PHYSICS

CLASS –XII

DESIGN OF THE QUESTION PAPER

Time : 3 Hrs. **Max. Marks : 70**

The weightage of the distribution of marks over different dimensions of the question paper shall be as follows :

1. Weightage to Learning Outcomes

S. No.	Objective	Marks	Percentage
1.	Knowledge	21	30
2.	Understanding	35	50
3.	Application	14	20
	TOTAL	**70**	**100**

2. Weightage to content/subject units

Unit	Marks
1. Electrostatics	8
2. Current electricity	8
3. Magenetic Effects of Current and Magnetism	8
4. Electromagnetic Induction and Alternating Current	8
5. Electromagnetic waves	3
6. Optics	10
7. Dual Nature of Matter and Radiations	4
8. Atomic Nucleus	6
9. Solids and Semiconductor Devices	8
10. Principles of Communication	7
Total	**70**

3. Weightage to form of questions

S. No.	Form of Questions	Marks for each Question	No. of Questions	Total Marks
1.	Long Answer Type (LA)	5	3	15
2.	Short Answer (SAI)	3	12	36
3.	Short Answer (SA II)	2	7	14
4.	Very Short Answer (VSA)	1	5	5
	TOTAL	–	**27**	**70**

Note : Although the weightage to different content areas and forms of questions has been assigned and the paper setters will adhere to the weightage but there can be slight variation in distribution of marks over different units/forms of questions in the Board Examination depending upon the situation.

Note : The expected time required for attempting different forms of questions would be as follows :

S.No.	Form of Questions	Expected time for each Question
1.	Long Answer Type (LA)	12 Minutes
2.	Short Answer Type (SA) I/II	8 Minutes / 4 Minutes
3.	Very Short Answer Type (VSA)	2 Minutes

This is only **an approximation.** The total time is calculated on the basis of the number of questions required to be answered and the lengths of their anticipated answers. It would be adivsable for the candidates to budget their time properly by avoiding unnecessary details.

4. Scheme of Options

(1) There will be no overall option.

(2) Internal choices (either/or type) on a very selective basis has been given in **five questions**. This internal choice will be given in any one question of 2 marks, any one question of 3 marks and all questions of 5 marks weightage.

5. A weightage of 15 – 18 marks in total, has been assigned to numericals.

6. Weightage to difficulty level of questions.

S.No.	**Estimated difficulty level**	**Percentage**
1.	Esay	15
2.	Average	70
3.	Difficult	15

A question may vary in difficulty level from individual to individual. As such, the approximation in respect of each question will be made by the paper setter on the basis of general expectation from the group as a whole. The provision is only to make the paper balanced in nature rather than to determine the pattern of marking at any stage.

BLUE PRINT –I

PHYSICS

CLASS XII

ime : 3 Hours **Max Marks**

bjectives →	**Knowledge**				**Understanding**				**Application**				**Total**
nit ↓	VSA	SAII	SAI	LA	VSA	SAII	SAI	LA	VSA	SAII	SAI	LA	
Electrostatics	1(1)					2(1)	3(1)			2(1)			8(4
Current Electricity							3(1)			2(1)	3(1)		8(3
Magnetic Effects of Current and Magnetism		2(1)		5(1)	1(1)								8(3
Eletromagnetic Induction and Alterna-ting current	1(1)	2(1)								2(1)	3(1)		8(4
Electomagnetic waves							3(1)						3(1
Optics			3(1)					5(1)		2(1)			10(3
Dual Nature of Matter and Radiation					1(1)		3(1)						4(2
Atomic Nucleus			3(1)				3(1)						6(2
Solids and Semic-onductor Devices							3(1)	5(1)					8(2
). Principles of Communication	1(1)		3(1)				3(1)						7(3
Total		**21(9)**					**35(12)**				**14(6)**		**70 (2**

SAMPLE QUESTION PAPER-I

PHYSICS

CLASS XII

Time : 3 Hours **Max. Marks : 70**

General Instructions

(i) All questions are compulsory.

(ii) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and three questions of five marks. You have to attempt only one of the choices in such questions.

(iii) Question number 1 to 5 are very short answer questions carrying 1 mark each.

(iv) Question number 6 to 12 are short answer questions, carrying 2 marks each.

(v) Question number 13 to 24 are short answer questions, carrying 3 marks each.

(vi) Question number 25 to 27 are long answer questions, carrying 5 marks each.

(vii) Use of calculators is not permitted. However, you may use log tables if necessary.

(viii) You may use the following values of physical constants wherever necessary :

$$c = 3 \times 10^{8}\,\mathrm{ms^{-1}}$$

$$h = 6.6 \times 10^{-34}\,\mathrm{Js}$$

$$e = 1.6 \times 10^{-19}\,C$$

$$\mu_0 = 4\pi \times 10^{-7}\,\mathrm{T\ m\ A^{-1}}$$

Mass of neutron $m_n \cong 1.6 \times 10^{-27}\,\mathrm{kg}$

Boltzmann's constant $k = 1.38 \times 10^{-23}\,\mathrm{JK^{-1}}$

Avogadro's number $N_A = 6.023 \times 10^{23}$ / mole

1. Which physical quantity has its SI unit as

   (i) C – m

   (ii) Vm

2. State the phase relationship between the current flowing and the voltage applied in an a c circuit for (i) a pure resistor (ii) a pure inductor.

3. Name the type of communication corresponding to the case where the signal is

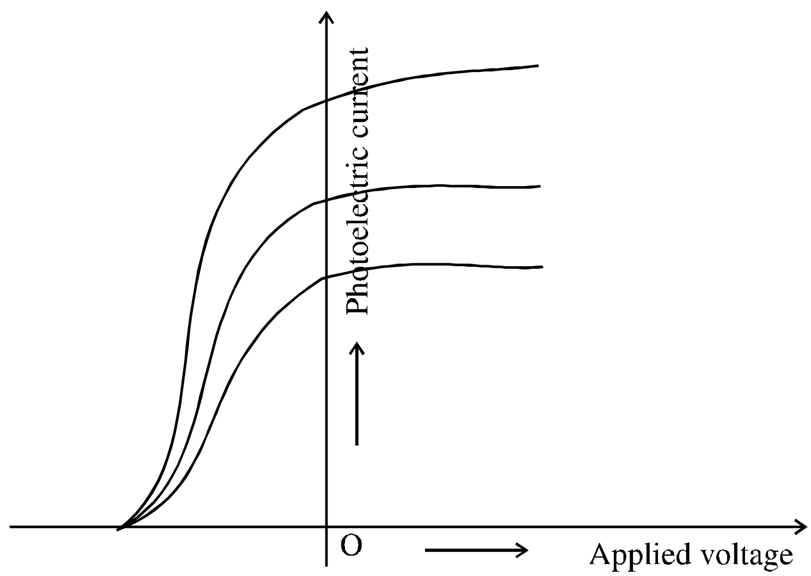
   (i) a continuous signal essentially similar to the message or information.

   (ii) a discrete and binary coded version of the message or information.

4. An electron and a proton, having equal momenta, enter a uniform magnetic field at right angles to the field lines. What will be the ratio of the radii of curvature of their trajectories?

5. In a photoelectric effect experiment, the following graphs were obtained between the photoelectric current and the applied voltage.

   Name the characteristic of the incident radiation that was kept constant in this experiment.



6. Write the expression for the magnitude of force per unit length between two infinitely long parallel, straight current carrying conductors. Hence define the SI unit of current.

7. State the principle of an a c generator. Write an expression for the maximum emf produced in it.

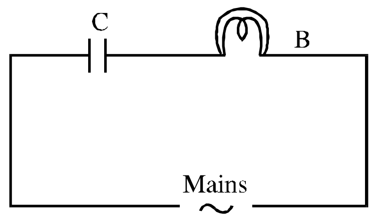
8. An incident beam of light of intensity I_o is made to fall on a polaroid A. Another polariod B is so oriented with respect to A that there is no light emerging out of B. A third polaroid C is now introduced mid-way between A dnd B and is so oriented that its axis bisects the angle between the axes of A and B. What is the intensity of light now between.

   (i) A and C ?

   (ii) C and B ?

   Give reasons for your answers.

