

BRAIN INTERNATIONAL SCHOOL
SESSION 25-26

PRACTICE PAPER -1
CLASS -XIITH
SUBJECT: PHYSICS (042)

Max. Marks: 70

Time allotted: 3 hrs.

General instructions:

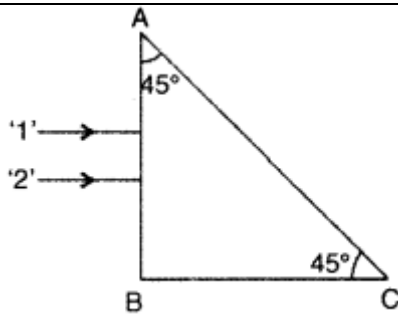
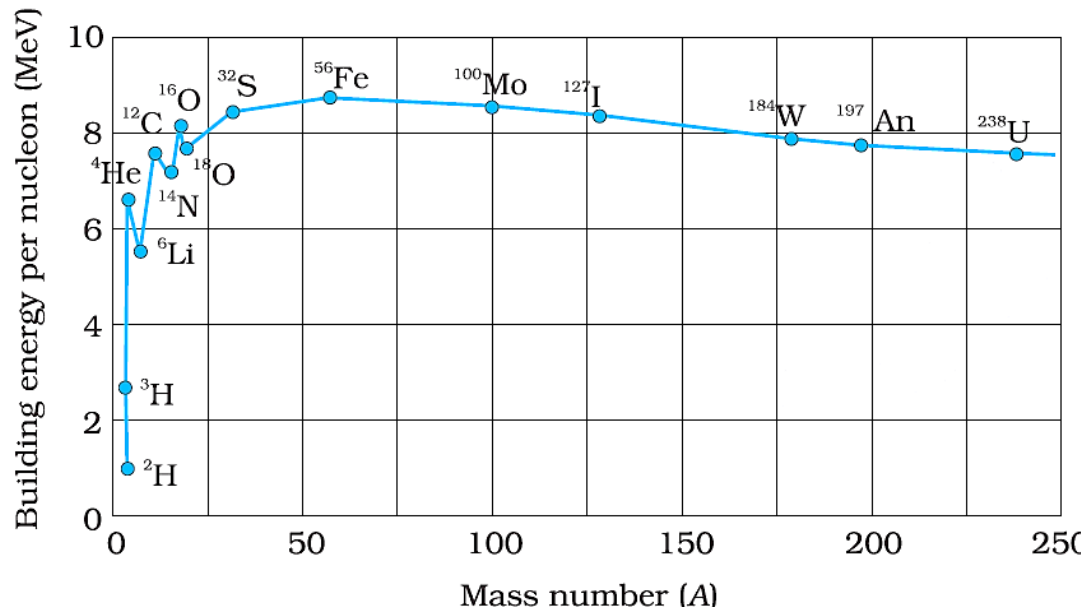
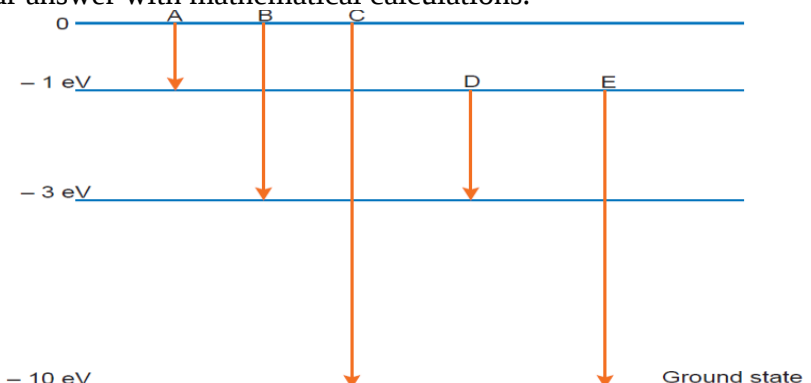
1. There are 33 questions in all. All questions are compulsory.
2. This question paper has five sections: **Section A, Section B, Section C, Section D and Section E**. All sections are compulsory.
3. **Section A contains 16 questions** (twelve MCQ and four Assertion-Reasoning) of **one mark each**, **Section 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**.
4. There is no overall choice. However, an internal choice has been provided for one question in Section B, one in Section C, one in each CBQ in Section D, and all three questions in Section E. You must attempt only one of the choices in such questions.
5. Use of calculators is not allowed.
6. You may use the following values of physical constants wherever necessary

