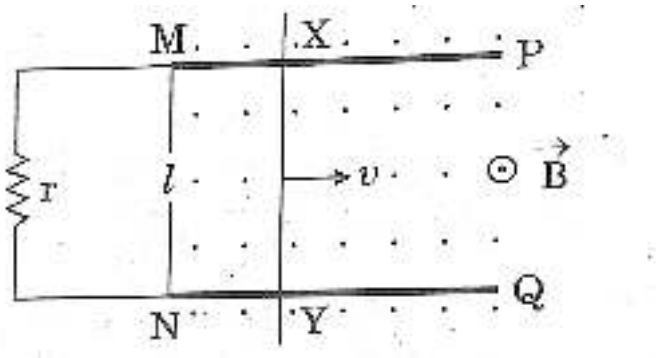
OR

a) Use Gauss s theorem to find the electric field due to a uniformly charged infinitely large plane thin sheet with uniform charge density σ

b) An infinitely large thin plane sheet has a uniform surface charge density $+\sigma$. Obtain the expression for the amount of work done in bringing a point charge q from infinity to a point distant r in front of the charged plane sheet.

32. a) A conducting rod XY of length l slides on two smooth parallel rails PM and QN with a uniform velocity v. The resistances of the rod and the rails are negligible

A uniform magnetic field Perpendicular to the plane PMNQ is present in the region pointing vertically upwards as shown in the figure. A small resistance r is connected between the ends M and N of the rails. Obtain



i) The expression for emf induced across the ends of the rod and its polarity.
ii) The magnitude and direction of induced current that flows through resistance r

b) Two coplanar and concentric circular loops are of radii 0.5cm and 11cm respectively. These loops are placed in a uniform external magnetic field of 0.4 T acting perpendicular to their plane. Calculate the mutual inductance of the arrangement.

OR

i) With the help of a diagram explain the Principle and working of a moving coil galvanometer. Justify the necessity of using

a) Radial magnetic field

b) And phosphor bronze suspension strip in it

ii) Increasing the current sensitivity of a galvanometer may not necessarily increase its voltage sensitivity. Explain giving reason

33. a) Explain with reason how the power of a diverging lens changes when i) it is kept in a medium of refractive index greater than that of the lens ii) incident red light is replaced by violet light

b)consider a convex spherical surface of radius of curvature R., separating two media of refractive indices n_1 and $n_2 > n_1$.A point object is placed at a distance u in front of the surface in medium of refractive index n_1.Its real image is formed at a distance v.obtain a relation between u and v in terms of n_1 , n_2 and R

OR

a) With the help of a ray diagram explain the working of a reflecting telescope .Modern telescopes use mirror objectives than a lens for the objective. Mention two advantages of telescopes with mirror objective

b) A compound microscope consists of an objective lens of focal length 2cm and an eyepiece of focal length 6.25cm separated by a distance 15cm. How far from the objective should an object be placed in order to obtain the final image at the least distance of distinct vision. Calculate the magnifying power of the microscope. Also calculate the length of the microscope tube

SECTION E

34 CASE STUDY

Read the following paragraph and answer the questions

A ray of light travels from a denser medium to a rarer medium .After refraction it bends away from the normal. When we keep increasing the angle of incidence the angle of refraction also increases till the refracted ray grazes along the interface of the two media. The angle of incidence for which it happens is called critical angle .If the angle of incidence is increased further the ray will not emerge and it will be reflected back in to the denser medium. This phenomenon is called total internal reflection of light

i) Calculate the critical angle for a pair of two media A and B of refractive indices 2 and 1 respectively

ii) The critical angle for a pair of medium and air is 30°.Calculate the speed of light in the medium

iii) A point source of light is placed at the bottom of a tank filled with water of refractive index μ to a depth d. Find the area of the surface of water through which light from the source can emerge in terms of depth d and refractive index μ.

OR

A diver at a depth 12m inside water $\mu_w^a = \frac{4}{3}$ sees the sky in a cone.Calculate the semi vertical angle of the cone

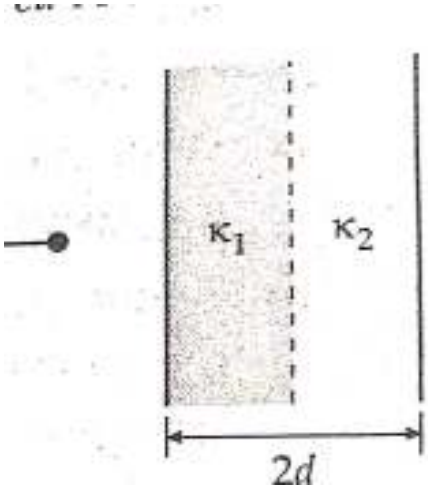
35. CASE STUDY

Capacitor is a system of two conductors separated by an insulator. The conductors will have charges Q and –Q with a potential difference V between them. When a dielectric is inserted between the plates the dielectric is polarized by the field and the effect is equivalent to two charged sheets with surface charge densities σ_p and -σ_p.The electric field in the dielectric then corresponds to the case when the net surface charge density on the plates is $\sigma - \sigma_p$.Thus the dielectric constant of a substance is the factor by which the capacitance increases from its vacuum value when a dielectric slab is inserted fully between the plates of a capacitor.

i) A parallel plate capacitor C is charged to a potential. Without disconnecting the battery the distance between the plated is tripled and a dielectric medium of k=10 is inserted between the plates of the capacitor such that dielectric occupies the whole space between the plates .How will the capacitance of the capacitor be affected?

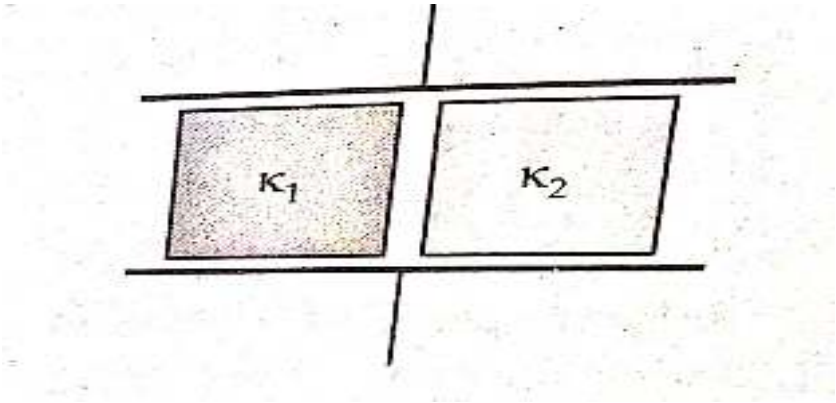
ii) How will the energy density in the above case be affected?

iii) Find the net capacitance of the capacitor shown in fig having each plate of area A, plate separation 2d and filled with dieletctrics of constants k_1 and k_2



OR

Find the net capacitance of the following capacitor combination



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