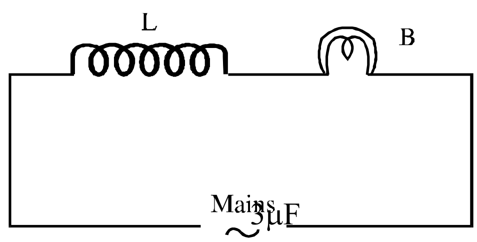
9. A bulb B and a capacitor C are connected in series to the a.c. mains as shown in the given figure:



The bulb glows with some brightness. How will the glow of the bulb change when a dielectric slab is introduced between the plates of the capacitor? Give reasons in support of your answer.

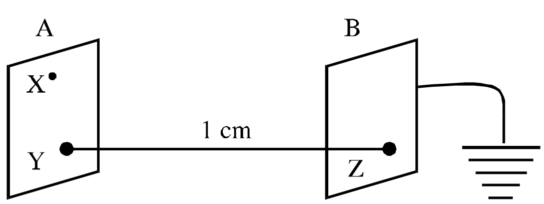
OR

An air cored coil L and a bulb B are connected in series to the a.c. mains as shown in the given figure:



The bulb glows with some brightness. How will the glow of the bulb change if an iron rod is inserted in the coil? Give reasons in support of your answer.

10. Two identical plane metallic surfaces A and B are kept parallel to each other in air, separated by a distance of 1 cm as shown in the figure.



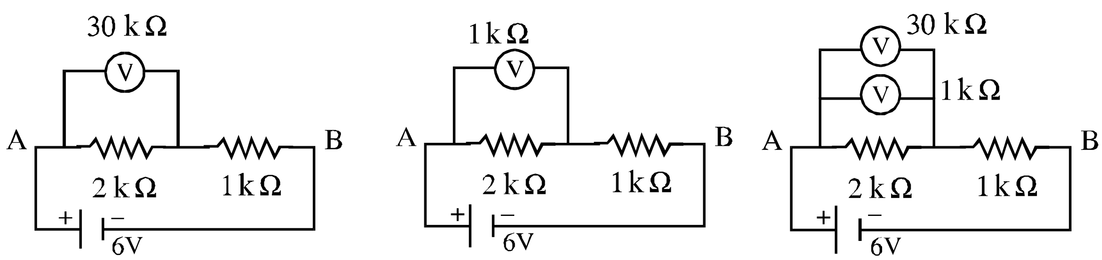
A is given a positive potential of 10V and the outer surface of B is earthed.

(i) What is the magnitude and direction of the uniform electric field between Y and Z?

(ii) What is the work done in moving a charge of 20 μ C from X to Y ?

11. Two capacitors, of capacitances and $6\mu F$, are charged to potentials of 2V and 5V respectively. These two charged capacitors are connected in parallel. Find the charge across each of the two capacitors now.

12. A series combination of a $2\,k\Omega$ resistor and a resistor, is connected across a battery of emf 6V and negligible internal resistance. The potential drop, across the resistor, is measured by (i) a voltmeter (ii) a voltmeter and (iii) both these voltmeters connected across it. If the voltmeter readings in the three cases are , V_2 and V_3 respectively, arrange these readings in descending order.



How will the three readings compare with one another if the potential drop were measured across the series combination of the $2\,k\Omega$ and the resistor i.e., across the points A and B ?

13. Define the term modulation. Name three different types of modulation used for a message signal using a sinusoidal continuous carrier wave. Explain the meaning of any one of them.

14. Explain how the optical communication system offers the possibility of millions of channels with increased band width. Give an additional advantage of optical communication system over a system employing a co–axial cable.

15. Two nearby narrow slits are illuminated by a single monochromatic source. Name the pattern obtained on the screen.

One of the slits is now completely covered. What is the name of the pattern now obtained on the screen?

Write two differences between the patterns obtained in the two cases.

16. A nucleus makes a transition from one permitted energy level to another level of lower energy. Name the region of the electromagnetic spectrum to which the emitted photon belongs. What is the order of its energy in electron volts?

Write four characteristics of nuclear forces.

17. A small square loop, of side 2mm' is placed inside, and normal to the axis, of a long solenoid. The solenoid has a total of 2000 turns of wire uniformly wound over its total length of 2m. If the current flowing in the solenoid wire changes from 1A to 3A in

of a second, calculate the emf induced in the square loop.

18. Under what condition is the heat produced in an electric circuit

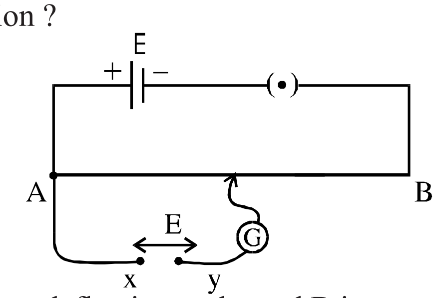
(i) directly proportional

(ii) inversely proportional

to the resistance of the circuit?

A resistor R is put in series with a voltameter having electrodes made from a metal of chemical equivalant E. A mass m of the metal gets deposited in a time t when a current is made to flow through the combination. Obtain an expression for the heat produced in the resistor during this time.

19. For the potentiometer circuit, shown in the given figure, points X and Y represent the two terminals of an unknown emf E. A student observed that when the jockey is moved from the end A to the end B of the potentiometer wire, the deflection in the galvanometer remains in the same direction. What are the two possible faults in the circuit that could result in this observation ?



If the galvanometer deflection at the end B is

(i) more

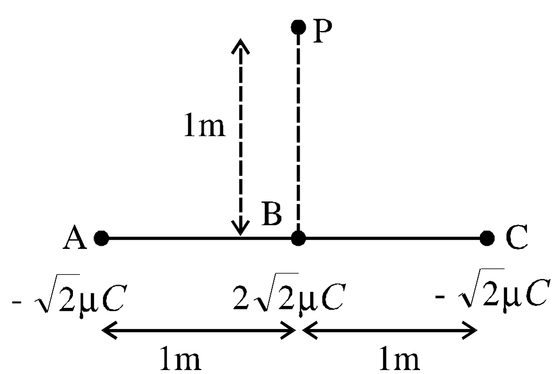
(ii) less $-\sqrt{2}\mu C$

than that at the end A, which of the two faults, listed above, would be there in the circuit? Give reasons in support of your answer in each case.

20. Name the part of electromagnetic spectrum to which waves of wavelength (i) $1A^0$ and (ii) 10^{-2}m belong.

Using the relation $\lambda T = (0.29\text{cm})\,K$, obtain the characteristic kelvin temperature corresponding to these two wavelengths.

21. Three charges , $2\sqrt{2}\mu C$ and $-\sqrt{2}\mu C$ are arranged along a straight line as shown in the figure. Calculate the total electric field intensity due to all these three charges at the point P.



OR

A point charge of $+2\mu C$ is kept fixed at the origin. Another point charge of $+4\mu C$ is brought from a far off point to a point distant 50 cm from the origin. Calculate the electrostatic potential energy of this two charge system.

Another charge of $+1\mu C$ is brought to a point distant 100 cm from each of these two charges (assumed to be kept fixed). What is the work done?

22. A star converts all its hydrogen to helium achieving 100% helium composition. It then converts helium to carbon via the reaction.

$$ {}_2^4He + {}_2^4He + {}_2^4He \longrightarrow {}_6^{12}C + 7.27\ MeV $$

The mass of the star is 5.0×10^{32} kg and it generates energy at the rate of 5×10^{30} watt. How long will it take to convert all its helium to carbon?

23. The ratios of the number density, of free electrons to holes, $\left(\frac{n_e}{n_h}\right)$, for two different materials A and B, are equal to one and less than one respectively. Name the type of semiconductor to which A and B belong. Draw energy level diagrams for A and B.

24. Neutrons, in thermal equilibrium with matter at a temperature of T kelvin, are known to have an average kinetic energy of $\frac{3}{2}kT$. Compute the deBroglie wavelength associated with a neutron at 300K.

25. What arre the two main considerations that have to be kept in mind while designing the 'objective' of an astronomical telescope?

Obtain an expression for the angular magnifying power and the length of the tube of an astronomical telescope in its 'normal adjustment' position.

An astronomical telescope having an 'objective' of focal length 2m and an eyepiece of focal length 1 cm, is used to observe a pair of stars with an actual angular separation of 0.75. What would be their observed angular separation as seen through the telescope?

