ROLL NUMBER					

SET	A

INDIAN SCHOOL MUSCAT
HALF YEARLY EXAMINATION 2023
PHYSICS (042)

CLASS : XII
DATE: 18.09.2023

TIME ALLOTED : 3 HRS.
MAXIMUM MARKS: 70

GENERAL INSTRUCTIONS:

(1) There are 33 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.

(3) All the sections are compulsory.

(4) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study based questions of four marks each and Section E contains three long answer questions of five marks each.

(5) There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.

(6) Use of calculators is not allowed.

(7) You may use the following values of physical constants where ever necessary

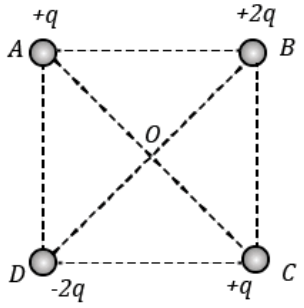
c = 3 x 10^8 m/s ; e = 1.6 x 10^{-19} C ; h= 6.63 x 10^{-34} Js ; $\varepsilon_0 = 8.854\ x\ 10^{-12}\ C^2N^{-1}m^{-2}$

SECTION A

1

1. Four point charges are arranged at the corners of a square ABCD, as shown in the adjoining figure. The force on a positive charge kept at the center O is

1



(a) Zero (b) Along the diagonal AC (c) Along the diagonal BD (d) Perpendicular to the side AB

2. A hollow metallic sphere of radius 10 cm is charged such that the potential on its surface is 80 V. The potential at the centre of the sphere would be 1

(a) 80 V (b) 800 V (c) Zero (d) 8 V

3. A piece of Copper and another of Germanium are heated from 77 K to room temperature .The resistance of 1

(a) each of these decreases (b) copper strip increases and that of germanium decreases

(c) copper strip decreases and that of germanium increases (d) each of these increases

4. 10 resistors, each of resistance R are connected in series to a battery of emf E and negligible internal resistance. Then those are connected in parallel to the same battery, the current is increased n times. The value of n is: 1

(a) 100 (b) 1 (c) 1000 (d) 10

5. Ultraviolet radiations of energy 6.2 eV falls on a metal surface of work function 4.2 eV .The kinetic energy of the electron ejected is approximately 1

(a) 2 J (b) 10.4 J (c) 3.2×10^{-19} J (d) photoelectric emission does not occur

6. An alpha particle of energy ½ mv^2 bombards a heavy nuclear target of charge Ze. Then the distance of closest approach for the alpha nucleus will be proportional to 1

(a) $\frac{1}{Ze}$ (b) v^2 (c) $\frac{1}{m}$ (d) $\frac{1}{v^4}$

7. When a hydrogen atom is raised from the ground state to an excited state 1

(a) both kinetic energy and potential energy increases

(b) both kinetic energy and potential energy decreases

(c) kinetic energy increases and potential energy decreases

(d) kinetic energy decreases and potential energy increases

8. When a p-n junction diode is forward biased, then 1

(a) the depletion layer is reduced and barrier height is increased

(b) the depletion layer is widened and barrier height is reduced

(c) both the depletion layer and barrier heights are reduced

(d) both the depletion layer and barrier height is increased

9. In a full wave rectifier circuit operating from 50 Hz mains frequency ,the fundamental frequency in the ripple would be 1

(a) 25 Hz (b) 50 Hz (c) 100 Hz (d) 0 Hz

10. What happens to light as it passes from air to glass ? 1

(a) its frequency decreases because its speed decreases

(b) its wavelength increases because its speed decreases

(c) its wavelength decreases because its speed decreases

(d) its wavelength increases because its speed increases

11. The curve of binding energy per nucleon as a function of atomic mass number has a sharp peak for Helium nucleus. This implies that Helium 1

(a) can easily be broken up (b) is very stable

(c) can be used as fissionable material (d) is radioactive

12. When the number of nucleons in nuclei increases, the binding energy per nucleon 1

(a) increases continuously with mass number

(b) decreases continuously with mass number

(c) remains constant with mass number

(d) first increases and then decreases with increase of mass number.

For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.

(a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.

(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) If Assertion is true but Reason is false.

(d) If both Assertion and Reason are false.

13. **Assertion (A):**For the radiation of a frequency greater than the threshold frequency, photoelectric current is proportional to the intensity of the radiation. 1

Reason (R) :Greater the number of energy quanta available, greater is the number of electrons absorbing the energy quanta and greater is number of electrons coming out of the metal.

14. **Assertion(A)** :The capacitance of a given conductor remains same even if charge is varied on it. 1

Reason (R): Capacitance does not depend upon the medium as well as the size and shape of conductor.

15. **Assertion(A)** :Light of different colours travel with different speed in vacuum. 1

Reason (R): The refractive index of the medium does not depend on the wavelength of the light.

16. **Assertion (A):** The mass of nucleus in its ground state is always less than the total mass of its constituents neutrons and protons. 1

Reason (R) : Some energy is used up in binding constituent neutrons and protons.

SECTION B

17. (a) Write any two properties of an equipotential surface. 2

(b) Two uniformly large thin parallel plates having charge densities $+\sigma$ and $-\sigma$ are kept in the X- Y plane at a distance d apart.(a) Sketch the equipotential surface due to electric field between the plates.