- (a) $c = 3 \times 10^8$ m/s
 (b) $m_e = 9.1 \times 10^{-31}$ kg
 (c) $m_p = 1.7 \times 10^{-27}$ kg
 (d) $e = 1.6 \times 10^{-19}$ C
 (e) $\mu_0 = 4\pi \times 10^{-7}$ T mA⁻¹
 (f) $h = 6.63 \times 10^{-34}$ J s
 (g) $\epsilon_0 = 8.854 \times 10^{-12}$ C²N⁻¹m⁻²

S.No.	Question	Marks								
Section-A										
1	Two-point charges placed in a medium of dielectric constant 3 are at a distance 'r' between them and experience an electrostatic force 'F'. The electrostatic force between them in a vacuum at the same distance 'r' will be <table><tr><td>(a)</td><td>3F</td><td>(b)</td><td>F</td></tr><tr><td>(c)</td><td>F/2</td><td>(d)</td><td>F/3</td></tr></table>	(a)	3F	(b)	F	(c)	F/2	(d)	F/3	1
(a)	3F	(b)	F							
(c)	F/2	(d)	F/3							
2	The universal property among all substances is <table><tr><td>(a)</td><td>Diamagnetism</td><td>(b)</td><td>Paramagnetism</td></tr><tr><td>(c)</td><td>Ferromagnetism</td><td>(d)</td><td>Both (a) and (b)</td></tr></table>	(a)	Diamagnetism	(b)	Paramagnetism	(c)	Ferromagnetism	(d)	Both (a) and (b)	1
(a)	Diamagnetism	(b)	Paramagnetism							
(c)	Ferromagnetism	(d)	Both (a) and (b)							
3	The direction of magnetic field lines close to a straight conductor carrying current will be <table><tr><td>(a)</td><td>Along the length of the conductor</td><td>(b)</td><td>Radially outward</td></tr><tr><td>(c)</td><td>Circular in a plane perpendicular to the conductor</td><td>(d)</td><td>Helical</td></tr></table>	(a)	Along the length of the conductor	(b)	Radially outward	(c)	Circular in a plane perpendicular to the conductor	(d)	Helical	1
(a)	Along the length of the conductor	(b)	Radially outward							
(c)	Circular in a plane perpendicular to the conductor	(d)	Helical							
4	The induced charge in electromagnetic induction is independent of <table><tr><td>(a)</td><td>Flux change</td><td>(b)</td><td>Time</td></tr><tr><td>(c)</td><td>Coil resistance</td><td>(d)</td><td>Magnetic Field Strength</td></tr></table>	(a)	Flux change	(b)	Time	(c)	Coil resistance	(d)	Magnetic Field Strength	1
(a)	Flux change	(b)	Time							
(c)	Coil resistance	(d)	Magnetic Field Strength							

5	In a p-type semiconductor, the current conduction is due to				1
	(a)	Holes	(b)	Atoms	
	(c)	Electrons	(d)	Protons	
6	In a compound microscope, the images formed by the objective and the eyepiece are respectively				1
	(a)	Virtual, real	(b)	Real, virtual	
	(c)	Virtual, virtual	(d)	Real, Real	
7	A 20V AC is applied to a circuit consisting of a resistance and a coil with negligible resistance. If the voltage across the resistance is 12V, the voltage across the coil is				1
	(a)	16V	(b)	10V	
	(c)	8V	(d)	6V	
8	In an insulator, the forbidden energy gap between a valence band and a conduction band is of the order of				1
	(a)	Equal to 3 eV	(b)	Less than 3 eV	
	(c)	Greater than 3 eV	(d)	Both (a) and (b)	
9	Two sources of monochromatic light are said to be coherent if light waves produced by them have the same				1
	(a)	Frequency and constant phase differences	(b)	Frequency only	
	(c)	Amplitude only	(d)	Amplitude and same wavelength	
10	Electromagnetic waves transport				1
	(a)	Charge and momentum	(b)	Frequency and wavelength	
	(c)	Energy and momentum	(d)	Wavelength and energy	
11	If r_1 and r_2 are the radii of the atomic nuclei of mass numbers 4 and 32, respectively, then the ratio (r_1/r_2) is				1
	(a)	1:2	(b)	1:3	
	(c)	1:4	(d)	1:5	
12	If the ground state ionisation energy of the H-atom is 13.6 eV, the energy required to ionise a H-atom from the second excited state is				1
	(a)	1.51 eV	(b)	3.4 eV	
	(c)	13.6 eV	(d)	12.1 eV	
<u>Assertion and Reason Type Questions</u> Directions: In each of the following questions, a statement of assertion (A) is followed by a statement of reason (R). While answering questions, choose the correct one and mark it as (a) If both assertion (A) and reason (R) are true and reason (R) is the correct explanation of the assertion (A). (b) If both assertion (A) and reason (R) are true, but reason (R) is not the correct explanation of the assertion (A). (c) If assertion (A) is true and reason (R) is false. (d) If both assertion (A) and reason (R) are false					
13	Assertion: The electrostatic force between the plates of a charged isolated capacitor decreases when dielectric fills whole space between plates. Reason: The electric field between the plates of a charged isolated capacitance increases when dielectric fills whole space between plates.				1
14	Assertion: In Lyman series, the ratio of minimum and maximum wavelength is $\frac{3}{4}$. Reason: Lyman series constitute spectral lines corresponding to transition from higher energy to ground state of hydrogen atom.				1
15	Assertion: If the circuit is continuous, a large magnetic flux through a coil maintains a current in the coil.				1

