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Your JEE Guide

MP Board Class XII · Physics

Sample Question Paper 1 · 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:* The SI unit of electric dipole moment is: (a) N C^{-1} (b) V m (c) C m^{-1} (d) C m	1
	(ii) Resistors of 4 Ω and 12 Ω are connected in parallel. Their equivalent resistance is: (a) 0.33 Ω (b) 3 Ω (c) 16 Ω (d) 8 Ω	1
	(iii) The magnetic field inside a long solenoid having n turns per unit length and carrying a current I is: (a) $\mu_0 nI$ (b) zero (c) $\frac{\mu_0 nI}{2}$ (d) $\frac{\mu_0 I}{2\pi n}$	1
	(iv) A step-up transformer increases the: (a) power (b) frequency (c) voltage (d) current	1

	(v) Optical fibres work on the principle of: (a) total internal reflection (b) diffraction (c) refraction (d) polarisation	1
	(vi) The energy of a photon of wavelength λ is: (a) $\frac{h}{\lambda}$ (b) $\frac{h\lambda}{c}$ (c) $h\lambda c$ (d) $\frac{hc}{\lambda}$	1
2.	**(i)** *Fill in the blanks:* The capacitance of a parallel-plate capacitor increases when a _____ is placed between its plates.	1
	(ii) The SI unit of magnetic flux is the _____.	1
	(iii) In a purely inductive a.c. circuit, the current _____ the voltage by π/2.	1
	(iv) The rest mass of a photon is _____.	1
	(v) In a p-type semiconductor, the majority charge carriers are _____.	1
	(vi) Lenz's law is a consequence of the law of conservation of _____.	1
3.	Match column A with column B and write the correct pairs:	6

Column A	Column B
(i) Ohm's law	(a) $\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$
(ii) Coulomb's law	(b) $\varepsilon = -\frac{d\Phi}{dt}$
(iii) Faraday's law of induction	(c) $V = IR$
(iv) Lens maker's formula	(d) $\lambda = \frac{h}{p}$
(v) Einstein's photoelectric equation	(e) $F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$
(vi) de Broglie relation	(f) $K_{max} = h\nu - \phi_0$

4.	**(i)** *Write True or False:* Electric field lines can cross each other.	1
	(ii) The resistance of a metal wire increases with temperature.	1
	(iii) A diamagnetic substance is weakly attracted by a magnet.	1
	(iv) Infrared waves have longer wavelengths than visible light.	1
	(v) In forward bias, the depletion layer of a p-n junction becomes wider.	1
5.	**(i)** *Answer in one word or one sentence:* Name the device that converts alternating current into direct current.	1
	(ii) What is the power of a convex lens of focal length 50 cm?	1

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	(iii) Name the electromagnetic waves used in radar.	1
	(iv) Write the relation between the radius of a nucleus and its mass number.	1
	(v) What is the SI unit of mutual inductance?	1
6.	Define electric flux. Write its SI unit.	2
7.	Charges of +3 μC and −3 μC are 2 cm apart. Calculate the electric dipole moment and state its direction.	2
8.	Write two properties of magnetic field lines.	2
9.	The magnetic flux through each turn of a 100-turn coil changes from 0.05 Wb to 0.01 Wb in 0.2 s. Calculate the induced emf.	2
10.	Calculate the critical angle for glass of refractive index 1.5. ($\sin 41.8° \approx 0.667$)	2
11.	Define the work function of a metal. Write its unit.	2
12.	Draw the circuit symbol of a p-n junction diode. Why can it be used as a rectifier?	2
13.	State Kirchhoff's two laws for electric circuits. Which conservation law is each based on? **OR** A cell of emf 2.0 V and internal resistance 0.5 Ω is connected to a 3.5 Ω resistor. Find the current in the circuit and the terminal voltage of the cell.	3
14.	State the Biot–Savart law and write it in vector form. **OR** Write the expression for the force per unit length between two long parallel conductors carrying currents. Use it to define one ampere.	3
15.	In a series LCR circuit, R = 30 Ω, X_L = 80 Ω and X_C = 40 Ω. It is connected to a 200 V (rms) a.c. supply. Find the impedance, the rms current and the power factor. **OR** What is resonance in a series LCR circuit? Write the resonant frequency and the impedance at resonance.	3
16.	An object is placed 30 cm in front of a concave mirror of focal length 20 cm. Find the position, nature and magnification of the image. **OR** In Young's double-slit experiment, the slits are 0.5 mm apart and the screen is 1.0 m away. Light of wavelength 600 nm is used. Calculate the fringe width.	3

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17.	State Gauss's law. Use it to find the electric field due to an infinitely long straight wire with uniform linear charge density λ. **OR** Derive the expression for the capacitance of a parallel-plate capacitor of plate area A and separation d. How does it change when a dielectric of constant K fills the space?	4
18.	Derive the expression for the torque on a rectangular current loop placed in a uniform magnetic field. Define the magnetic moment of the loop. **OR** Describe the principle of a moving-coil galvanometer. How is it converted into an ammeter?	4
19.	Draw a labelled ray diagram of a compound microscope forming the final image at the near point. Write the expression for its magnifying power. **OR** Draw a labelled ray diagram of an astronomical telescope in normal adjustment and write the expression for its magnifying power.	4
20.	Draw the circuit diagram of a full-wave rectifier using two diodes, explain its working and draw the input and output waveforms. **OR** State Bohr's postulates for the hydrogen atom. The energy of the electron in the nth orbit is $E_n = -\frac{13.6}{n^2}$ eV. Calculate the energy and wavelength of the photon emitted when the electron moves from n = 3 to n = 2. (hc = 1240 eV nm)	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)** C m. *Working:* p = q × 2a: charge × distance.