18. Write any two characteristics features in photoelectric effect which cannot be explained on the basis of wave theory of light ,but can be explained only using Einstein's equation. 2

OR

Explain giving reason for the following

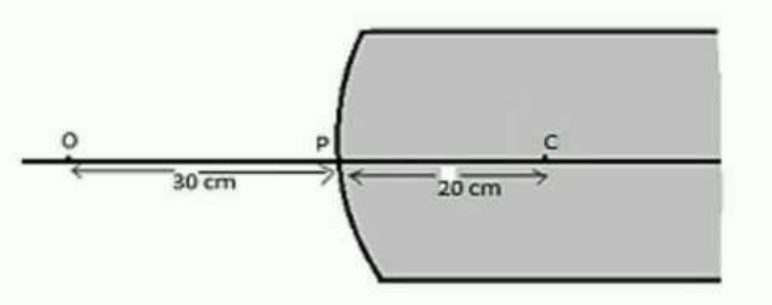
(a) Photoelectric current increases with intensity of incident radiation.

(b) Maximum kinetic energy of photoelectrons is independent of the intensity of radiation.

19. (a) Define the distance of closest approach for alpha particle scattering experiment. 2

(b) An alpha particle of kinetic energy K is bombarded on a thin gold foil. The distance of closest approach is r. What will be the distance of closest approach of alpha particle if we double the kinetic energy?

20. A spherical convex surface of radius of curvature 20 cm, made of glass (n= 1.5) is placed in air. Find the position of the image formed ,if a point object is placed at 30 cm in front of the convex surface on the principal axis. 2



21. Show that the potential energy of a dipole making angle Θ with the direction of the electric field is given by $U_{(\theta)} = -\vec{p}.\vec{E}$. 2

SECTION C

22. A parallel plate capacitor is charged by a battery ,which is then disconnected .A dielectric slab is then inserted in the space between plates. Explain what changes , if any, occur in the values 3

of (i) Capacitance (ii) Electric field (iii) The energy stored in the capacitor. Give reason for your answer.

23. Define the term drift velocity of charge carriers in a conductor. Obtain the expression for the current through the conductor in terms of drift velocity. 3

24. When a photosensitive material is irradiated with the light of frequency ϑ ,the maximum speed of electrons is given by v_{max} . (a) Plot the variation of maximum kinetic energy with respect to frequency of incident radiation. (b) Use Einstein's photoelectric equation to find the expression for Planck's constant and work function of the given photosensitive material. 3

25. (a) Name the phenomenon on which the working of an optical fibre is based. What are the necessary conditions for the phenomenon to occur? 3

(c) Determine the value of the angle of incidence for a ray of light travelling from a medium of refractive index $n_1 = \sqrt{2}$ into the medium of refractive index $n_2 = 1$,so that it just grazes along the surface of separation.

OR

(a) Draw a labelled diagram of reflecting type telescope.

(b) Write any two advantages of reflecting type telescope over refracting type.

26. (a)State two distinguishing features of nuclear force. 3

(b) Draw a plot showing the variation of potential energy of a pair of nucleons as a function of their of separation. Mark the regions on the graph where the force is attractive and repulsive.

27. (a)Using Gauss's law obtain the expression for the electric field due to a uniformly charged thin spherical shell of radius R at a point outside the shell. (b) Draw a graph showing the variation of electric field (E) with respect to distance (r) from the centre of the shell. 3

28. Draw energy band diagram of n -type and p -type semiconductor at temperature T > 0 K. Mark the donor and acceptor energy levels in the diagram. 3

SECTION D
Case Study Based Questions

29. **Read the following paragraph and answer the questions that follow.** 4

Coulomb's law states that the electrostatic force of attraction or repulsion acting between two stationary point charged is given by $F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$ Where F denotes the force between two charges q_1 and q_2 represented by a distance r in free space, ε_0 is a constant known as permittivity of the space. If free space is replaced by a medium, then ε_0 is represented by $(\varepsilon_0 k)$, where k is known as dielectric constant or relative permittivity.

(i) A negatively charged object X is repelled by another charged object Y .However an object Z is attracted to object Y. Which of the following is the most possible for object Z?

(a) positively charged only (b) negatively charged only

(c) neutral or positively charged (d) neutral or negatively charged

(ii) Two balls carrying charges -5μC and +8μC attract each other with a force F. If a charge of -3μC is added to both the balls, then the force between then will become

(a) 2 F (b) F/2 (c) F (d) Zero

(iii) Two charges $2\mu\ C$ and $8\ \mu\ C$ are separated by 6 m.The neutral point between the line joining the charges

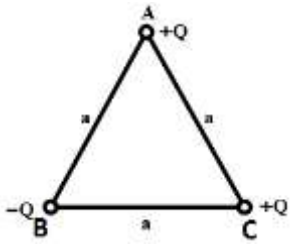
(a) 2 m from $2\mu\ C$ (b) 2 m from $8\mu\ C$ (c) 5 m from $2\mu\ C$ (d) 5 m from $8\mu\ C$