	Reason: Only a change in magnetic flux will maintain an induced current in the coil.	
16	Assertion: The kinetic energy of photoelectrons emitted by a photosensitive surface depends upon the intensity of the incident photon. Reason: The ejection of electrons from the metallic surfaces is possible with the frequency of incident photons below the threshold frequency.	1
Section-B		
17	The relative magnetic permeabilities of the two magnetic materials, A and B, are 0.96 and 500, respectively. Which magnetic materials, A and B, are they?	2
18	Derive an expression for the drift velocity of free electrons in a conductor in terms of relaxation time.	2
19	The self-inductance of a solenoid of 600 turns is 108 mH. Find the self-inductance of a coil with 500 turns with the same length, radius, and medium. OR Calculate the current drawn by the primary of a transformer, which steps down 200V to 20V to operate a device of resistance 20 ohm. Assume the efficiency of the transformer to be 80%.	2
20	The graph in Figure shows the variation of stopping potential with frequency ν of the incident radiation for two photosensitive metals, X and Y. Which of the metals has a large threshold wavelength? Give reason.	2
21	How is forward biasing different from reverse biasing in a p-n junction diode? Justify your answer.	2
Section-C		
22	Two point electric charges of value q and $2q$ are kept at a distance d apart from each other in air. A third charge Q is to be kept along the same line in such a way that the net force acting on q and $2q$ is zero. Calculate the position of charge Q in terms of q and d .	3
23	A long straight wire in the horizontal plane carries a current of 50 A in north to south direction. Give the magnitude and direction of magnetic field at a point 2.5 m east of the wire. OR Using Ampere's circuital law, obtain an expression for the magnetic field along the axis of a solenoid of length l and having N number of turns and carrying current I .	3
24	Two monochromatic light rays are incident normally on the face AB of an isosceles right-angled prism ABC. The refractive indices of the glass prism for the two rays '1' and '2' are respectively 1.35 and 1.45. Trace the path of these rays entering through the prism.	3

		
25	In Young's double-slit experiment, the slits are 0.5 mm apart, and interference is observed on a screen placed at a distance of 100 cm from the slits. It is found that the 9th bright fringe is at a distance of 8.835 mm from the second dark fringe from the centre of the fringe pattern. Find the wavelength of light used.	3
26	A graph below shows the variation of binding energy per nucleon with mass number . In the graph, mark regions where nuclei are: (a) Prone to fusion. (b) Prone to fission. (c) Give a reason for your marking. 	3
27	The energy levels of an atom of element X are shown in the diagram. Which one of the level transitions will result in the emission of photons of wavelength 620 nm? Support your answer with mathematical calculations. 	3

