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Your JEE Guide

MP Board Class XII · Physics

Sample Question Paper 7 · Session 2026-27

Time allowed: 3 hours **Maximum marks: 70**

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This is an original practice paper written to the MPBSE 2027 sample question paper pattern; it is not issued by MPBSE.

General instructions:

1. All questions are compulsory.
2. Questions 1 to 5 are objective questions (28 in all): choose the correct option, fill in the blanks, true/false, match the columns and answer in one word or sentence. Each sub-question carries 1 mark.
3. Questions 6 to 12 are very short answer questions of 2 marks each. Answer each in about 30 words.
4. Questions 13 to 16 are short answer questions of 3 marks each. Answer each in about 75 words.
5. Questions 17 to 20 are long answer questions of 4 marks each. Answer each in about 120 words.
6. Internal options are given in questions 13 to 20.
7. Draw neat and labelled diagrams wherever necessary.
8. The general meanings of the symbols in the question paper are according to the textbook.

1.	**(i)** *Choose the correct option and write it:* When a glass rod is rubbed with silk, the glass rod becomes: (a) magnetised (b) negatively charged (c) uncharged (d) positively charged	1
	(ii) The temperature coefficient of resistance of a semiconductor is: (a) positive (b) negative (c) zero (d) infinite	1
	(iii) A proton and an electron enter a uniform magnetic field with the same velocity at right angles to it. Then: (a) both paths have the same radius (b) the electron's path has the larger radius (c) the proton's path has the larger radius (d) neither particle is deflected	1
	(iv) The frequency of the output of a transformer, compared with the input, is: (a) the same (b) higher (c) zero (d) lower	1

	(v) For light going from glass into air, total internal reflection takes place when the angle of incidence is: (a) equal to 45° always (b) less than the critical angle (c) greater than the critical angle (d) zero	1
	(vi) The energy gap between the valence and conduction bands of silicon is about: (a) 1.1 eV (b) 6 eV (c) 13.6 eV (d) 0.01 eV	1
2.	**(i)** *Fill in the blanks:* The electric potential everywhere inside a charged hollow conductor is _____.	1
	(ii) The heat produced in a resistor is proportional to the _____ of the current through it.	1
	(iii) The magnetic field outside an ideal toroid is _____.	1
	(iv) The production of an emf in a circuit when the magnetic flux through it changes is called _____.	1
	(v) Rays parallel to the principal axis meet, after reflection from a concave mirror, at its _____.	1
	(vi) In nuclear fusion, energy is released because the binding energy per nucleon of the product nucleus is _____ than that of the reacting nuclei.	1
3.	Match each material in column A with its property in column B: Column A | Column B (i) Copper | (a) good conductor (ii) Glass | (b) diamagnetic (iii) Silicon | (c) semiconductor (iv) Bismuth | (d) paramagnetic (v) Aluminium | (e) ferromagnetic (vi) Nickel | (f) insulator	6
4.	**(i)** *Write True or False:* In electrostatic equilibrium, the electric field inside a conductor is zero.	1
	(ii) The drift velocity of free electrons in a wire is close to the speed of light.	1
	(iii) The magnetic field inside a long current-carrying solenoid is nearly uniform.	1
	(iv) A convex lens always forms a real image.	1
	(v) The binding energy per nucleon of uranium is greater than that of iron.	1

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5.	**(i)** *Answer in one word or one sentence:* What is the net charge of an electric dipole?	1
	(ii) Write the expression for the drift velocity of electrons in terms of the relaxation time τ.	1
	(iii) Name the instrument used to detect small currents in a circuit.	1
	(iv) Which colour of visible light has the longest wavelength?	1
	(v) Name the device that emits light when a p-n junction in it is forward biased.	1
6.	Why do electrostatic field lines not form closed loops?	2
7.	A current of 1.5 A flows through a wire for 2 minutes. Find the charge that passes and the number of electrons.	2
8.	A wire bent into a semicircle of radius 5 cm carries a current of 10 A. Find the magnetic field at the centre. ($\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1})	2
9.	How does the self-inductance of a coil change when a soft iron core is put inside it? Why?	2
10.	Give two advantages of alternating current over direct current.	2
11.	Name two phenomena that show the wave nature of light and one that shows its particle nature.	2
12.	How does the electrical conductivity of a semiconductor change as its temperature rises? Why?	2
13.	A 10 μF capacitor is charged to 100 V and then connected across an identical uncharged capacitor. Find the energy stored before and after, and the energy lost. **OR** What are polar and non-polar molecules? Give one example of each. How does each kind behave in an external electric field?	3
14.	Distinguish between the emf and the terminal voltage of a cell. When can the terminal voltage be greater than the emf? **OR** You have resistors of 2 Ω, 3 Ω and 6 Ω. Find the largest and the smallest resistance you can obtain using all three, and draw the arrangements.	3
15.	A coil of 100 turns and area 0.1 m^2 rotates at 50 revolutions per second in a uniform magnetic field of 0.01 T. Find the maximum emf induced in it. **OR** State four causes of energy loss in a transformer and how each is reduced.	3