OR

Two point charges 8 q and -2 q are located at x=0 and x = L respectively. The point on X axis at which net electric field is zero due to these charges is

(a) x= L (b) x = 2 L (c) x = L/2 (d) x = 3L

(iv) Three charges are placed at the vertices of an equilateral triangle of side a as shown in figure. The force experienced by the charge placed at the vertex A in a direction normal to BC is



(a) $\frac{Q^2}{4\ \pi\ \varepsilon_0 a^2}$ (b) $\frac{-\ Q^2}{4\ \pi\ \varepsilon_0 a^2}$ (c) Zero (d) $\frac{Q^2}{2\ \pi\ \varepsilon_0 a^2}$

30. **Read the following paragraph and answer the questions that follow.** 4

Hydrogen spectrum consists of discrete bright lines in a dark background and it is specifically known as hydrogen emission spectrum. There is one more type of hydrogen spectrum that exists where we get dark lines on the bright background, It is known as the absorption spectrum. Balmer found an empirical formula by observation of a small part of this spectrum and it is represented by $\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$ where n= 3,4,5,….

(i) Hydrogen is excited from ground state to another state with principal quantum number equal to 4.Then calculate the number of spectral lines in the spectra.

(a) 2 (b) 3 (c) 5 (d) 6

(ii) Which series of hydrogen spectrum corresponds to UV region?

(a) Lyman (b) Balmer (c) Paschen (d) Pfund

(iii) In terms of Rydberg constant R ,the shortest wavelength in Balmer series of hydrogen atom spectrum will have wavelength

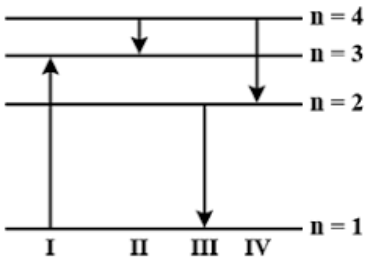
(a) $\frac{1}{R}$ (b) $\frac{4}{R}$ (c) $\frac{3}{2R}$ (d) $\frac{9}{R}$

OR

The ratio of minimum to maximum wavelength in Balmer series is

(a) 1:2 (b) 5:9 (c) 2: 5 (d) 2:1

(iv) The diagram shows the energy levels for an electron in a certain atom. Which transition shown represents the emission of a photon with the most energy?

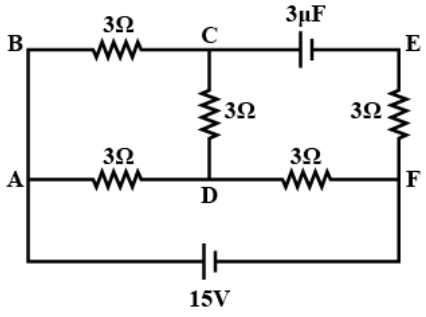


(a) I (b) II (c) III (d) IV

SECTION E

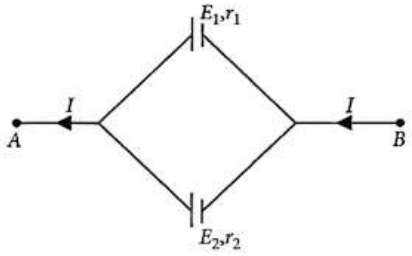
31. (a) Draw a circuit diagram showing balancing of Wheatstone bridge. Using Kirchoff's rules obtain the balance condition in terms of the resistance of four arms of Wheatstone Bridge. 5

(b) In the circuit shown in the figure, find the total resistance of the circuit and the current in the arm AD.



OR

(a) Two cells of emfs E_1 and E_2 and internal resistances r_1 and r_2 respectively are connected in parallel as shown in figure. Deduce the expression for the (i) equivalent emf of the combination (ii) equivalent internal resistance of the combination.



(b) Battery of emf E and internal resistance r gives a current of 0.5 A with an external resistance of 12 ohm and current of 0.25 A with an external resistance of 25 ohm. Find the value of emf of the cell and the internal resistance of the cell.

32. (a) Draw the ray diagram showing refraction of light through a glass prism and hence obtain the relation between refractive index of the prism, angle of the prism and angle of minimum deviation. 5

(b) A ray of light passes through an equilateral prism such that the angle of incidence is equal to angle of emergence and each of these angles is equal to ¾ of angle of prism. What is the value of angle of deviation?

OR

(a) A point object is placed on the principal axis of a convex spherical surface of radius of curvature R, which separates the two media of refractive indices n_1 and n_2 ($n_2 > n_1$) .Draw the ray diagram and deduce the relation between object distance (u) ,image distance (v) and the radius of curvature (R) for refraction to take place at the convex spherical surface from rarer to denser medium.

(b) A double convex lens made of glass of refractive index 1.5 has its both surfaces of equal radii of curvature of 20 cm each. An object of 5 cm height is placed at a distance of 10 cm from the lens. Find the position of the image.

33. (a) State the principle of working of p-n diode as a rectifier.

(b)Explain with the help of a circuit diagram, the use of p-n diode as a full wave rectifier. Also draw the input and output waveforms. 5

OR

(a) Draw the circuit arrangement for studying the V-I characteristics of a p-n junction diode (i) in forward bias and (ii) reverse bias and draw the typical V-I characteristics of a silicon diode.