28	With the help of a circuit diagram, explain how a p-n junction diode works as a full wave rectifier. Draw its input and output waveform.	3																																								
Section-D																																										
29	An arrangement of two conductors separated by an insulating medium can be used to store electric charge and electric energy. Such a system is called a capacitor. The more charge a capacitor can store, the greater is its capacitance. Usually, a capacitor consists of two capacitors having equal and opposite charge + Q and –Q. Hence, there is a potential difference V between them. By the capacitance of a capacitor, we mean the ratio of the charge Q to the potential difference V. By the charge on a capacitor we mean only the charge Q on the positive plate. Total charge of the capacitor is Zero. The capacitance of a capacitor is a constant and depends on geometric factors, such as the shapes, sizes and relative positions of the two conductors, and the nature of the medium between them. The unit of capacitance is Farad (F). But μF and pF are the more convenient units commonly used. Capacitor consists of two long strips or metal foils, separated by two long strips of dielectrics, rolled up into a small cylinder. Common dielectric materials are plastics (such as polyester and polycarbonates) and aluminium oxide. Capacitors are widely used in television, computer, and other electric circuits. (i) A parallel plate capacitor C has charge Q. The actual charge on its plates are: <table> <tr> <td>(a)</td> <td>+Q, +Q</td> <td>(b)</td> <td>+Q/2, +Q/2</td> </tr> <tr> <td>(c)</td> <td>+Q, -Q</td> <td>(d)</td> <td>+Q/2, -Q/2</td> </tr> </table> (ii) A parallel plate capacitor is charged. If the plate are pulled apart, <table> <tr> <td>(a)</td> <td>The capacitance increases</td> <td>(b)</td> <td>The potential difference increases</td> </tr> <tr> <td>(c)</td> <td>The total charge increase</td> <td>(d)</td> <td>The charge and the potential difference remains the same</td> </tr> </table> (iii) What is the value of capacitance of a capacitor if it has a charge of 9C and voltage of 5V? <table> <tr> <td>(a)</td> <td>1.8F</td> <td>(b)</td> <td>45F</td> </tr> <tr> <td>(c)</td> <td>8.1F</td> <td>(d)</td> <td>4.5F</td> </tr> </table> (iv). How to increase the capacity of the parallel plate capacitor? <table> <tr> <td>(a)</td> <td>Decrease the area of the plate</td> <td>(b)</td> <td>Increase the area of the plate</td> </tr> <tr> <td>(c)</td> <td>Increase the distance between the plate</td> <td>(d)</td> <td>Both (a) and (b)</td> </tr> </table> OR (v). Energy is stored in a capacitor in the form of <table> <tr> <td>(a)</td> <td>Magnetic energy</td> <td>(b)</td> <td>Light energy</td> </tr> <tr> <td>(c)</td> <td>Heat energy</td> <td>(d)</td> <td>Electrostatic energy</td> </tr> </table>	(a)	+Q, +Q	(b)	+Q/2, +Q/2	(c)	+Q, -Q	(d)	+Q/2, -Q/2	(a)	The capacitance increases	(b)	The potential difference increases	(c)	The total charge increase	(d)	The charge and the potential difference remains the same	(a)	1.8F	(b)	45F	(c)	8.1F	(d)	4.5F	(a)	Decrease the area of the plate	(b)	Increase the area of the plate	(c)	Increase the distance between the plate	(d)	Both (a) and (b)	(a)	Magnetic energy	(b)	Light energy	(c)	Heat energy	(d)	Electrostatic energy	4
(a)	+Q, +Q	(b)	+Q/2, +Q/2																																							
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(c)	Heat energy	(d)	Electrostatic energy																																							
30	Kartikay and Rahul were both creating a series of circular waves by jiggling their legs in water. The waves formed a pattern similar to the diagram, as shown. Their friend, Shubham, advised Kartikay and Rahul not to play with water for a long time. He then observed beautiful patterns of ripples that became very colourful when his friend Lakshay poured an oil drop on them. Lakshay, a 12th-standard student, had explained the cause of colourful ripple patterns to Kartikay.	4																																								



(i) Name the phenomenon involved in the activity

(a)	Reflection	(b)	Refraction
(c)	Interference	(d)	Polarisation

(ii) A surface over which an optical wave has a constant phase is called.

(a)	Wave	(b)	Wavefront
(c)	Elasticity	(d)	None of these

(iii) Which of the following is correct for light diverging from a point source?

(a)	The intensity decreases in proportion to the distance squared	(b)	The wavefront is parabolic.
(c)	The intensity at the wavelength does depend on the distance.	(d)	The intensity increases in proportion to the distance squared

(iv) The phenomena which is not explained by Huygens's construction of

(a)	Wavefront	(b)	Diffraction
(c)	Refraction	(d)	Origin of spectra

OR

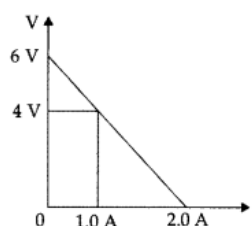
(v) Huygens's concept of secondary wave

(a)	allows us to find the focal length of a thick lens	(b)	is a geometrical method to find a wavefront
(c)	is used to determine the velocity of light	(d)	is used to explain polarisation

Section-E

31

(a) The graph shows a plot of terminal voltage 'V' versus the current 'i' of a given cell.



Calculate from the graph

- (I) emf of the cell and. (ii) internal resistance of the cell.
(b) Write any two factors on which internal resistance of a cell depends.

OR

- (a) Using Gauss's law, derive an expression for the electric field at any point outside a uniformly charged thin spherical shell of radius 'R' and charge density σ C/m².