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16.	What is displacement current? Why did Maxwell introduce it? Write its expression. **OR** Arrange the following in increasing order of frequency: X-rays, radio waves, infrared, visible light, ultraviolet, microwaves, gamma rays. Write one source of each of two of them.	3
17.	Capacitors of 4 μF and 8 μF are connected in parallel, and this combination is connected in series with a 6 μF capacitor across a 30 V supply. Find the equivalent capacitance, the charge on each capacitor and the voltage across each. **OR** Distinguish between conductors and dielectrics in their behaviour in an electric field. Define the dielectric constant.	4
18.	A proton moving at 10^6 m s^{-1} enters a uniform magnetic field of 0.5 T at right angles to it. Find (a) the radius of its path, (b) its frequency of revolution. Does the field change its kinetic energy? (m = 1.67 × 10^{-27} kg, e = 1.6 × 10^{-19} C) **OR** Explain the atomic origin of paramagnetism, diamagnetism and ferromagnetism. How does the susceptibility of a paramagnetic substance depend on temperature?	4
19.	Derive the lens formula $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ for a convex lens forming a real image. **OR** Draw a graph of the angle of deviation against the angle of incidence for a prism. What is dispersion, and why does a prism disperse white light?	4
20.	Explain, with energy band diagrams, how n-type and p-type semiconductors are formed. **OR** Using the Rydberg formula $1/\lambda = R(1/n_1^2 - 1/n_2^2)$, with R = 1.097 × 10^7 m^{-1}, find (a) the wavelength of the first line of the Balmer series, (b) the shortest wavelength in the Lyman series.	4

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Answers and Marking Scheme

Marks for each step are shown in brackets. Any correct alternative method gets full credit.

Question 1

(i) **(d)** positively charged. *Working:* Electrons pass from the glass to the silk.

(ii) **(b)** negative. *Working:* Its resistance falls as temperature rises.

(iii) **(c)** the proton's path has the larger radius. *Working:* r = mv/(qB); the charges are equal in magnitude and the proton is much heavier.

(iv) **(a)** the same. *Working:* A transformer changes voltage, not frequency.

(v) **(c)** greater than the critical angle. *Working:* Beyond the critical angle no refracted ray exists.

(vi) **(a)** 1.1 eV. *Working:* A small gap, typical of a semiconductor.

Question 2

(i) constant (equal to that at its surface).

(ii) square.

(iii) zero.

(iv) electromagnetic induction.

(v) principal focus.

(vi) greater.

3. (i) – (a) good conductor; (ii) – (f) insulator; (iii) – (c) semiconductor; (iv) – (b) diamagnetic; (v) – (d) paramagnetic; (vi) – (e) ferromagnetic

Question 4

(i) True.

(ii) False: it is only of the order of millimetres per second.

(iii) True.

(iv) False: it forms a virtual image when the object is within its focal length.

(v) False: it is less.

Question 5

(i) Zero.

(ii) $v_d = eE\tau/m$.

(iii) A galvanometer.

(iv) Red.

(v) A light emitting diode (LED).

6. They begin on positive charges and end on negative charges (1). The electrostatic field is conservative, so the work done round a closed path is zero, which a closed field line would contradict (1).

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7. $Q = It = 1.5 \times 120 = 180$ C (1). $n = Q/e = 180/(1.6 \times 10^{-19}) \approx 1.1 \times 10^{21}$ (1).

8. For a semicircle $B = \mu_0 I/(4R)$ (1) $= 4\pi \times 10^{-7} \times 10/(4 \times 0.05) \approx 6.28 \times 10^{-5}$ T (1).

9. It increases greatly (1). $L = \mu_r \mu_0 n^2 Al$, and soft iron has a very large relative permeability μ_r (1).

10. It can be stepped up or down easily with transformers, so it can be transmitted over long distances with little loss (1). It is easily converted into direct current, and a.c. generators are simpler (1).

11. Interference and diffraction (or polarisation) (1). The photoelectric effect (1).

12. It increases (1). More covalent bonds break, so the numbers of free electrons and holes increase (1).

13. Before: $U = \tfrac{1}{2}CV^2 = \tfrac{1}{2} \times 10^{-5} \times 10^4 = 0.05$ J (1). The charge is shared, so the common voltage is 50 V across 20 μF: $U = \tfrac{1}{2} \times 2 \times 10^{-5} \times 2500 = 0.025$ J (1). Energy lost = 0.025 J, as heat and radiation in the connecting wires (1).

OR Polar molecules have a permanent dipole moment, e.g. H_2O; non-polar molecules do not, e.g. O_2 or CO_2 (1). In a field, the dipoles of polar molecules tend to line up with it (1). In non-polar molecules the field displaces the charges and induces dipole moments along it (1).