OR

What are the two ways of adjusting the position of the eyepiece while observing the final image in a compound microscope? Which of these is usually preferred and why?

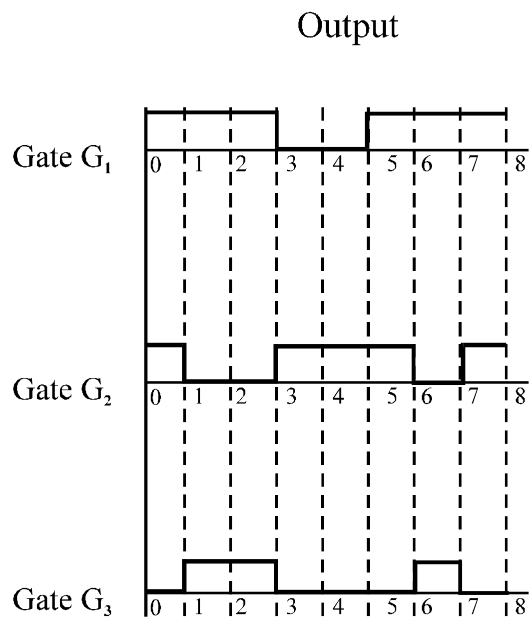
Obtain an expression for the magnifying power of a compound microscope. Hence explain why

(i) we prefer both the 'objective' and the 'eye-piece' to have small focal length? and

(ii) we regard the 'length' of the microscope tube to be nearly equal to be separation between the focal points of its objective and its eye-piece?

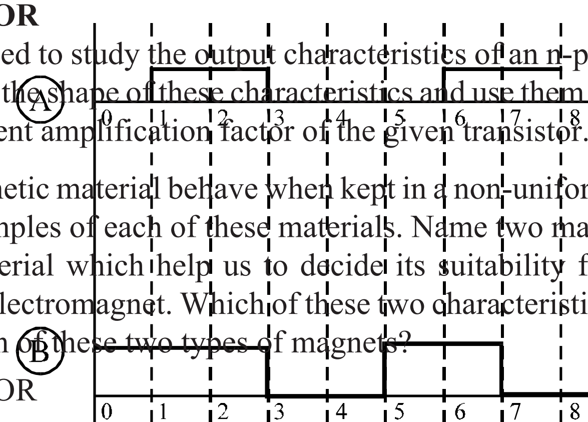
Calculate the magnification obtained by a compound microscope having an objective of focal length 1.5cm and an eyepiece of focal length 2.5 cm and a tube length of 30 cm.

26. Two signals, A and B, shown in the figure, are used, one by one, as the two inputs of three different gates G_1, G_2 and G_3. The outputs obtained from the three gates are as shown.



Identify the three gates. Which of these is referred to as the universal gate? Give the truth table and symbol of this gate. Explain, with the help of diagrams, how a combination of suitable number of this gate, can be used to get the other two gates.

Input



OR

Draw the diagram of the circuit used to study the output characteristics of an n-p-n transistor in the CE configuration. Give the shape of these characteristics and use them to define the (*i*) output resistance (*ii*) current amplification factor of the given transistor.

27. How will a dia–, para – and a ferromagnetic material behave when kept in a non-uniform external magnetic field? Give two examples of each of these materials. Name two main characteristics of a ferromagnetic material which help us to decide its suitability for making (i) a permanent magnet (ii) an electromagnet. Which of these two characteristics should have high or low values for each of these two types of magnets?

OR

State Biot-Savart Law. Use it to obtain the magnetic field, at an axial point, distance Z from the centre of a circular coil of radius ‘a’, carrying a current I.

Hence compare the magnitudes of the magnetic field of this coil at its centre and at an axial point for which $z = \sqrt{3}\,a$.

MARKING SCHEME–I

SAMPLE QUESTION PAPER-I

PHYSICS

Note : The marking scheme given here does not provide complete detailed answers for all the questions. At few places, the actual answer is too obvious and therefore, only the scheme of distribution of marks has been indicated. Students are advised to write complete answers in the actual examination.

Q.No.	Value Points	Marks
1.	(i) dipole - moment	½
	(ii) electric - flux	½
2.	(i) current is in phase with the applied voltage (or zero phase difference)	½
	(ii) Current lags behind the applied voltage in phase by 90^0	½
3.	(i) Analogue	½
	(ii) Digital	½
4.	The ratio is 1:1	1
5.	Frequency $I_o/2$ $I_o/4$	1
6.	Formula	1
	Definition of an ampere	1
7.	Statement of Principle	1
	Maximum Emf = NAB	1
	where symbols have their usual meaning	
8.	(i) ($\because$ The polariod allows only the component parallel to its axis to pass through it)	1
	(ii) $\left(\because I = \frac{I_o}{2}\cos^2 45^0 = \frac{I_o}{4}\right)$	1

9. The bulb will glow brighter ½

$\therefore$ As dielectric slab is introduced between the plates of the capacitor its Capacitance increases. ½

As capacitance increses reactance of the capacitor decreases, resulting in decrease in the impedence of the circuit ½

As a result, the current in the circuit increases. Hence the glow of the bulb increases. ½

OR

The glow of the bulb will diminish ½

As the iron-rod is inserted in the coil, its inductance increases.

As inductance increases, its reactance also increases resulting in an increase in the impedance of the circuit. ½+½

As a result, the current in the circuit, and hence the glow of the bulb will decrease. ½

10. (i) $E = -\frac{dV}{dr} = \frac{10V}{\left(10^{-2}\right)m} = 1000 Vm^{-1}$ ½

$\therefore$ Magnitude of the uniform electric field between Y and Z =

Its direction is from the higher potential point to the lower potential point, i.e. from Y to Z ½

(ii) The surface of a charged metal plate is an equipotential surface

$\therefore$ X and Y are at equal potential.

½

Work done in moving a charge in an electric field $= q(V_1 - V_2) = 0$ $V = \frac{Q}{C} = \frac{36\mu C}{9\mu F} = 4$ volt

$\therefore$ Work done in moving a charge of

20 C from X to Y = $20\times10^{-6}\times0 = 0$ ½

Total Charge = $(3\times2 + 6\times5)$ C = $36\,\mu C$

Let V be the common potential across the two capacitors when they are connected in parallel.

Total capacitance of the parallel combination = (3+6) F = $9\,\mu F$ ½

$\therefore$ Charge on the first capacitor = 4×3 C = $12\,\mu C$ ½

And charge on the second capacitor = 4×6 C = $24\,\mu C$ ½

Potential across the capacitor $= \frac{Q}{C_1} = \frac{36\mu C}{3\mu F} = 12V$ ½

12. First case $V_1 > V_2 > V_3$ 1

Second case 1

Q.No.	Value Points	Marks

13. Modulation is the process in which some characteristic of the transmitted carrier wave is varied in accordance with the information or message signal.

Three different types of modulations are

(i) Amplitude modulation

(ii) Frequency modulation

(iii) Phase modulation 1

Explanation of the meaning of any one of the three 1

14. Frequencies used for optical communication are Hz. The normal transmission band width available per channel $\sim 10^4$ Hz. 1

$\therefore$ No. of channels available through the optical communication

$= \frac{\tilde{10}^{14}}{10^{4}} = 10^{10}$

Even if we provide 100 times greater band width for transmission 10^8 channels i.e. 100 million channels will still be available. 1

Additional advantage – e.g. low transmission losses or better signal security. 1

15. Interference pattern ½

Diffraction pattern ½

Two differences between Interference and Diffraction patterns. 1+1

16. Gamma Rays ½

Millions of electron – volts ½

Four characteristics :

(i) Strong attractive force (stronger than the repulsive electric force between the protons)

(ii) a short range force

(iii) a charge independent force

(iv) a secondary effect of the strong force that binds quarks together to form neutrons and protons. (4 × ½ = 2)

17. Axial magnetic field inside the long solenoid = μ_0 nI

Q.No.	Value Points	Marks

$$= 4\pi \times 10^{-7} \times \frac{2000}{2} \times I \text{ tesla}$$ 1

$\therefore$ Flux linked with the square loop = Field × area

tesla × ( )

$$= 16\pi \times 10^{-10} \times I \text{ T} - \text{m}^2$$ 1

$\therefore$ Rate of change of flux = induced emf

volt = volt = $0.32\mu V$ 1

18. (i) Current remains constant ½

(ii) Voltage remains constant ½

$$m = z\,I\,t = \frac{E}{F}\,i\,t \quad (\text{F = faraday})$$ ½

$$\therefore \quad I = \frac{m\,F}{E\,t}$$ ½

$$= \frac{[\text{illegible}](3-1)}{\pi \times 10^{-2}}$$

$$\therefore \quad H = i^2Rt = \frac{m^2\,F^2}{E^2\,t^2}\;R\,t$$

$$= \frac{m^2\,F^2\,R}{E^2\,t}$$ 1

19. Two possible faults

(i) The unknown emf E is connected across the potentiometer wire with wrong polarity.