5

	(b) Draw the field lines when the charge density of the spherical shell is (i) positive, (ii) negative (c) A uniformly charged conducting spherical shell of 2.5 m in diameter has a surface charge density of $100 \mu\text{C}/\text{m}^2$. Calculate the total electric flux passing through the spherical shell.																
32	(a) With the help of a diagram, explain the principle and working of a moving coil galvanometer. (b) What is the importance of a radial magnetic field, and how is it produced? OR A device 'X' is connected to an AC source. $V = V_0 \sin \omega t$. The variation of voltage, current and power in one cycle is shown in the following graph: (a) Identify the device 'X'. (b) Which of the curves, A, B, and C, represent the voltage, current, and power consumed by the circuit? Justify your answer. (c) How does its impedance vary with the frequency of the AC source? (d) Obtain an expression for the current in the circuit and its phase relation with AC voltage.	5															
33	(i) Calculate the radius of curvature of an equi-concave lens of refractive index 1.5 when kept in a medium of refractive index 1.4 to have a power of -5D. (ii) Draw a labelled ray diagram to show the formation of an image at the least distance of vision in an astronomical telescope. (iii) Using the data given below, state which of the given lenses you prefer to use as an eyepiece and the objective to design a compound microscope. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Lens</th><th>Power</th><th>Aperture</th></tr> </thead> <tbody> <tr> <td>A</td><td>20D</td><td>0.02m</td></tr> <tr> <td>B</td><td>10D</td><td>0.02m</td></tr> <tr> <td>C</td><td>10D</td><td>0.05m</td></tr> <tr> <td>D</td><td>1.0D</td><td>0.1m</td></tr> </tbody> </table> OR (i) When a tiny circular obstacle is placed in the path of light from a distant source, a bright spot is seen at the centre of the obstacle. Explain why? (ii) If a diffraction pattern is observed using a beam of red light, then replacing the red light with blue light will cause the diffraction bands to become broader. Explain why? (iii) How will you differentiate interference and diffraction through observation?	Lens	Power	Aperture	A	20D	0.02m	B	10D	0.02m	C	10D	0.05m	D	1.0D	0.1m	5
Lens	Power	Aperture															
A	20D	0.02m															
B	10D	0.02m															
C	10D	0.05m															
D	1.0D	0.1m															

BRAIN INTERNATIONAL SCHOOL
SESSION 25-26

PRACTICE PAPER-2
CLASS – XIIITH
SUBJECT: PHYSICS (042)

CLASS: XII

SUBJECT: PHYSICS

M.M.-70

TIME:3 HOURS

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 MCQs 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 for one question in Section B, one in Section C, one 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 wherever necessary

- (a) $c = 3 \times 10^8 \text{ m/s}$
- (b) $m_e = 9.1 \times 10^{-31} \text{ kg}$
- (c) $m_p = 1.7 \times 10^{-27} \text{ kg}$
- (d) $e = 1.6 \times 10^{-19} \text{ C}$
- (e) $\mu_0 = 4\pi \times 10^{-7} \text{ T mA}^{-1}$
- (f) $h = 6.63 \times 10^{-34} \text{ J s}$
- (g) $\epsilon_0 = 8.854 \times 10^{-12} \text{ C}^2\text{N}^{-1}\text{m}^{-2}$

Section -A

1. A charge 'q' is placed at the centre of a room having cubical shape. Find the electric flux through each wall of the room

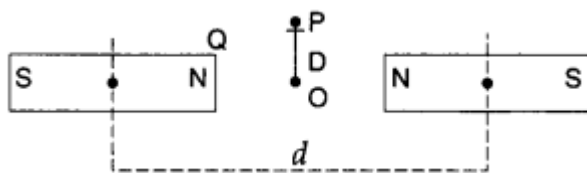
(a) $\frac{q}{6\epsilon_0}$ (b) $\frac{q}{4\epsilon_0}$ (c) $\frac{q}{2\epsilon_0}$ (d) $\frac{q}{\epsilon_0}$

2. In a moving coil galvanometer, the deflection (Φ) on the scale by a pointer attached to the spring is:

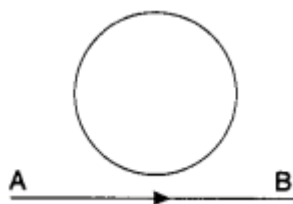
(a) $\left(\frac{NAB}{kB}\right)I$ (b) $\left(\frac{N}{kAB}\right)I$ (c) $\left(\frac{NAB}{k}\right)I$ (d) $\left(\frac{NAB}{kI}\right)$

3. Two identical bar magnets are fixed with their centres at a distance d apart. A stationary charge Q is placed at P in between the gap of the two magnets at a distance D from the centre O as shown in the

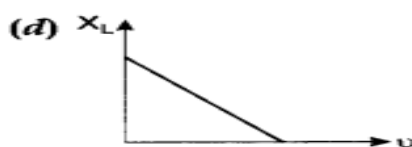
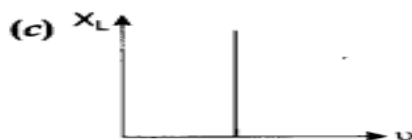
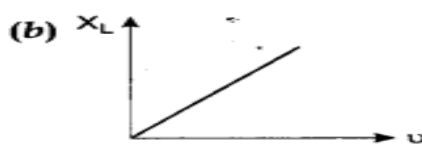
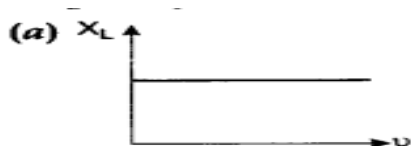
figure. The force on the charge Q is