(b)Give reason for the following for a p-n junction diode:

(i) Why is the current under reverse bias almost independent of applied potential up to critical voltage?

(ii) Why does the reverse current show a sudden increase at the critical voltage.

******END OF THE QUESTION PAPER******

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PHYSICS (042)

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GENERAL INSTRUCTIONS:

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(4) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study based questions of four marks each and Section E contains three long answer questions of five marks each.

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SECTION A

1. A force F acts between two charges +Q and -Q that is placed at a certain distance from each other. The third sphere of charge Q is placed at the midpoint between them. What is the magnitude and force experienced by the third charge? 1

   (a) 2F in the direction of -Q charge (b) 4F in the direction of +Q charge

   (c) 8F in the direction of -Q charge (d) No direction and magnitude is zero

2. The electric potential inside a conducting sphere is 1

   (a) zero (b) increases from centre to the surface

   (c)decreases from centre to the surface (d) remains constant from centre to the surface

3. 10 resistors, each of resistance R are connected in series to a battery of emf E and negligible internal resistance. Then those are connected in parallel to the same battery, the current is increased n times. The value of n is: 1

(a) 100 (b) 1 (c) 1000 (d) 10

4. As the intensity of incident radiation increases 1

(a) photoelectric current increases (b) photoelectric current decreases

(c) kinetic energy of photo electrons increase (d) kinetic energy of photo electrons decrease

5. An electron makes a transition from orbit n= 4 to the orbit n=2 of a hydrogen atom. What is the wavelength of the emitted radiation ?(R is Rydberg's constant) 1

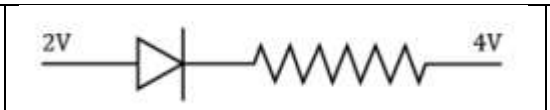
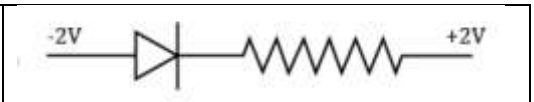
(a) $\frac{16}{4R}$ (b) $\frac{3R}{16}$ (c) $\frac{16}{2\,R}$ (d) $\frac{16}{3\,R}$

6. A piece of Copper and another of Germanium are cooled from room temperature to 77 K.The resistance of 1

(a) each of these decreases (b) copper strip increases and that of germanium decreases

(c) copper strip decreases and that of germanium increases (d) each of these increases

7. The forward biased diode connection is 1

(a)		(b)	
(c)		(d)	

8. The curve of binding energy per nucleon as a function of atomic mass number has a sharp peak for Helium nucleus. This implies that Helium 1

(a) can easily be broken up (b) is very stable

(c) can be used as fissionable material (d) is radioactive

9. When the number of nucleons in nuclei increases, the binding energy per nucleon 1

(a) increases continuously with mass number

(b) decreases continuously with mass number

(c) remains constant with mass number

(d) first increases and then decreases with increase of mass number.

10. A light wave travels from glass to water. The refractive index for glass and water are 3/2 and 4/3 respectively. The value of the critical angle will be 1

(a) $sin^{-1}\left(\frac{1}{2}\right)$ (b) $sin^{-1}\left(\frac{9}{8}\right)$ (c) $sin^{-1}\left(\frac{8}{9}\right)$ (d) $sin^{-1}\left(\frac{5}{7}\right)$

11. A cell of emf 4 V and internal resistance 0.5 ohm is connected to a 7.5 ohm external resistance, The terminal potential difference of the cell is 1

(a) 3.75 V (b) 4.25 V (c) 4 V (d) 0.375 V

12. When a hydrogen atom is raised from the ground state to an excited state 1

(a) both kinetic energy and potential energy increases

(b) both kinetic energy and potential energy decreases

(c) kinetic energy increases and potential energy decreases

(d) kinetic energy decreases and potential energy increases

For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.

(a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.

(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) If Assertion is true but Reason is false.

(d) If both Assertion and Reason are false.

13. **Assertion (A)** : Kinetic energy of photoelectrons emitted by a photosensitive surface depends upon the intensity of incident photon. 1

Reason (R):The ejection of electrons from metallic surface is possible when the frequency of incident photon is below the threshold frequency.

14. **Assertion (A)** : All of the wavelengths in the Balmer series lies in the visible region of electromagnetic spectrum. 1

Reason (R): In Balmer series wavelength of radiation emitted is given by $\frac{1}{\lambda} = R\left(\frac{1}{3^2} - \frac{1}{n^2}\right)$ where n = 4,5,6…

15. **Assertion (A) :** A double convex air bubble inside glass behaves as a concave lens. 1

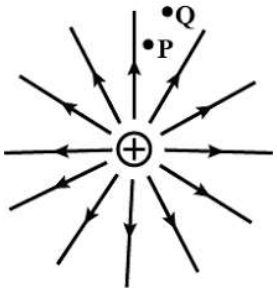
Reason (R): Air lens is surrounded by glass which is a denser medium.

16. **Assertion (A)** : Electrons move away from a region of lower potential to a region of higher potential. 1

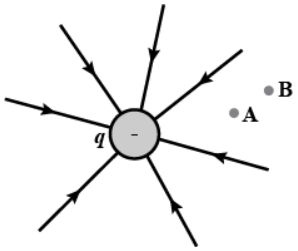
Reason (R): electrons are negatively charged.