14. The emf is the potential difference between the terminals when no current is drawn; the terminal voltage is the potential difference when a current flows (1). While the cell supplies current, $V = \varepsilon - Ir < \varepsilon$ (1). When the cell is being charged, current flows into it and $V = \varepsilon + Ir > \varepsilon$ (1).

OR Largest: all in series, $2 + 3 + 6 = 11\ \Omega$ (1½). Smallest: all in parallel, $1/R = 1/2 + 1/3 + 1/6 = 1$, $R = 1\ \Omega$ (1½).

15. $\varepsilon_0 = NBA\omega$ (1), with $\omega = 2\pi \times 50 = 314$ rad s^{-1} (1). $\varepsilon_0 = 100 \times 0.01 \times 0.1 \times 314 \approx 31.4$ V (1).

OR Copper loss (heating of the windings): use thick copper wire (¾). Eddy currents in the core: use a laminated core (¾). Hysteresis loss: use a core of soft iron with a narrow hysteresis loop (¾). Flux leakage: wind the primary and secondary over each other (¾).

16. A current that arises from a changing electric field (1). Ampere's law gave different results for surfaces passing through and beside a charging capacitor; the displacement current restores consistency (1). $i_d = \varepsilon_0 \, d\Phi_E/dt$ (1).

OR Radio waves < microwaves < infrared < visible light < ultraviolet < X-rays < gamma rays (2). E.g. radio waves from accelerated charges in aerials; gamma rays from radioactive nuclei (1).

17. Parallel part: 12 μF; in series with 6 μF: $C = 12 \times 6/18 = 4$ μF (1). Total charge $Q = 4 \times 30 = 120$ μC, which is the charge on the 6 μF capacitor (1). V across 6 μF = 20 V and across the parallel pair = 10 V (1). Charges: 4 μF has 40 μC and 8 μF has 80 μC (1).

OR In a conductor free electrons move until the field inside becomes zero (1). In a dielectric there are no free charges; the field polarises the molecules (1). Surface charges reduce the field inside but do not cancel it (1). Dielectric constant K is the ratio of the capacitance with the dielectric filling the space to the capacitance with vacuum (or E_0/E) (1).

18. (a) $r = mv/(eB) = 1.67 \times 10^{-27} \times 10^6/(1.6 \times 10^{-19} \times 0.5) \approx 2.1 \times 10^{-2}$ m (1½). (b) $v = eB/(2\pi m) \approx 7.6 \times 10^6$ Hz (1½). No: the force is always perpendicular to the velocity, so it does no work (1).

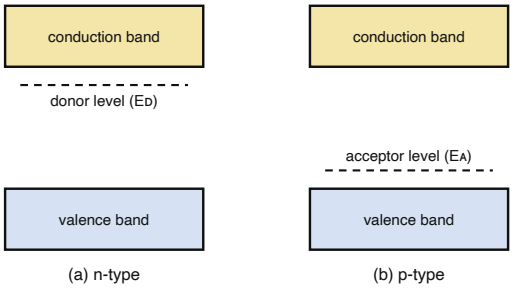
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OR Paramagnetism: atoms have permanent magnetic moments, which partly line up with the field (1). Diamagnetism: atoms have no net moment; the field induces moments opposing it (1). Ferromagnetism: strong interactions line up the moments of neighbouring atoms in domains, which grow and align in a field (1). Curie's law: $\chi = C/T$, inversely proportional to absolute temperature (1).

19. Ray diagram: object AB beyond F, image A′B′, with rays through the optical centre and parallel to the axis (1). Similar triangles ABO and A′B′O: A′B′/AB = OB′/OB (1). Similar triangles MOF and A′B′F: A′B′/AB = B′F/OF = (OB′ − OF)/OF (1). Equating and applying the sign convention (OB = −u, OB′ = v, OF = f) gives $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ (1).

OR Graph: δ first falls with i, reaches a minimum D, then rises (1½). Dispersion is the splitting of white light into its colours (1). The refractive index of glass differs for different wavelengths, being greater for violet than red, so each colour is deviated by a different amount (1½).

20. Diagrams (2):



Doping silicon with a pentavalent atom such as phosphorus adds a donor level just below the conduction band; electrons from it become free carriers: n-type (1). Doping with a trivalent atom such as boron adds an acceptor level just above the valence band; holes are left in the valence band: p-type (1).

OR (a) Balmer, $n_1 = 2$, first line $n_2 = 3$: $1/\lambda = R(1/4 - 1/9) = 5R/36$ (1); $\lambda \approx 656$ nm (1). (b) Lyman shortest: $n_1 = 1$, $n_2 = \infty$: $1/\lambda = R$ (1); $\lambda \approx 91.2$ nm (1).

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