- (a) zero
 - (b) directed along OP
 - (c) directed along PO
 - (d) directed perpendicular to the plane of the paper
4. In the given figure, the current from A to B in the straight wire is decreasing. The direction of the induced current in the loop is A



- (a) clockwise
 - (b) anticlockwise
 - (c) changing
 - (d) nothing can be said
5. Which of the following graphs represents the correct variation of inductive reactance X_L with frequency ν ?



6. If E and B denote electric and magnetic fields, respectively, which of the following is dimensionless?

(a) $\sqrt{\mu_0 \epsilon_0} \frac{E}{B}$

(b) $\mu_0 \epsilon_0 \frac{E}{B}$

(c) $\mu_0 \epsilon_0 \left(\frac{B}{E} \right)^2$

(d) $\frac{E}{\epsilon_0} \frac{\mu_0}{B}$

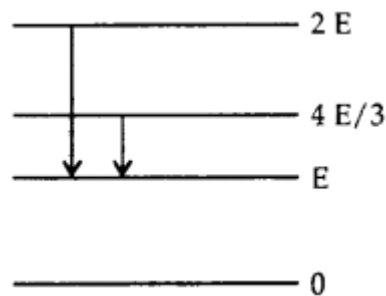
7. Two thin lenses of focal lengths 20 cm and – 40 cm are held in contact. If an object is placed at infinity, then the image will be formed by the combination at

- (a) 10 cm
- (b) 20 cm
- (c) 40 cm
- (d) infinity

8. The refractive index of glass is 1.5 for light waves of wavelength $\lambda = 6000 \text{ \AA}$ in vacuum. Its wavelength in glass is:

- (a) $2000 \text{ \AA}$
- (b) $4000 \text{ \AA}$
- (c) $1000 \text{ \AA}$
- (d) $3000 \text{ \AA}$

9. The adjoining figure indicates the energy levels of a certain atom; when the system moves from $2E$ to E level, a photon of wavelength λ is emitted. The wavelength of the photon produced during its transition from $4E/3$ to E is:



- (a) $\lambda/3$
- (b) $3\lambda/4$
- (c) $4\lambda/3$
- (d) 3λ

10. The binding energies per nucleon for a deuteron and an α -particle are x_1 and x_2 , respectively. The energy Q released in reaction ${}_1\text{H}^2 + {}_1\text{H}^2 \rightarrow {}_2\text{He}^4 + Q$ is:

- (a) $4(x_1 + x_2)$
- (b) $4(x_1 - x_2)$
- (c) $2(x_1 + x_2)$
- (d) $4(x_2 - x_1)$

11. The mobility of conduction electrons is greater than that of holes since electrons

- (a) are negatively charged.
- (b) are lighter
- (c) require smaller energy to move through the crystal lattice.
- (d) Undergo a smaller number of collisions.

12. In p-type semiconductor, the conduction current is due to

- (a) Holes
- (b) Atoms
- (c) Electrons
- (d) Protons

Directions: These questions consist of two statements, each printed as Assertion and Reason. While answering these questions, you must choose any of the following four responses.

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

(b) If both assertion and reason are correct, then reason is not a correct explanation of assertion.

(c) If the Assertion is correct but the Reason is incorrect.

(d) If both the Assertion and Reason are incorrect.

13.Assertion: If the distance between parallel plates of a capacitor is halved and the dielectric constant is three times, then the capacitance becomes 6 times.

Reason: The capacity of the capacitor does not depend upon the nature of the dielectric material.

14.Assertion: Induced e.m.f. will always occur whenever there is a change in magnetic flux.

Reason: Current is always induced whenever there is a change in magnetic flux.

15.Assertion: Though the light of a single frequency (monochromatic) is incident on a metal, the energies of emitted photoelectrons are different.

Reason: The energy of electrons emitted from inside the metal surface is lost in collision with the other atoms in the metal.

16. Assertion: The minimum and maximum wavelength ratio is $\frac{3}{4}$ in the Lyman series.

Reason: Lyman series constitute spectral lines corresponding to the transition from higher energy to the ground state of the hydrogen atom.

Section B

17. A potential difference of 6 V is applied across a conductor of length 0.12 m. Calculate the drift velocity of electrons if the electron mobility is $5.6 \times 10^{-6} \text{ m}^2 \text{ V}^{-1} \text{ s}^{-1}$.