(ii) The main emf ε is less than the unknown emf E.

First Case :

Fault — Fault no. (i) given above 1

Reason : The two emf's support each other and the resultant total emf becomes maximum at the end B.

Q.No.	Value Points	Marks

Second Case :

Fault — Fault No. (ii) given above

Reason : Even the full value of the main battery emf (ε) is not able to balance the unknown emf E. However, since the two emf's oppose each other, the resultant deflection at the end B [where the (opposing) main emf is maximum] would be less than that at the end A. 1

20. (i) X – rays ½

(ii) Micro waves ½

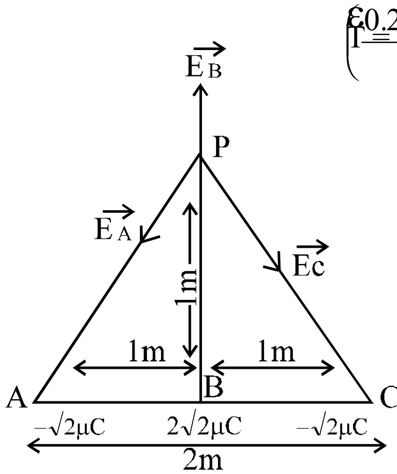
T =

$\therefore$ (i) $K = 29 \times 10^{-8} K$ 1

(ii) $T = \dfrac{0.29cm}{1cm} K = 0.29K$ 1

$$T = \left(\frac{0.29\,cm}{\lambda}\right) k \qquad \frac{0.29cm}{1 \times 10^{-10}\,cm}$$

21.



½

$$|E_A| = \frac{1}{4\pi\Sigma_0} \frac{\sqrt{2} \times 10^{-6}}{\left(\sqrt{2}\right)^2} N/C = 4.5\sqrt{2} \times 10^3 \, N/C$$ ½

$$\left|\vec{E}_C\right| = \left|\vec{E}_A\right| = 4.5\sqrt{2} \times 10^3 \, N/C$$ ½

Q.No.	Value Points	Marks

$|E_C| + |E_A| = 2 \times 4.5\sqrt{2} \times 10^3 \times \cos 45^0 \; N/C = 9 \times 10^3 \; N/C$ ½

It is directed along $\overrightarrow{PB}$

$$|E_B| = \frac{1}{4\pi\varepsilon_0} \frac{2\sqrt{2} \times 10^{-6}}{1^2} N/C = 18\sqrt{2} \times 10^3 \; N/C$$

It is directed along $\overrightarrow{BP}$

$\therefore |E_A + E_C + E_B| = \left(18\sqrt{2} - 9\right) \times 10^3 \; N/C = 16.45 \times 10^3 \; N/C$ and the net resultant field is directed along $\overrightarrow{BP}$ 1

OR

Electrostatic P.E. of the two charge system $= \dfrac{1}{4\pi \in_0} \dfrac{q_1 \, q_2}{r}$ ½

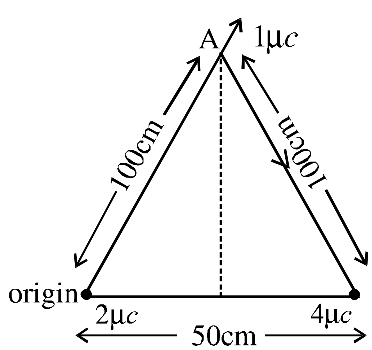
$$= 9 \times 10^9 \times \frac{\left(2 \times 10^{-6}\right) \times \left(4 \times 10^{-6}\right)}{50 \times 10^{-2}} \text{ joule}$$

1.44×10^{-1} $9 \times 10^{9} \times 6 \times 10^{-6}$

$=$ joule $=$ 144 mJ 1

$$V_A = \frac{1}{4\pi \in_0} \frac{(2+4) \times 10^{-6}}{1} \text{ volt}$$

volt $= 54 \times 10^3$ volt ½



$W = qV_A = 1 \times 10^{-6} \times 54 \times 10^3$ joule 1

= 54 mJ

Q.No.	Value Points	Marks

22. We know that 4×10^{-3} kg. of helium contains $N_A = 6.023\times10^{23}$ helium atoms. ½

Total no. of helium atoms in the star $= \left(\dfrac{6.023\times10^{23}}{4\times10^{-3}}\times5.0\times10^{32}\right)$ atoms

$= 7.52875\times10^{58}$ atoms

Now 3 helium atoms produce 7.27 MeV of energy ($=7.27\times1.6\times10^{-13}$J) ½

$\therefore$ Total Energy produced by all the atoms = joule

$\cong 29.2\times10^{45}$ joule 1

Power $= 5\times10^{30}$ watt

$\therefore$ Time taken to convert all helium atoms into carbon = seconds

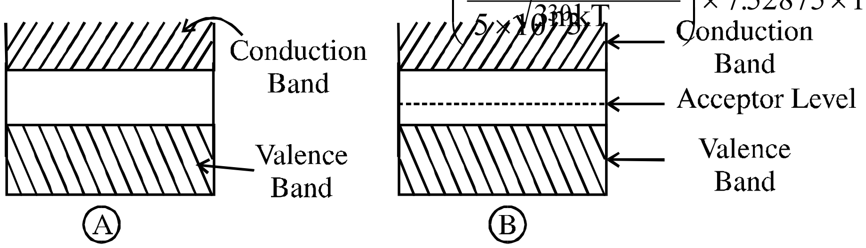
$= 5.84\times10^{15}$ seconds

$= \dfrac{5.84\times10^{15}}{365\times24\times60\times60}$ years $= 1.85\times10^{8}$ years 1

23. A $\longrightarrow$ Intrinsic semiconductor ½

B $\longrightarrow$ p - type semicondoctor ½

$\left(\dfrac{7.27\times1.6\times10^{-13}}{3}\right)\times7.52875\times10^{58}$ $\dfrac{29.2\times10^{45}}{5\times10^{30}}$ $\lambda = \dfrac{h}{\sqrt{3mkT}}$



1+1

24. $\lambda = h/p$

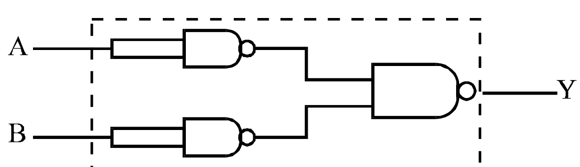
$p = \sqrt{2m(K.E)} = \sqrt{2m\tfrac{3}{2}kT} = \sqrt{3mkT}$ ½

$\therefore$ ½

$= \dfrac{6.6\times10^{-34}}{\left(3\times1.6\times10^{-27}\times1.38\times10^{-23}\times300\right)^{½}}$ metre 1

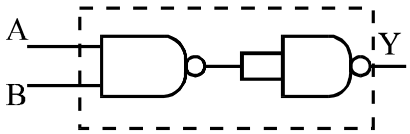
$= \dfrac{6.6\times10^{-34}}{\left(19.872\times10^{-48}\right)^{½}}$ metre $= \dfrac{6.6}{4.46}\times10^{-10}$ metre

