CBSE Class 12 Physics 2026 (Set 3 - 55/3/3)

Question Paper with Solutions

Conducted by the Central Board of Secondary Education (CBSE)

General Instructions

(i) This question paper contains **33 questions**. All questions are **compulsory**.

(ii) Question paper is divided into **five** Sections – Section **A, B, C, D** and **E.**

(iii) Section **A** - Questions no. 1 to 16 are Multiple Choice type questions. Each question carries 1 mark.

(iv) Section **B** - Questions no. 17 to 21 are Very Short Answer type questions. Each question carries 2 marks.

(v) Section **C** - Questions no. 22 to 28 are Short Answer type questions. Each question carries 3 marks.

(vi) Section **D** - Questions no. 29 and 30 are Case Study-based questions. Each question carries 4 marks.

(vii) Section **E** - Questions no. 31 to 33 are Long Answer type questions. Each question carries 5 marks.

(viii) There is no overall choice given in the question paper. However, an internal choice has been provided in few questions in all the Sections except Section A.

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

$$c = 3 \times 10^8 \text{ m/s}$$
$$h = 6.63 \times 10^{-34} \text{ Js}$$
$$e = 1.6 \times 10^{-19} \text{ C}$$
$$\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$$
$$\varepsilon_0 = 8.854 \times 10^{-12} \text{ C}^2\text{N}^{-1}\text{m}^{-2}$$
$$\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \text{ N m}^2\text{C}^{-2}$$

Mass of electron $(m_e) = 9.1 \times 10^{-31}$ kg

Mass of neutron $= 1.675 \times 10^{-27}$ kg

Mass of proton $= 1.673 \times 10^{-27}$ kg

Avogadro's number $= 6.023 \times 10^{23}$ per gm mole

Boltzmann constant $= 1.38 \times 10^{-23}$ JK^{-1}

Section A

1. A plane electromagnetic wave travels through a medium and the magnetic field associated with it is given by
$B = 5 \times 10^{-8} \sin(3 \times 10^{10} t - 150x)$ **T**
where x is in metres and t is in seconds.
The velocity of the wave is :

(A) 2.0×10^8 ms^{-1}
(B) 4.5×10^7 ms^{-1}
(C) 3.5×10^7 ms^{-1}
(D) 2.5×10^8 ms^{-1}

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2. A ray of monochromatic light travelling in air is incident on a glass slab and is partly reflected and partly refracted. Both the reflected and refracted lights will have :

(A) same wavelength
(B) same frequency
(C) same intensity
(D) same speed

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3. When the forward bias voltage in a semiconductor diode is changed from 0.8 V to 1.0 V, the forward current changes by 2.0 mA. The forward bias resistance of the diode will be :

(A) 200 Ω
(B) 175 Ω
(C) 100 Ω
(D) 125 Ω

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4. A square loop of side L lies in the x-y plane in a magnetic field $\vec{B} = B_0(2\hat{i} + 3\hat{j} + 4\hat{k})$, where B_0 is a constant. The magnetic flux through the loop is :

(A) $\sqrt{29}B_0L^2$
(B) $4B_0L^2$
(C) $3B_0L^2$
(D) $2B_0L^2$

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5. An electric dipole with dipole moment $\vec{P} = (2.54 \times 10^{-28}$ C.m$)(2.00\hat{i} + 3.00\hat{j})$ is placed in an electric field $\vec{E} = \left(1000\frac{\text{N}}{\text{C}}\right)\hat{i}$. An external agent turns the dipole until its electric dipole moment is $\vec{P} = (2.54 \times 10^{-28}$ C.m$)(-3.00\hat{i} + 2.00\hat{j})$. The work done by the agent is :

(A) 2.54×10^{-25} J
(B) 1.27×10^{-24} J
(C) 1.02×10^{-23} J
(D) 2.29×10^{-26} J

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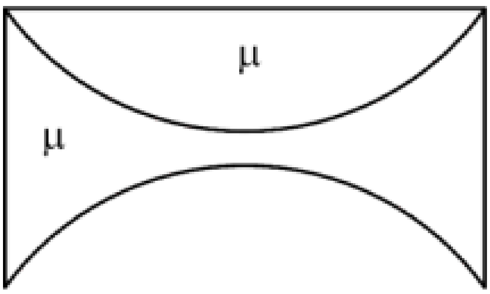
6. A thin plano-convex lens and a thin equi-concave lens are kept coaxially in contact as shown in the figure. Assuming both the lenses are made of glass of refractive index μ, and R is the radius of curvature of each curved surface, the focal length of the combination is :



(A) $\frac{R}{\mu-1}$
(B) $-\frac{R}{\mu-1}$
(C) $\frac{2R}{\mu-1}$
(D) $-\frac{2R}{\mu-1}$

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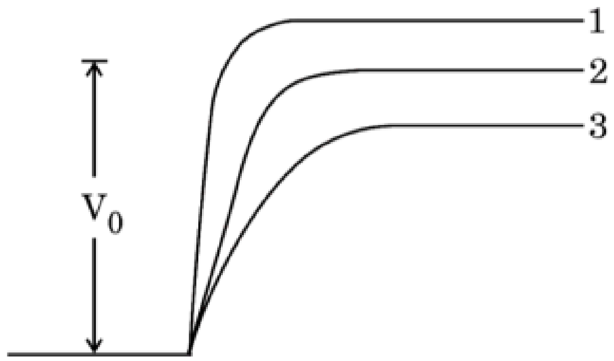
7. If the given figure, V_0 is the potential barrier across a p-n junction in an unbiased condition. Which of the following statements is correct ?