18. Define magnetic field strength. Give its SI unit.

19. Will the current be induced if a square loop of conducting material is moved with a constant velocity fully inside a uniform magnetic field perpendicular to the field? Explain.

20. The de-Broglie wavelengths associated with an electron and proton are equal. Prove that the electron's kinetic energy is greater than that of the proton.

21. What happens to the width of the depletion layer of a p-n junction when it is

(i) forward biased?

(ii) reverse biased?

OR

Draw a labelled energy band diagram of a P-type and N-type semiconductor.

Section C

22. (a) What characteristic property of nuclear force explains the constancy of binding energy per nucleon (BE/A) in the range of mass number 'A' lying $30 < A < 170$?

(b) Show that the density of nucleus over a wide range of nuclei is constant independent of mass number A.

23. a) Calculate the shortest wavelength of the spectral lines emitted in the Balmer series. (Rydberg constant = 10^7 m^{-1})

b) In which part of the electromagnetic spectrum all the wavelengths of the Balmer series fall?

OR

The total ground state energy of any hydrogen atom is -13.6 eV, then calculate:

(i) total energy, (ii) kinetic energy and (iii) potential energy in the first excited state?

24. (a) Draw the circuit diagram of a Full wave rectifier. Also, draw the input & Output waveforms.

(b) In half-wave rectification, what is the output frequency if the input frequency is 50 Hz? What is the output frequency of a full-wave rectifier for the same input frequency?

25. Identify the constituent radiation of the Electromagnetic Spectrum, which

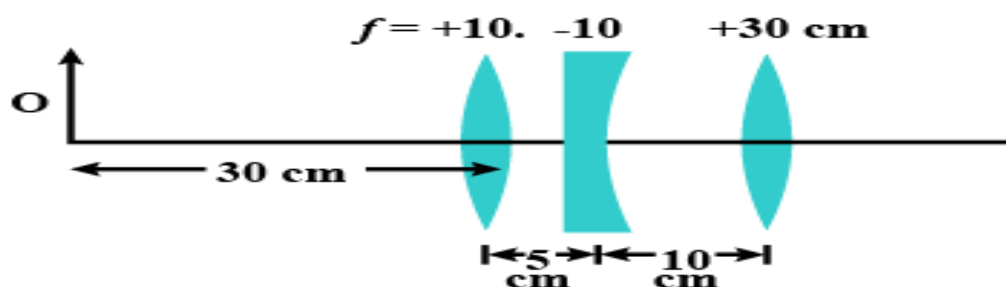
(i) is used to study crystal structure.

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

(iii) Mention one more application for each of this radiation

OR

Find the position of the image formed by the lens combination given in the figure.



26. State Huygens's postulates of wave theory. Using this, verify the laws of refraction.

27. Using Ampere's circuital law, obtain an expression for the magnetic field along the axis of a current carrying solenoid of length l and having N number of turns.

28. Using Gauss's law, derive an expression for electric field intensity due to an infinitely long, straight wire of linear charge density $\lambda \text{ C/m}$.

Section D

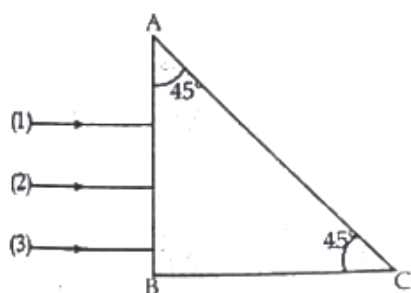
29. Total internal reflection is the phenomenon of light bouncing back into the same medium when light travels from one medium to another. For total internal reflection to take place, light has to travel from denser to rarer medium, and the angle of incidence has to be greater than the critical angle. Multiple internal reflections in diamonds, totally reflecting prisms, and mirages are some examples of total internal reflection.

- i) The refractive index of a material is $\sqrt{2}$. What should be the value of the incident angle so that the light undergoes total internal reflection?
- A) $\geq 45^\circ$ B) $\leq 45^\circ$
- C) $>45^\circ$ D) $< 45^\circ$
- ii) For a ray of light entering from glass to water, which of the following statements is true for the critical angle
- A) Maximum for red colour and minimum for violet colour
B) Maximum for violet colour and minimum for red colour
C) is independent of colour of incident light
D) Maximum for yellow colour
- iii) What will be the value of the angle of reflection when the angle of incidence is equal to the critical angle?
- A) 30° B) 45°
- B) 60° D) 90°

OR

What will be the speed of light in a medium whose critical angle is 30° ?

- A) 3×10^8 m/s
B) 3×10^{-8} m/s
C) 6×10^8 m/s
D) 1.5×10^8 m/s
- iv) As shown in the figure, Three rays 1,2 & 3 of different colours fall normally on one of the sides of an isosceles right angle prism. The refractive index of the prism for these rays is 1.39, 1.47 and 1.52, respectively. Which of these waves will get internally reflected?