Q.No.	Value Points	Marks
	$= 1.18\times10^{-10}$ metre $\cong$ 0.148 nm.	1
25.	Two main considerations	
	(i) Large Light gathering power	½
	(ii) Higher resolution (or resolving power)	
	Both these requirements are met better when an 'objective' of **large** focal length as well as **large aperture** is used.	½
	Ray diagram for normal adjustment position	1
	Derivation of the expression for angular magnifying power.	1
	Derivation of the expression for the 'Length' of the telescope tube :	½
	Angular magnifying power =	½
	observed angular separation = 0.75' ×200 = 150' = $2^0 30$	1
	OR	
	Two ways	
	Final Image formed at least distance of distinct vision Final Image formed at infinity.	½
	The second one is usually preferred as it helps the observer to observe the final image with his/her eye in a relaxed position.	½
	Ray diagram	1
	Calculation of magnifying power $= \frac{2\,m}{(1\times10^{-2})\,m}\left(=\frac{L}{f_0}\frac{D}{f_e}\right) = 200$	1
	(i) We get larger magnifying power	½
	(ii) The length of the tube is (f_o + L + f_0) which is nearly L only as both f_o and f_e are very small.	½
	Magnifying Power $= \frac{L}{f_0}\frac{D}{f_e} = \frac{30}{1.5}\times\frac{25}{2.5} = 200$	1
26.	Gate G_1 -------------> 'OR' gate	½
	Gate G_2 -------------> 'NAND' gate	½
	Gate G_3 --------------> 'AND' gate	½
	Gate G_2 (the 'NAND' gate) is referred to as the 'universal gate'	½
	Truth table of 'NAND' gate	½
	Symbol of 'NAND' gate	½
	Using three 'NAND' gates to get the 'OR' gate	1



Using two 'NAND' gates to get the 'AND' gate. 1

Q.No. **Value Points** **Marks**



1

OR

Correct circuit diagram with correct symbol of the transistor and all polarities correctly marked 2

Shape of output characteristics 1

Output resistance 1

Current amplification factor 1

27.	Diamagnetic :	moves (very weakly) away from strong field region towards the weak field region.	½
	Para magnetic :	moves (weakly) towards the strong field region.	½
	Ferromagnetic :	moves (strongly) towards the strong field region.	½
	Two examples :	Diamagnetic (Bismuth, Copper)	½
		Paramagnetic (Aluminium, Oxygen)	½
		Ferromagnetic (Iron, Nickel)	½
	Two charatertics of ferromagnetic materials :	Coercivity and Retentivity	1
	For Permanent Magnets :	High Coercivity and High Retentivity	½
	For Electromagnets :	Low Coercivity and Low Retentivity	½

OR

Correct statement of Biot-Savart law in complete vector form 1
(Give ½ mark only if the statement is restricted only to the magnitude of the magnetic field. However if the rule for finding the direction of the megnetic field is explained along with, the remaining ½ mark may also be given)

Calculation of the magnetic field

Writing expression for $d\vec{B}$ ½

Explaining why only the axial components of diffrent $d\vec{B}$ values need to be added.
Adding (Integrating) the axial components to get the magnitude of the resultant magnetic field 1

$$\left[B = \frac{\mu_0 I a^2}{2\left(z^2 + a^2\right)^{3/2}}\right]$$

1

Stating that the direction of $\vec{B}$ is along the axis of the coil ½

$$\frac{B_{centre}}{B_{Z=\sqrt{3a}}} = \frac{8\,a^3}{a^3} = \frac{8}{1}$$ 1

BLUE PRINT –II

PHYSICS

CLASS XII

Time : 3 Hours **Max Marks : 70**

Objectives →	**Knowledge**				**Understanding**				**Application**				**Total**
Unit ↓	**VSA**	**SAII**	**SAI**	**LA**	**VSA**	**SAII**	**SAI**	**LA**	**VSA**	**SAII**	**SAI**	**LA**	
1.Electrostatics							3(1)	5(1)					8(2)
2. Current Electricity		2(1)	3(1)				3(1)						8(3)
3. Magnetic Effects of Current and Magnetism	1(1)				1(1)		3(1)				3(1)		8(4)
4. Eletromagnetic Induction and Alternating current		2(1)			1(1)							5(1)	8(3)
5. Electomagnetic waves							3(1)						3(1)
6. Optics			3(1)					5(1)		2(1)			10(3)
7. Dual Nature of Matter and Radiations		2(1)								2(1)			4(2)
8. Atomic Nucleus			3(1)				3(1)						6(2)
9. Solids and Semiconductor Devices	1(1)					2(1)	3(1)			2(1)			8(2)
10. Principles of Communication	1(1)		3(1)				3(1)						7(3)
Total		**21(10)**					**35(12)**				**45(5)**		**70 (27)**

SAMPLE QUESTION PAPER –II

PHYSICS

CLASS XII

Time : 3 Hrs. **Max. Marks : 70**

General Instructions :

(i) All questions are compulsory.

(ii) There is no overall choice. However, an internal choice has been provided in one question of two marks, one question of three marks and three questions of five marks. You have to attempt only one of the choices in such questions.

(iii) Question number 1 to 5 are very short answer questions carrying 1 mark each.

(iv) Question number 6 to 12 are short answer questions, carrying 2 marks each.

(v) Question number 13 to 24 are short answer questions, carrying 3 marks each.

(vi) Question number 25 to 27 are long answer questions, carrying 5 marks each.

(vii) Use of calculators is not permitted. However, you may use log tables if necessary.

(viii) You may use the following values of physical constants wherever necessary :

$$c = 3 \times 10^{8}\,\mathrm{ms^{-1}}$$

$$h = 6.6 \times 10^{-34}\,\mathrm{Js}$$

$$h = 6.6 \times 10^{-34}\,\mathrm{Js}$$

$$\mu_0 = 4\pi \times 10^{-7}\,\mathrm{T\ m\ A^{-1}}$$

Mass of neutron $m_n \cong 1.6 \times 10^{-27}\,\mathrm{kg}$

Boltzmann's constant $k = 1.38 \times 10^{-23}\,\mathrm{JK^{-1}}$

Avogadro's number $N_A = 6.023 \times 10^{23}$ / mole

1. A compass needle, pivoted about the horizontal axis, and free to move in the magnetic meridian, is observed to point along the

   (*i*) vertical direction at a place A.

   (*ii*) horizontal direction at a place B.

   Give the value of the angle of dip at these two places.

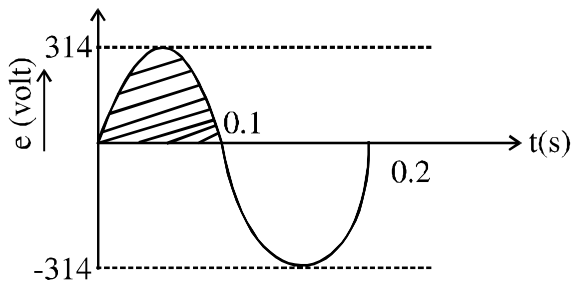
2. Give the value of the threshold voltage for a

   (*i*) silicon diode (*ii*) germanium diode

3. State the two functions performed by a modem.

4. An electron is moving with a velocity v, along the axis of a long straight solenoid, carrying a current I. What will be the force acting on the electron due to the magnetic field of the solenoid ?

5. The figure given below shows the variation of an alternating *emf* with time. What is the average value of the *emf* for the shaded part of the graph ?



6. Give the nature of V–I graph for

   (i) ohmic

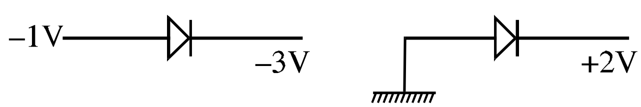
   (ii) non-ohmic

   circuit elements. Give one example of each type.

7. Name the phenomenon associated with the production of back *emf* in a coil due to change of electric current through the coil itself.
   Name and define the SI unit used for measuring this characteristic of the coil.

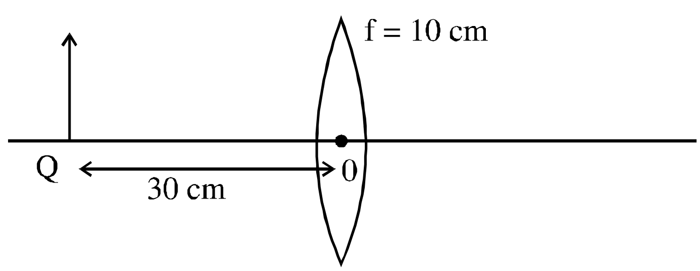
8. Name the device that converts changes in intensity of illumination into changes in electric current. Give any three applications of this device.