SECTION B

17. (a) Figure shows the field lines on a positive charge. Is the work done by the field in moving a small positive charge from Q to P positive or negative? Give reason. 2



(b) The field lines of a negative point charge are as shown in figure. Does the kinetic energy of a small negative charge increase or decrease in going from B to A?



18. (a) Write any two properties of an equipotential surface. 2

(b) Two uniformly large thin parallel plates having charge densities $+\sigma$ and $-\sigma$ are kept in the X- Y plane at a distance d apart. Sketch the equipotential surface due to electric field between the plates.

19. Write any two characteristics features in photoelectric effect which cannot be explained on the basis of wave theory of light ,but can be explained only using Einstein's equation 2

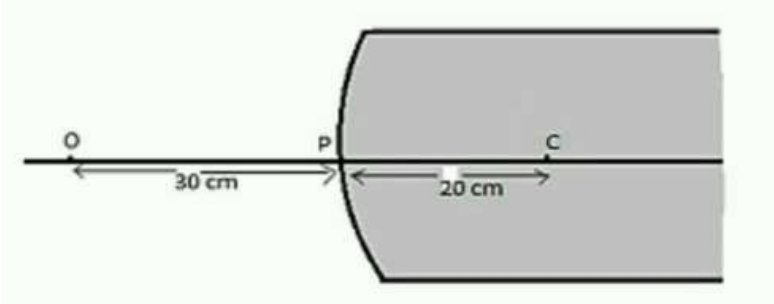
OR

(a) A photosensitive surface emits photoelectrons when red light falls on it .Will the surface emit photoelectrons when blue light falls on it. Give reason.

(b) Define the term stopping potential in relation to photoelectric effect.

20. State Bohr's quantization condition of angular momentum. The ground state energy of hydrogen atom is -13.6 eV .What is the kinetic energy and potential energies of the electron in the ground state? 2

21. A spherical convex surface of radius of curvature 20 cm, made of glass (n= 1.5) is placed in air. Find the position of the image formed ,if a point object is placed at 30 cm in front of the convex surface on the principal axis. 2



SECTION C

22. A parallel plate capacitor is charged by a battery .While the battery is connected ,a dielectric slab is then inserted in the space between plates. Explain what changes , if any, occur in the values of (i) Capacitance (ii) Electric field (iii) The energy stored in the capacitor. Give reason for your answer. 3

23. Define drift velocity and derive an expression for drift velocity of free electrons in a conductor in terms of relaxation time of electrons. 3

24. A photosensitive material is irradiated with the light of frequency ϑ . (a) Plot the variation of stopping potential V_0 with respect to frequency of incident radiation. (b) Use Einstein's photoelectric equation to find the expression for Planck's constant and work function of the given photosensitive material. 3

25. (a) Draw a labelled ray diagram to show the image formation by an astronomical telescope in the normal adjustment position. 3

(b) Write expression for the magnifying power of the astronomical telescope when the final image is formed at the least distance of distinct vision.

OR

(a) Draw a labelled diagram of reflecting type telescope.

(b) Write any two advantages of reflecting type telescope over refracting type.

26. Draw the necessary energy band diagrams to distinguish between conductors ,semiconductors and insulators . 3

27. State Gauss's theorem in electrostatics. Using Gauss's theorem deduce an expression for electric field intensity at a point near a thin infinite plane sheet of charge. 3

28. (a)State two distinguishing features of nuclear force. 3

(b) Draw a plot showing the variation of potential energy of a pair of nucleons as a function of their of separation. Mark the regions on the graph where the force is attractive and repulsive.

SECTION D

Case Study Based Questions

29. **Read the following paragraph and answer the questions that follow.** 4

Coulomb's law states that the electrostatic force of attraction or repulsion acting between two stationary point charged is given by $F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$ Where F denotes the force between two charges q_1 and q_2 represented by a distance r in free space, ε_0 is a constant known as permittivity of the space. If free space is replaced by a medium, then ε_0 is represented by ($\varepsilon_0 k$) , where k is known as dielectric constant or relative permittivity.

(i) A negatively charged object X is repelled by another charged object Y .However an object Z is attracted to object Y. Which of the following is the most possible for object Z?

(a) positively charged only (b) negatively charged only

(c) neutral or positively charged (d) neutral or negatively charged

(ii) Two balls carrying charges -5μC and +8μC attract each other with a force F. If a charge of -3μC is added to both the balls, then the force between then will become

(a) 2 F (b) F/2 (c) F (d) Zero

(iii) Two charges $2\mu\ C$ and 8 $\mu\ C$ are separated by 6 m.The neutral point between the line joining the charges

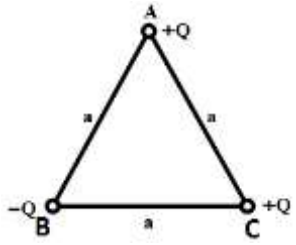
(a) 2 m from $2\mu\ C$ (b) 2 m from $8\mu\ C$ (c) 5 m from $2\mu\ C$ (d) 5 m from $8\mu\ C$