(ii) **(b)** 3 Ω. *Working:* $\frac{4\times12}{4+12} = 3\ \Omega$.

(iii) **(a)** $\mu_0 n I$. *Working:* From Ampere's circuital law applied to a rectangular loop.

(iv) **(c)** voltage. *Working:* $V_s/V_p = N_s/N_p > 1$; power stays (nearly) the same, so the current falls.

(v) **(a)** total internal reflection. *Working:* Light is repeatedly totally reflected at the core–cladding boundary.

(vi) **(d)** $\frac{hc}{\lambda}$. *Working:* E = hν = hc/λ.

Question 2

(i) dielectric.

(ii) weber (Wb).

(iii) lags behind.

(iv) zero.

(v) holes.

(vi) energy.

3. (i) – (c) $V = IR$; (ii) – (e) $F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$; (iii) – (b) $\varepsilon = -\frac{d\Phi}{dt}$; (iv) – (a) $\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$; (v) – (f) $K_{max} = h\nu - \phi_0$; (vi) – (d) $\lambda = \frac{h}{p}$

Question 4

(i) False: at a crossing point the field would have two directions.

(ii) True.

(iii) False: it is weakly repelled.

(iv) True.

(v) False: it becomes narrower.

Question 5

(i) A rectifier.

(ii) +2 D (P = 1/f = 1/0.5 m).

(iii) Microwaves.

(iv) $R = R_0 A^{1/3}$.

(v) The henry (H).

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6. The electric flux through a surface is the number of electric field lines passing through it: $\Phi = \vec{E} \cdot \vec{A}$ (or $\oint \vec{E} \cdot d\vec{A}$) (1). SI unit: N m² C⁻¹ (or V m) (1).

7. p = q × 2a = 3 × 10^{-6} × 0.02 = 6 × 10^{-8} C m (1). It points from the negative charge to the positive charge (1).

8. Any two: they form closed loops; they never intersect; the tangent at a point gives the direction of the field; they are crowded where the field is strong (1 + 1).

9. $\varepsilon = N\frac{\Delta\Phi}{\Delta t} = 100 \times \frac{0.04}{0.2}$ (1) = 20 V (1).

10. $\sin C = \frac{1}{n} = \frac{1}{1.5} = 0.667$ (1), so C ≈ 41.8° (1).

11. The minimum energy needed to remove an electron from the surface of the metal (1). It is usually expressed in electron volts (eV) (or joules) (1).

12. Symbol: a triangle (arrow) pointing to a bar, the arrow being the p side (1). It conducts only when forward biased, so it allows current in one direction only (1).

13. Junction rule: the sum of the currents entering a junction equals the sum of the currents leaving it; conservation of charge (1½). Loop rule: the algebraic sum of the changes in potential around any closed loop is zero; conservation of energy (1½).

OR $I = \frac{\varepsilon}{R+r} = \frac{2.0}{4.0} = 0.5$ A (1½). Terminal voltage V = IR = 0.5 × 3.5 = 1.75 V (1½).

14. The magnetic field dB at a point due to a current element I dl is proportional to I, to dl and to the sine of the angle between dl and r, and inversely proportional to r² (1½). $d\vec{B} = \frac{\mu_0}{4\pi}\frac{I\,d\vec{l}\times\vec{r}}{r^3}$ (1½).

OR $\frac{F}{l} = \frac{\mu_0 I_1 I_2}{2\pi d}$; attractive for currents in the same direction (1½). One ampere is the current which, flowing in two infinitely long parallel conductors 1 m apart in vacuum, produces a force of 2 × 10^{-7} N per metre of length (1½).

15. $Z = \sqrt{R^2 + (X_L - X_C)^2} = \sqrt{900 + 1600} = 50\ \Omega$ (1). I = 200/50 = 4 A (1). Power factor cos ϕ = R/Z = 0.6 (1).

OR The condition in which $X_L = X_C$, so the current is maximum (1). $\nu_0 = \frac{1}{2\pi\sqrt{LC}}$ (1). At resonance Z = R, its minimum value (1).

16. $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ with u = –30 cm, f = –20 cm: $\frac{1}{v} = -\frac{1}{20} + \frac{1}{30} = -\frac{1}{60}$, v = –60 cm, in front of the mirror (1½). The image is real and inverted (½); m = –v/u = –2, twice the size of the object (1).