9. A given *p-n* function is biased in two different ways as shown in the figure.
   Identify the type of biasing used in each case. What is the effect of these biasings on the barrier potential across the given *p-n* junction ?



(a) (b)

10. Find the position of the image formed by the lens shown in the figure.



Another lens is placed in contact with this lens to shift the image further away from the lens. What is the nature of the second lens ?

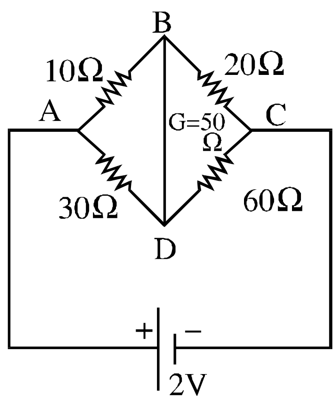
11. A nucleus of mass M. initially at rest, splits into two fragments of masses $\frac{M'}{3}$ and, $\frac{2M'}{3}$ $(M > M')$. Find the ratio of de-Broglie wavelengths of the two fragments.

OR

Calculate the ratio of de-Broglie wavelengths associated with a deutron moving with velocity 2v and an alpha particle moving with a velocity v.

12. The output of an unregulated dc power supply needs to the regulated. Name the device that can be used for this purpose and draw the relevant circuit diagram.

13. The given figure shows a net work of resistances. Name the circuit so formed.



$\angle A$
p

What is the current flowing in the arm BD of this circuit? State the two laws used to find the current in different branches of this circuit.

14 Write the relation between the angle of incidence (i); the angle of emergence (e), the angle of prism (A) and the angle of deviation (δ) for rays undergoing refraction through a prism. What is the relation between $\angle i$ and $\angle e$ for rays undergoing minimum deviation ? Using this relation obtain an expression for the refractive index (μ) of the material of the prism in terms of and the angle of minimum deviation.

15. Define the terms (i) disintegration constant and (ii) half-life for a radioactive nucleus. Obtain the relation between the two.

16. State any three reasons for preferring diode lasers as light sources for optical communication links.

17. An electric dipole with moment , is placed in a uniform electric field of intensity $\vec{E}$.

Write the expression for the torque $\vec{\tau}$ experienced by the dipole. Identify two pairs of perpendicular vectors in the expression.

Show diagramatically the orientation of the dipole in the field for which the torque is (*i*) maximum

(*ii*) half the maximum value

(*iii*) zero

18. Explain the cause of production of *emf* when two junctions of two dissimilar metals are maintained at different temperatures.

    With the cold junction at 0°C, the neutral temperature for a thermo-couple is obtained at 270°C. The cold junction temperature is now lowered to –10°C. Obtain the

    (*i*) neutral temperature

    (*ii*) the temperature of inversion

    in this case.

19. Obtain an expression for the magnetic moment of an electron, moving with a speed 'v', in a circular orbit of radius 'r'. State the rule to find its direction. How does this magnetic moment change when

    (*i*) the frequency of revolution is doubled

    (*ii*) the orbital radius is halved ?

20. Electromagnetic waves with wavelength

    (*i*) λ_1 are used to treat muscular strain.

    (*ii*) λ_2 are used by a FM radio station for broadcasting.

    (*iii*) λ_3 are used to detect fracture in bones.

    (*iv*) λ_4 are absorbed by the ozone layer of the atmosphere.

    Identify and name the part of electromagnetic spectrum to which these radiations belong. Arrange these wavelengths in decreasing order of magnitude.

21. Define mass number (A) of an atomic nucleus. Assuming the nucleus to be spherical, give the relation between the mass number (A) and the radius (R) of the nucleus.

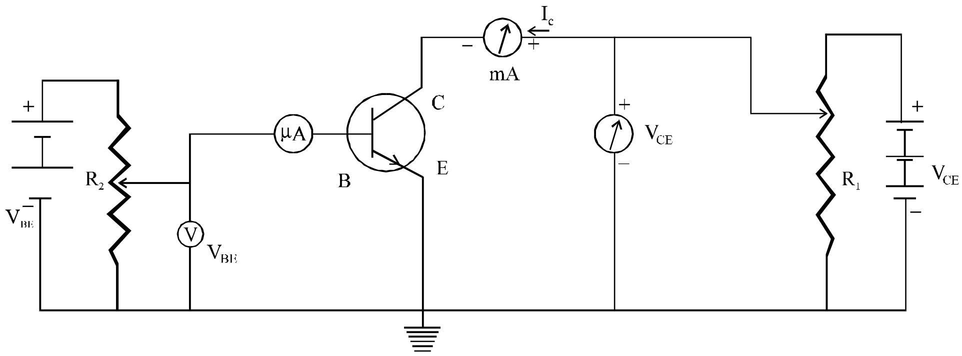
    Calculate the density of nuclear matter. Radius of nucleus of ${}^1_1H = 1.1 \times 10^{-5}$Å.

    What is the ratio of the order of magnitude of density of nuclear matter and density of ordinary matter ?

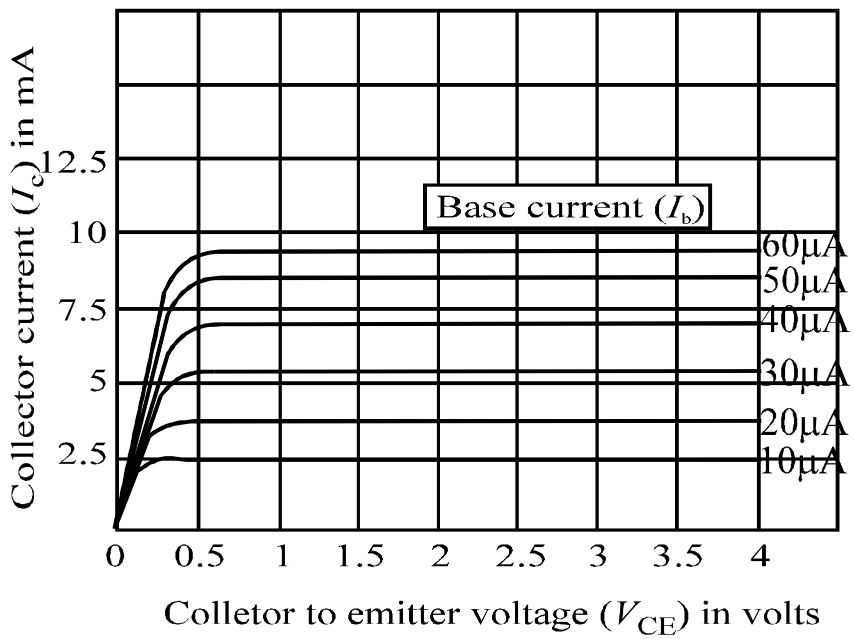
22. For the transistor circuit shown here, identify the

    (*i*) type of transistor used and

    (*ii*) biasing configuration employed.



The output characteristics of the transistor, for this biasing configuration are as shown



Use these graphs to estimate the value of the current amplification factor for the transistor for $V_{CE} = 3V$.

23. A ground receiver station is receiving a signal at (*a*) 5 MHz and (*b*) 100 MHz, transmitted from a ground transmitter at a height of 300 m. located at a distance of 100 km. from the receiver station. Identify whether the signal is coming via space wave propagation or sky wave propagation or via satellite transponder. Radius of earth = 6.4×10^6m.

    N_{max} of Ionosphere = 10^{12} per m^3.

24. State Ampere's circuital law. Use this law to obtain an expression for the magnetic field due to a toroidal solenoid.

OR

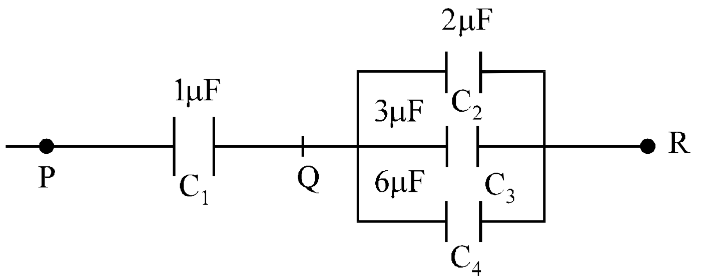
Obtain an expression for the frequency of revolution of a charged particle moving in a uniform transverse magnetic field. How does the time period of the circulating ions in a cyclotron depend on

(i) the speed

(ii) the radius of the path of ions?