OR

Two point charges 8 q and -2 q are located at x=0 and x = L respectively. The point on X axis at which net electric field is zero due to these charges is

(a) x= L (b) x = 2 L (c) x = L/2 (d) x = 3L

(iv) Three charges are placed at the vertices of an equilateral triangle of side a as shown in figure. The force experienced by the charge placed at the vertex A in a direction normal to BC is



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(iii) In terms of Rydberg constant R ,the shortest wavelength in Balmer series of hydrogen atom spectrum will have wavelength

(a) $\frac{1}{R}$ (b) $\frac{4}{R}$ (c) $\frac{3}{2R}$ (d) $\frac{9}{R}$

OR

The ratio of minimum to maximum wavelength in Balmer series is

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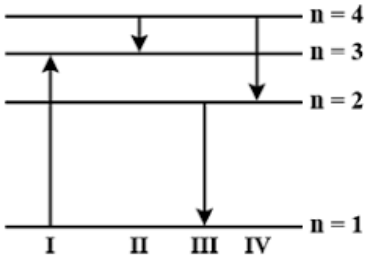

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31. (a) State the principle of working of p-n diode as a rectifier. 5

(b)Explain with the help of a circuit diagram, the use of p-n diode as a full wave rectifier. Also draw the input and output waveforms.

OR

(a) Draw the circuit arrangement for studying the V-I characteristics of a p-n junction diode (i) in forward bias and (ii) reverse bias and draw the typical V-I characteristics of a silicon diode.

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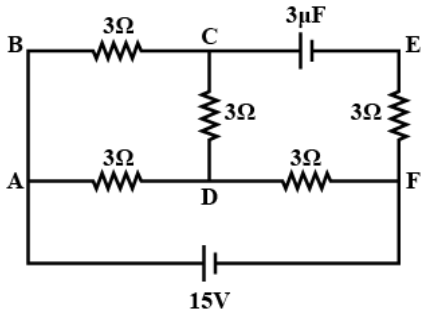

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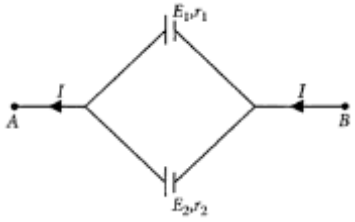
(a) Two cells of emfs E_1 and E_2 and internal resistances r_1 and r_2 respectively are connected in parallel as shown in figure. Deduce the expression for the (i) equivalent emf of the combination (ii) equivalent internal resistance of the combination.



(b) Battery of emf E and internal resistance r gives a current of 0.5 A with an external resistance of 12 ohm and current of 0.25 A with an external resistance of 25 ohm. Find the value of emf of the cell and the internal resistance of the cell.

33. (a) Draw the ray diagram showing refraction of light through a glass prism and hence obtain the relation between refractive index of the prism, angle of the prism and angle of minimum deviation. 5

(b) A ray of light passes through an equilateral prism such that the angle of incidence is equal to angle of emergence and each of these angles is equal to ¾ of angle of prism. What is the value of angle of deviation?

OR

(a) A point object is placed on the principal axis of a convex spherical surface of radius of curvature R, which separates the two media of refractive indices n_1 and n_2 ($n_2 > n_1$) .Draw the ray diagram and deduce the relation between object distance (u) ,image distance (v) and the radius of curvature (R) for refraction to take place at the convex spherical surface from rarer to denser medium.

(b) A double convex lens made of glass of refractive index 1.5 has its both surfaces of equal radii of curvature of 20 cm each. An object of 5 cm height is placed at a distance of 10 cm from the lens. Find the position of the image.

******END OF THE QUESTION PAPER******

ROLL NUMBER					

SET	C

INDIAN SCHOOL MUSCAT
HALF YEARLY EXAMINATION 2023
PHYSICS (042)

CLASS : XII
DATE: 18.9.2023

TIME ALLOTED : 3 HRS.
MAXIMUM MARKS: 70

GENERAL INSTRUCTIONS:

(1) There are 33 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.

(3) All the sections are compulsory.

(4) Section A contains sixteen questions, twelve MCQ and four Assertion Reasoning based of 1 mark each, Section B contains five questions of two marks each, Section C contains seven questions of three marks each, Section D contains two case study based questions of four marks each and Section E contains three long answer questions of five marks each.

(5) There is no overall choice. However, an internal choice has been provided in one question in Section B, one question in Section C, one question in each CBQ in Section D and all three questions in Section E. You have to attempt only one of the choices in such questions.

(6) Use of calculators is not allowed.