OR $\beta = \frac{\lambda D}{d}$ (1) $= \frac{600\times10^{-9}\times1.0}{0.5\times10^{-3}}$ (1) = 1.2 × 10^{-3} m = 1.2 mm (1).

17. The total electric flux through a closed surface is $\frac{q}{\varepsilon_0}$, where q is the charge enclosed (1). Take a cylindrical Gaussian surface of radius r and length l coaxial with the wire; flux passes only through the curved surface (1). $E \times 2\pi r l = \frac{\lambda l}{\varepsilon_0}$ (1), so $E = \frac{\lambda}{2\pi\varepsilon_0 r}$, directed radially (1).

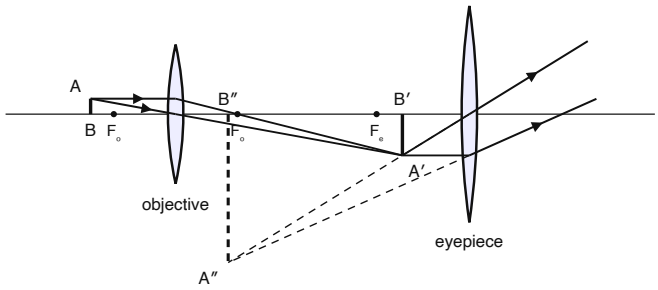
OR The field between the plates is $E = \frac{\sigma}{\varepsilon_0} = \frac{Q}{\varepsilon_0 A}$ (1). The potential difference is V = Ed = $\frac{Qd}{\varepsilon_0 A}$ (1). $C = \frac{Q}{V} = \frac{\varepsilon_0 A}{d}$ (1). With the dielectric, $C = \frac{K\varepsilon_0 A}{d}$: it increases K times (1).

18. Forces on the two sides parallel to the field are zero or cancel; the forces on the other two sides, each IbB, are equal and opposite and form a couple (1½). With the normal at angle θ to B, the torque is τ = IbB × a sin θ = IAB sin θ, or NIAB sin θ for N turns (1½). Magnetic moment m = NIA, directed along the normal, so $\vec{\tau} = \vec{m} \times \vec{B}$ (1).

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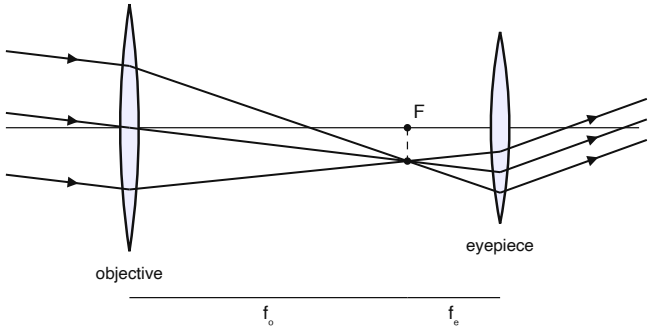
OR A current-carrying coil in a radial magnetic field experiences a torque NIAB (1). This is balanced by the restoring torque kϕ of the spring, so ϕ = (NAB/k)I: the deflection is proportional to the current (1). To make an ammeter, a low resistance (shunt) is connected in parallel with the coil (1), $S = \frac{I_g G}{I - I_g}$, so that most of the current bypasses the coil (1).

19. Ray diagram (2):



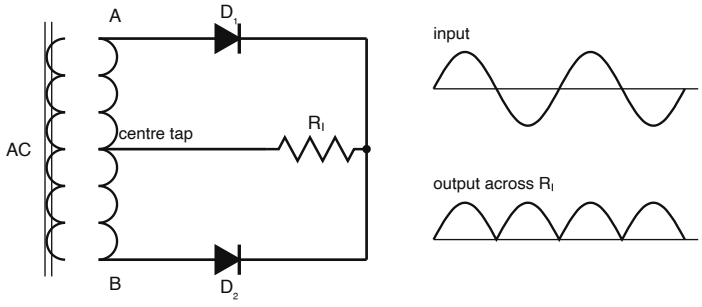
$m = -\frac{L}{f_o}\left(1 + \frac{D}{f_e}\right)$ approximately, where L is the tube length and D = 25 cm (2).

OR Ray diagram (2):



$m = -\frac{f_o}{f_e}$; the length of the telescope is $f_o + f_e$ (2).

20. Circuit with a centre-tapped transformer, two diodes and the load (1):



In one half-cycle diode D_1 is forward biased and conducts, and in the next half-cycle D_2 conducts (1). The current through the load is in the same direction in both halves (1). Waveforms: a sinusoidal input and a pulsating output with both halves positive (1).

OR Electrons move in certain stable orbits without radiating; the angular momentum is a multiple of h/2π; a photon of energy equal to the difference is emitted or absorbed when the electron jumps between orbits (2). E = 13.6(1/4 − 1/9) = 1.89 eV (1); λ = 1240/1.89 ≈ 656 nm (1).

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