25. Obtain an expression for the energy stored in a parallel plate capacitor.

In the following figure, the energy stored in C_4 is 27J. Calculate the total energy stored in the system.



OR

State the theorem which relates the enclosed charge, inside a closed surface, with the electric flux through it. Use this theorem to obtain the electric field due to a uniformly charged thin spherical shell at an (*i*) outside point (*ii*) inside point.

An electric charge of 8.85×10^{-13}C is placed at the centre of a sphere of radius 1 m. What is the total electric flux linked with the sphere ? How will the electric flux change if another equal and opposite charge in introduced at a distance of

(i) 0.5 m from the centre

(ii) 1.5 m from the centre.

26. Following figure shows an experimental set up similar to Young's double slit experiment to observe interference of light.

Here $SS_2 – SS_1 = \frac{\lambda}{4}$.

Write the condition of

(i) constructive

(ii) destructive interference at any point *P* in terms of path difference

$\Delta = S_2P – S_1P$.

Does the central fringe observed in the above set up lie above or below O? Give reason in support of your answer.

Yellow light of wavelength 6000Å produces fringes of width 0.8 mm in Youngs double slit experiment. What will be the fringe width if the light source is replaced by another monochromatic source of wavelength 7500 Å and separation between the slits is doubled?

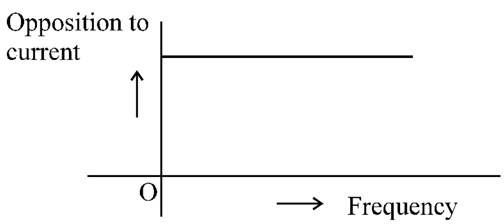
OR

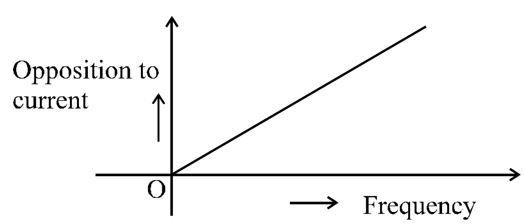
Draw a graph showing the variation of intensity with angle in a single slit diffraction pattern. Expalin why the intensity of the first secondary maximum is much less than that of the central maximum.

Light of wavelength 6000 Å, is used to illuminate a slit of width 0.1 mm. Obtain the angular position of the first minimum in the resulting diffraction pattern. What will happen to the intensity of the central maximum if the width of the slit were to be reduced to 0.05mm?.

27. The given graphs (*a*) and (*b*) represent the variation of the opposition offered by the circuit element to the flow of alternating current, with frequency of the applied *emf*.

Identify the circuit element corresponding to each graph.





A circuit is set up by connecting $L = 100$ mH, $C = 5\ \mu F$ and $R = 100\ \Omega$ in series. An alternating emf of $\left(150\sqrt{2}\right)$volt, $\left(\frac{500}{\pi}\right)$Hz is applied across this series combination.

Calculate the impedence of the circuit. What is the average power dissipated in

(a) the resistor

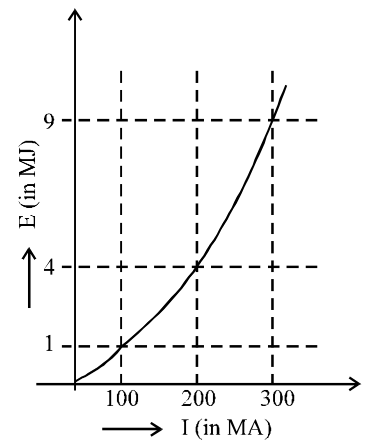
(b) the capacitor and

(c) the complete circuit ?

OR

State Lenz's law

The energy E, required to build up a steady current I, in a given coil, varies with I in the manner shown. Calculate the self inductance of the coil



A circular coil of radius r, is placed co-axially with another circular coil of radius R (R>>r) with the centres of the two coils coinciding with each other. Obtain an expression for the mutual inductance of this pair of coils.

MARKING SCHEME–II

SAMPLE QUESTION PAPER–II

PHYSICS

Note : The marking scheme given here does not provide complete detailed answers for all the questions. At few places, the actual answer is too obvious and therefore, only the scheme of distribution of marks has been indicated. Students are advised to write complete answers in the actual examination.

Q.No.	Value Points	Marks
1.	Angle of dip at A is 90°.	½
	Angle of dip at B is 0°.	½
2.	Knee voltage for silicon 0.7V.	½
	Knee voltage for germanium 0.2V.	½
3.	Modulation	½
	De-modulation	½
4.	Force is zero, because $\vec{V}$ and $\vec{B}$ are parallel vectors	**1**
5.	Average emf $= \frac{2e_0}{\pi}$	½
	$= \frac{2 \times 314}{3.14} = 200$ V	½
6.	Linear graph for ohmic	½
	Non-linear graph for non-ohmic	½
	One example for each type	½ + ½
7.	Self induction	½
	henry	½
	Definition	**1**
8.	Photocell	½
	Three applications	
	(i) Light meters in photographic camera	½
	(ii) Automatic switching on and off of streetlight	½
	(iii) Automatic counting devices	½

Q.No.	Value Points	Marks
9.	(a) Forward bias	½
	(b) Reverse bias	½
	In forward bias ; barrier potential decreases	½
	In reverse bias ; barrier potential increases	½
10.	Formula :	
	$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$	½
	u = – 30 cm	
	$\therefore$	½
	$\therefore$ v = 15 cm.	½
	Nature of lens L_2 is concave	½
11.		½
	From law of conservation of linear momentum	
	$\frac{1}{v} = \frac{1}{10} + \frac{1}{(-30)}$ $\lambda = \frac{h}{p}$	
	$\lvert\vec{p}_1\rvert = \lvert\vec{p}_2\rvert$	½
	$\therefore \lambda_1 = \lambda_2$	½
	Ratio 1 : 1	½
	OR	
	$p_1 = 2m \times 2v = 4\ mv$	½
	$p_2 = 4m \times v = 4\ mv$	½
	$p_1 = p_2$	
	$\lambda_1 = \lambda_2$	½
	Ratio = 1 : 1	½
12.	Zener diode	½
	Correct circuit diagram (Fig 15.22 Page 431, NCERT text book) Correct symbol for Zener diode	½

Q.No.	Value Points	Marks
13.	(i) Wheatstone's bridge	½
	(ii) Zero	½
	Statement of Kirchoff's first law	1
	Statement of Kirchoff's second law	1
14.		½
	For minimum deviated ray	
	$\angle i = \angle e$	½
	$\therefore$	½
	Also for $\angle i = \angle e$;	
	$r = r' = A/2$	½
	$\therefore$	(1)
	$\angle i + \angle e = \angle\delta_m + \angle A$	
	$\log \frac{N}{No} = -\lambda t$	
	$\mu = \frac{\sin i}{\sin r} = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$	
15.	Definition of disintegration constant	½
	Definition of half-life	½
	$\frac{dN}{dt} = -\lambda\ N(t)$	½
	integrating,	
	$\int_{No}^{N} \frac{dN}{N} = = -\lambda \int_{to}^{t} dt$	
	$\log_e N - \log_e\ N_O = -\lambda\ (t - t_0)$	**1**
	or	
	$\therefore\ N(t) = N_0\ e^{-\lambda t}$	½

Q.No.	Value Points	Marks

16. Three reasons

(i) Characteristics compatible with optical fibre 1

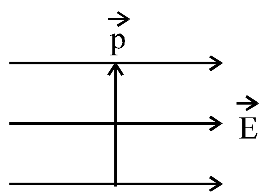
(ii) Gives adequate power 1

(iii) Give light that can be easily modulated 1

(or any other correct reason)

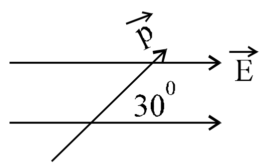
17. $\vec{\tau} = \vec{p} \times \vec{E}$ ½