(7) You may use the following values of physical constants where ever necessary

c = 3 x 10^8 m/s ; e = 1.6 x 10^{-19} C ; h= 6.63 x 10^{-34} Js ; $\varepsilon_0 = 8.854\ x\ 10^{-12}\ C^2N^{-1}m^{-2}$

SECTION A

1. A piece of Germanium and another of Copper are cooled from room temperature to 77 K .The resistance of 1

   (a) each of these decreases (b) copper strip increases and that of germanium decreases

   (c) copper strip decreases and that of germanium increases (d) each of these increases

2. A force F acts between two charges +Q and -Q that is placed at a certain distance from each other. The third sphere of charge Q is placed at the midpoint between them. What is the magnitude and force experienced by the third charge? 1

   (a) 2F in the direction of -Q charge (b) 4F in the direction of +Q charge

   (c) 8F in the direction of -Q charge (d) No direction and magnitude is zero

3. A hollow metallic sphere of radius 10 cm is charged such that the potential of its surface is 1

80 V. The potential at the centre of the sphere would be

(a) 80 V (b) 800 V (c) Zero (d) 8 V

4. An alpha particle of energy ½ mv^2 bombards a heavy nuclear target of charge Ze. Then the distance of closest approach for the alpha nucleus will be proportional to 1

(a) $\frac{1}{Ze}$ (b) v^2 (c) $\frac{1}{m}$ (d) $\frac{1}{v^4}$

5. In a half wave rectifier circuit operating from 50 Hz mains frequency ,the fundamental frequency in the ripple would be 1

(a) 25 Hz (b) 50 Hz (c) 100 Hz (d) 0 Hz

6. A light wave travels from glass to water. The refractive index for glass and water are 3/2 and 4/3 respectively. The value of the critical angle will be 1

(a) $sin^{-1}(\frac{1}{2})$ (b) $sin^{-1}(\frac{9}{8})$ (c) $sin^{-1}(\frac{8}{9})$ (d) $sin^{-1}(\frac{5}{7})$

7. When a metallic surface is illuminated with radiation of wavelength λ, the stopping potential is V. If the same surface is illuminated with radiation of wavelength 2 λ, the stopping potential is V/4 .The threshold wavelength for metallic surface is 1b

(a) 5 (b) 3λ (c) 5/2 λ (d) 4 λ

8. When a hydrogen is raised from the ground state to an excited state 1

(a) both kinetic energy and potential energy increase

(b) both kinetic energy and potential energy decrease

(c) kinetic energy increases and potential energy decreases

(d) kinetic energy decreases and potential energy increases

9. The curve of binding energy per nucleon as a function of atomic mass number has a sharp peak for Helium nucleus. This implies that Helium 1

(a) can easily be broken up (b) is very stable

(c) can be used as fissionable material (d) is radioactive

10. When the number of nucleons in nuclei increases, the binding energy per nucleon 1

(a) increases continuously with mass number

(b) decreases continuously with mass number

(c) remains constant with mass number

(d) first increases and then decreases with increase of mass number.

11. 10 resistors, each of resistance R are connected in series to a battery of emf E and negligible internal resistance. Then those are connected in parallel to the same battery, the current is increased n times. The value of n is: 1

(a) 100 (b) 1 (c) 1000 (d) 10

12. In the depletion region of an unbiased p-n junction diode there are 1

(a) only electrons (b) only holes (c) both electrons and holes (d) only fixed ions

For Questions 13 to 16, two statements are given –one labelled Assertion (A) and other labelled Reason (R). Select the correct answer to these questions from the options as given below.

(a) If both Assertion and Reason are true and Reason is correct explanation of Assertion.

(b) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(c) If Assertion is true but Reason is false.

(d) If both Assertion and Reason are false.

13. **Assertion (A) :** A double convex air bubble inside glass behaves as a concave lens. 1

Reason (R): Air lens is surrounded by glass which is a denser medium.

14. **Assertion (A):** The mass of nucleus in its ground state is always less than the total mass of its constituents neutrons and protons. 1

Reason (R) : Some energy is used up in binding constituent neutrons and protons.

15. **Assertion (A):**For the radiation of a frequency greater than the threshold frequency, photoelectric current is proportional to the intensity of the radiation. 1

Reason (R) :Greater the number of energy quanta available, greater is the number of electrons absorbing the energy quanta and greater is number of electrons coming out of the metal.

16. **Assertion(A)** :The capacitance of a given conductor remains same even if charge is varied on it. 1

Reason (R): Capacitance does not depend upon the medium as well as the size and shape of conductor.

SECTION B

17. Write any two characteristics features in photoelectric effect which cannot be explained on the basis of wave theory of light ,but can be explained only using Einstein's equation 2

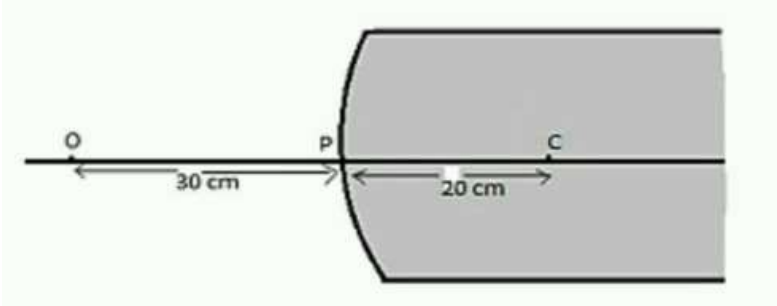
OR

(a) A photosensitive surface emits photoelectrons when red light falls on it .Will the surface emit photoelectrons when blue light falls on it. Give reason.

(b) Define the term stopping potential in relation to photoelectric effect.