A) 1 & 2

B) 2 & 3

C) 1 & 3

D) only 2

30. The electrolytic cell is a simple device that maintains a steady current in an electric circuit. A cell has two electrodes: positive (P) and negative (N). They are immersed in an electrolytic solution. Dipped in the solution, the electrodes exchange charges with the electrolyte. When a source of emf ε is connected to an external resistance R , the voltage V_{ext} across R is given by $V_{\text{ext}} = IR = \frac{\varepsilon}{R+r} R$, where 'r' is the internal resistance of the source.

i) A current of 2 A flows through a $2\ \Omega$ resistor when connected across a battery. The same battery supplies a current of 0.5 A when connected across a $9\ \Omega$ resistor. The internal resistance of the battery is

A) $1/3\ \Omega$ B) $3\ \Omega$ C) $0.5\ \Omega$ D) $1\ \Omega$

ii) Maximum current can be drawn from the cell when

A) $R = \infty$ B) $R = 0$ C) $R = r$ D) $r = 0$

OR

The maximum current that can be drawn from the cell is

A) $I = \frac{\varepsilon}{R+r}$ B) $I = \frac{\varepsilon}{r}$ C) $I = \frac{\varepsilon}{R}$ D) $I = \frac{V}{R+r}$

iii) A battery has an emf of 4V and internal resistance r . When the battery is connected to an external resistance of $2\ \Omega$, a current of 1 A flows through the circuit. How much current will flow if the terminals are directly connected?

A) 0 A

B) 1 A

C) infinite

D) 2 A

iv) For an open circuit, which of the following statements is true

A) $\varepsilon = V$ B) $\varepsilon > V$ C) $\varepsilon < V$ D) $\varepsilon \leq V$

Section E

31. (a) A resistor of $200\ \Omega$ and a capacitor of $15.0\ \text{mF}$ are connected in series to a 220 V, 50 Hz AC source.

(i) Calculate the current in the circuit;

(ii) Calculate the voltage (rms) across the resistor and the capacitor.

(iii) Is the algebraic sum of these voltages more than the source voltage? If yes, resolve the paradox.

(b) In a series LR circuit, the inductive reactance (X_L) is numerically equal to resistance (R) of a resistor used. (i.e. $X_L = R$) The power factor of the circuit is P_1 . When a capacitor with capacitance (C) such that $X_L = X_C$ is put in the circuit, the power factor becomes P_2 . Calculate P_1/P_2 .

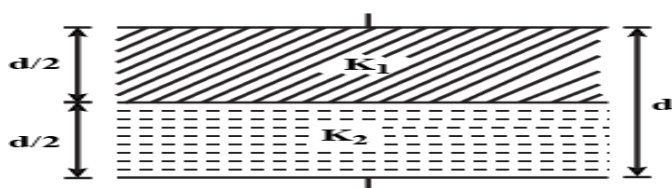
OR

Explain, with the help of a diagram, the principle and the workings of a step-up transformer, and

obtain the expression for the transformer equation. $\frac{i_p}{i_s} = \frac{v_s}{v_p} = \frac{N_s}{N_p}$, where the symbols have their usual meanings.

32. (a) What is a capacitor? Deduce an expression for the capacitance of a parallel plate capacitor fully filled with dielectric medium between the plates.

(b) A parallel plate capacitor of plate area A and separation d is filled with dielectrics of dielectric constant K_1 and K_2 , as shown in the figure. Find the net capacitance of the capacitor.



OR

A parallel plate capacitor is charged by a battery. After some time, the battery is disconnected, and a dielectric slab of dielectric constant K is inserted between the plates. What change will take place in the following :

- (i) Charge on the plates
- (ii) the capacitance of the capacitor
- (iii) potential difference between the plates
- (iv) electric field intensity between the plates
- (v) the energy stored in the capacitor? Justify your answer in each case.

33. (A) Draw a ray diagram to form an image using a compound microscope. Write the expression for its magnifying power, when the image is formed at infinity.

(B) A compound microscope uses an objective lens of a focal length of 4 cm and an eyepiece lens of a focal length of 10 cm. An object is placed at 6 cm from the objective lens. Calculate the magnifying power of the compound microscope.

OR

In Young's double-slit experiment, the two slits are 0.15 mm apart. The light emitted by the source has a wavelength of 450 nm. The screen is 2 m away from the slits.

- (i) Find the distance of the second bright fringe and the third dark fringe from the central maximum.
- (ii) Find the fringe width.
- (iii) What will happen to the fringe width if the whole setup is immersed in water with a refractive index of $4/3$?