(i) $\vec{\tau}$ and $\vec{p}$; $\vec{\tau}$ and $\vec{E}$ ½ + ½

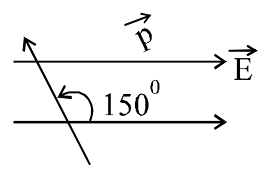


Maximum torque ½

(ii)

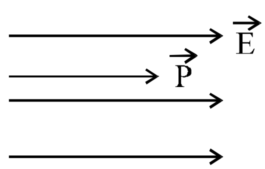


OR

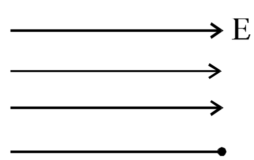


½

(iii)



OR



½

18. Origin of emf $\rightarrow$ difference of contact (or junction) potentials at the two junctions. 1

(a) Neutral temperature remains same (i.e. 270°C) 1

(b) Temperature of inversion becomes 550°C. 1

19. Expression for magnetic moment

$p_m = IA = (e\nu)\ \pi r^2$ 1

Statement of Right hand rule 1

(i) p_m is also doubled ½

Q.No.	Value Points	Marks
	(ii) p_m becomes one fourth	½
20.	(i) $\lambda_1 \rightarrow$ infra-red	½
	(ii) $\lambda_2 \rightarrow$ radio-waves	½
	(iii) $\lambda_3 \rightarrow$ x-rays	½
	(iv) $\lambda_4 \rightarrow$ ultra-violet rays	½
	$\lambda_2 > \lambda_1 > \lambda_4 > \lambda_3$	**1**
21.	Definition of mass number	½
	Correct relation, between A & R	
	$R = R_0 A^{1/3}$	½
	ρ_N = density of nuclear matter	
	$= \dfrac{\text{mass}}{\text{volume}} = \dfrac{1.66 \times 10^{-27}\,\text{kg}}{\frac{4}{3} \times 3.14 \times (1.1 \times 10^{-15})^3\ \text{m}^3}$	
	$\approx 3 \times 10^{17}$ kg m^{-3}	1
	ρ_0 = density of ordinary matter $\approx 10^3$ kg m^{-3}	½
	$\therefore \dfrac{\rho_N}{\rho_0} \approx 3 \times 10^{14}$	½
22.	(i) *n-p-n* transistor	½
	(ii) common-emitter configuration	½
	$\Delta I_B \approx (60 - 10) = 50\ \mu A$	½
	ΔI_C (9.5 – 2.5) = 7.0 mA	½
	$\beta = \dfrac{\Delta I_C}{\Delta I_B} = \dfrac{7.0 \times 10^{-3}}{50 \times 10^{-6}}$	
	$\cong 140$	1
23.	Maximum distance covered by space wave communication $\sqrt{2Rh} \approx 62$ km.	½

Q.No.	Value Points	Marks
	Critical frequency = $f_c = 9\,(N_{max})^{1/2} \simeq 9$ MHz	½
	(i) 5 MHz < f_c ; sky wave propagation (ionospheric propagation)	1
	(ii) 100 MHz > f_c via satellite transponder	1
24.	Statement of Ampere's circuital law	1
	Derivation of the magnetic field of the toroidal solenoid .	2
	OR	
	Derivation of expression of frequency	2
	(i) Independent of speed	½
	(ii) Independent of radius of path	½
25.	Derivation of energy stored	**2**

$$\frac{1}{2} \times 6 \times 10^{-6} \times V^2 = 27$$

$\therefore$ ½

$$V^2 = \frac{27 \times 2}{6 \times 10^{-6}}$$

$$\frac{q^2}{2 \times 11 \times 10^{-6}} = 49.5 \text{ J}$$

Energy stored in $C_2 = \frac{1}{2} \times 2 \times 10^{-6} \times \frac{27 \times 2}{6 \times 10^{-6}}$

$= 9$ J ½

Energy stored in $C_3 = \frac{1}{2} \times 3 \times 10^{-6} \times \frac{22 \times 2}{6 \times 10^{-6}}$

$= 13.5$ J ½

Total energy stored in C_2, C_3 and C_4

$= (27 + 9 + 13.5)$ J $= 49.5$ J ½

Equivalent capacitance of C_2, C_3 and C_4 in parallel = 11 μF

$\therefore$

Q.No.	Value Points	Marks

Energy stored in $C_1 = \frac{q^2}{2C_1} = 544.5\ \text{J}$ ½

Total energy stored in the arrangement

$= 544.5 + 49.5$

$= 594.0\ \text{J}$ ½

OR

Statement of Gauss Law 1

Derivation of electric field $1 + 1 = 2$

Flux linked with sphere $= q/\varepsilon_0$

$= 0.1\ \text{NC}^{-1}\,\text{m}^2$ 1

(i) Flux becomes zero ½

(ii) Flux remains unchanged i.e. $0.1\ \text{NC}^{-1}\,\text{m}^2$. ½

26. Constructive interference

$\Delta_{\text{Total}} = \Delta_{\text{Initial}} + \Delta = n\,\lambda, \qquad n = 0, 1, 2, ...$

Given $\Delta_{\text{Initial}} = \lambda/4$ $\qquad \frac{\lambda}{4} \mp \Delta\frac{\lambda}{4}$

$\therefore \qquad = n\lambda$

or $\qquad \Delta = \left(n - \frac{1}{4}\right)\lambda$ **1**

Destructive interference

$$\Delta_{\text{Total}} = \frac{\lambda}{4} + \Delta = (2n - 1)\,\frac{\lambda}{2} \qquad n = 1, 2, 3, ...$$

or $\qquad \Delta = \left(2n - \frac{3}{2}\right)\frac{\lambda}{2}$ **1**

For central fringe, n = 0 ; $\therefore$

The negative sign show that central fringe shifts below the point O. **1**

$$\beta = \text{fringe width} = \frac{\lambda D}{d}$$ ½

Q.No.	Value Points	Marks

$$\frac{\beta_2}{\beta_1} = \frac{\lambda_2 D / 2d}{\lambda_1 D / d}$$ ½

$\therefore$

= 0.5 mm **1**

OR

Graph showing the variation of intensity with angle 1

Explanation

At the central maximum, the contribution is from the entire wave front (slit)
At the first secondary maximum, the contribution is only from (nearly) one third of wave front (slit) 2

Angular position of the first minimum $\theta = \frac{\lambda}{a}$

$$= \frac{6 \times 10^{-7}}{1 \times 10^{-4}} \text{ radian}$$

$= 6 \times 10^{-3}$ radian $\quad \beta_2 = \frac{7500}{6000} \times \frac{1}{2} \times \beta_1 \quad Z = \sqrt{X_R^2 + (X_L - X_C)^2}$ 1

The Intensity of the central maximum gets reduced to

(nearly $\frac{1}{4}$th of its initial value

($\therefore$ its angular with becomes double of its initial value) 1

27. (i) Resistor ½
(ii) Inductor ½

½

$$X_R = 100\ \Omega$$

$$X_L = \omega L = 2\pi\upsilon L = 2\pi \times \frac{500}{\pi} \times 100 \times 10^{-3}\Omega$$

$= 100\ \Omega$ ½

$$X_C = \frac{1}{\omega C} = \frac{1}{2\pi\upsilon C}$$ ½

Q.No.	Value Points	Marks

$$= \frac{1}{2\pi\left(\frac{500}{\pi}\right) \times 5 \times 10^{-6}} = 200\,\Omega$$ ½

$$Z = \sqrt{(100)^2 + (100 - 200)^2}$$

$$= \sqrt{2} \times 100 = 141.4\,\Omega$$ ½

$$I = \frac{V}{Z} = \frac{150\sqrt{2}}{100\sqrt{2}} = 1.5\text{A}$$ ½

Power consumed

(i) in resistor = $I^2R = (1.5)^2 \times 100 = 225$ VA ½

(ii) in capacitor = zero

(iii) in circuit = power consumed in resistor = 225 VA ½

OR

Statement of Lenz's law ½

Statement of the relation $E = \frac{1}{2}LI^2$ ½

Calculation of L (=0.2H or 200 mH)
with correct units **2**

Writing $\Phi = \pi r^2 B_R$ ½

$\Phi = MI$ ½

$B_R = \frac{\mu_0 I}{2R}$ ½

Obtaining $M = \frac{\mu_0 \pi r^2}{2R}$ ½