18. Show that the potential energy of a dipole making angle Θ with the direction of the electric field is given by $U_{(\theta)} = -\vec{p}.\vec{E}$. 2

19. A spherical convex surface of radius of curvature 20 cm, made of glass (n= 1.5) is placed in air. Find the position of the image formed ,if a point object is placed at 30 cm in front of the convex surface on the principal axis. 2



20. (a) Write any two properties of an equipotential surface. 2

(b) Two uniformly large thin parallel plates having charge densities $+\sigma$ and $-\sigma$ are kept in the X- Y plane at a distance d apart.(a) Sketch the equipotential surface due to electric field between the plates.

21. State Bohr's quantization condition of angular momentum. The ground state energy of hydrogen atom is -13.6 eV .What is the kinetic energy and potential energies of the electron in the ground state? 2

SECTION C

22. When a photosensitive material is irradiated with the light of frequency ϑ ,the maximum speed of electrons is given by V_{max} . (a) Plot the variation of maximum kinetic energy with respect to frequency of incident radiation. (b) Use Einstein's photoelectric equation to find the expression for Planck's constant and work function of the given photosensitive material. 3

23. (a) Draw a labelled ray diagram to show the image formation by an astronomical telescope in the normal adjustment position. 3

(b) Write expression for the magnifying power of the telescope when the final image is formed at the least distance of distinct vision.

OR

(a) Draw a labelled diagram of reflecting type telescope.

(b) Write any two advantages of reflecting type telescope over refracting type.

24. (a)State two distinguishing features of nuclear force. 3

(b) Draw a plot showing the variation of potential energy of a pair of nucleons as a function of their of separation. Mark the regions on the graph where the force is attractive and repulsive.

25. Draw energy band diagram of n -type and p -type semiconductor at temperature T > 0 K. Mark the donor and acceptor energy levels in the diagram. 3

26. Define the term drift velocity of charge carriers in a conductor. Obtain the expression for the current through the conductor in terms of drift velocity. 3

27. A parallel plate capacitor is charged by a battery .While the battery is connected ,a dielectric slab is then inserted in the space between plates. Explain what changes , if any occur in the values of (i) Capacitance (ii) electric field (iii) The energy stored in the capacitor. 3

28. (a)Using Gauss's law obtain the expression for the electric field due to a uniformly charged thin spherical shell of radius R at a point outside the shell. (b) Draw a graph showing the variation of electric field (E) with respect to distance (r) from the centre of the shell. 3

SECTION D

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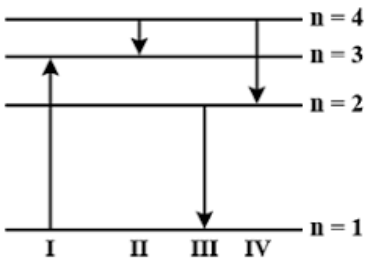

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Coulomb's law states that the electrostatic force of attraction or repulsion acting between two stationary point charged is given by $F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$ Where F denotes the force between two charges q_1 and q_2 represented by a distance r in free space, ε_0 is a constant known as permittivity of the space. If free space is replaced by a medium, then ε_0 is represented by (ε_0k) , where k is known as dielectric constant or relative permittivity.

(i) A negatively charged object X is repelled by another charged object Y .However an object Z is attracted to object Y. Which of the following is the most possible for object Z?

(a) positively charged only (b) negatively charged only

(c) neutral or positively charged (d) neutral or negatively charged

(ii) Two balls carrying charges -5μC and +8μC attract each other with a force F. If a charge of -3μC is added to both the balls, then the force between then will become

(a) 2 F (b) F/2 (c) F (d) Zero

(iii) Two charges $2\mu\ C$ and 8 $\mu\ C$ are separated by 6 m.The neutral point between the line joining the charges

(a) 2 m from $2\mu\ C$ (b) 2 m from $8\mu\ C$ (c) 5 m from $2\mu\ C$ (d) 5 m from $8\mu\ C$

OR

Two point charges 8 q and -2 q are located at x=0 and x = L respectively. The point on X axis at which net electric field is zero due to these charges is

(a) x= L (b) x = 2 L (c) x = L/2 (d) x = 3L

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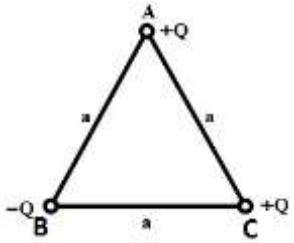

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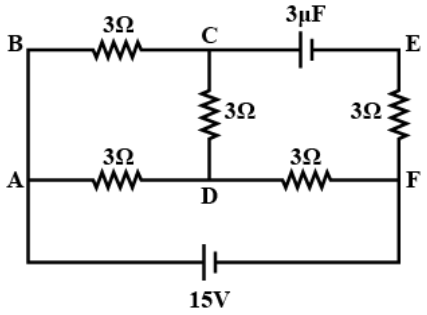

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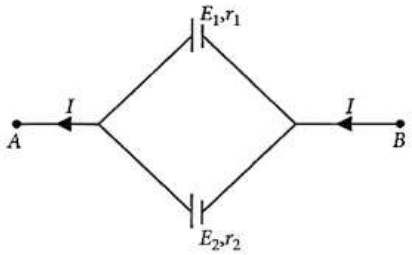

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