(A) Curves 1 and 3 both correspond to forward biasing of p-n junction.
(B) Curve 3 corresponds to forward biasing and Curve 1 corresponds to reverse biasing.
(C) Curve 1 corresponds to forward biasing and Curve 3 corresponds to reverse biasing.
(D) Curves 1 and 3 both correspond to reverse biasing.

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8. If r_1 and r_2 are the radii of atomic nuclei of mass numbers 64 and 27 respectively, then the value of $\left(\frac{r_1}{r_2}\right)$ is :

(A) 1
(B) $\frac{4}{3}$
(C) $\frac{3}{4}$
(D) $\frac{27}{64}$

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9. A ray of yellow light undergoes total internal reflection when it is incident at the interface of two media. This ray is successively replaced by the ray of blue, green and red lights. Which of the following statements is true if the angle of incidence is same in all cases ?

(A) Total internal reflection occurs for blue light only.
(B) Total internal reflection occurs for red light only.
(C) Total internal reflection occurs for both green and blue lights.
(D) None of them will undergo total internal reflection.

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10. The ratio of the de Broglie wavelengths associated with the electron revolving in the first and third orbits in hydrogen atom is :

(A) 2
(B) $\frac{1}{2}$
(C) 3
(D) $\frac{1}{3}$

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11. Radiation of wavelength 200 nm is incident on a photosensitive surface of work function 4.2 eV. The kinetic energy of fastest photoelectrons emitted from this surface will be close to :

(A) 3.5 eV
(B) 3.0 eV
(C) 2.5 eV
(D) 2.0 eV

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12. The phase difference between the two superimposing waves that give rise to a bright spot in a Young's double-slit experiment is (n is an integer) :

(A) $2n\pi$
(B) $2n\pi + \frac{\pi}{4}$
(C) $2n\pi + \frac{\pi}{2}$
(D) $2n\pi + \pi$

Question number 13 to 16 are Assertion (A) and Reason (R) type questions. Two statements are given — one labelled Assertion (A) and the other labelled Reason (R). Select the correct answer from the codes (A), (B), (C) and (D) as given below.
(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Both Assertion (A) and Reason (R) are false.

13. Assertion (A) : Nuclear forces are always attractive.
Reason (R) : The nuclear force between protons and neutrons in a nucleus is a weak force.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Both Assertion (A) and Reason (R) are false.

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14. Assertion (A) : Photoelectric current depends upon the intensity of the incident radiation.
Reason (R) : Stopping potential is independent of the intensity of the incident radiation.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Both Assertion (A) and Reason (R) are false.

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15. Assertion (A) : In a Wheatstone bridge circuit, if we interchange the position of the cell and the galvanometer, the balance condition $\frac{P}{Q} = \frac{R}{S}$ remains unchanged.
Reason (R) : $\frac{P}{Q} = \frac{R}{S} \Rightarrow \frac{Q}{S} = \frac{P}{R}$ so balance condition remains same.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Both Assertion (A) and Reason (R) are false.

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16. Assertion (A) : The cylindrical soft iron core in a moving coil galvanometer only makes the magnetic field radial and does not affect the strength of the magnetic field.
Reason (R) : In a moving coil galvanometer, the plane of the coil is always perpendicular to the magnetic field.

(A) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the Assertion (A).
(B) Both Assertion (A) and Reason (R) are true, but Reason (R) is not the correct explanation of the Assertion (A).
(C) Assertion (A) is true, but Reason (R) is false.
(D) Both Assertion (A) and Reason (R) are false.

Section B

17. Write any two points of difference between intrinsic and extrinsic semiconductors.

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18. Explain the terms mass defect and binding energy. How are they related ?

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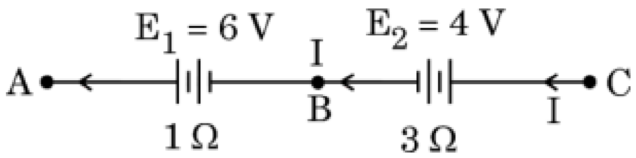
19. Light of frequency 5.0×10^{14} Hz is incident on a metal surface. If the maximum speed of photoelectrons emitted is 6.63×10^{5} ms^{-1}, calculate the threshold frequency for the surface.

20(a). In the given figure, a steady current I flows through the circuit when points A and C are connected by a wire of negligible resistance. Find the potential difference between points B and C.



OR

20(b)(i). A battery of emf 21 V and internal resistance 3 Ω is connected to a resistor. If the current in the circuit is 3 A, find the resistance of the resistor.

20(b)(ii). A battery of emf 21 V and internal resistance 3 Ω is connected to a resistor. If the current in the circuit is 3 A, find the terminal voltage of the battery.

21(a). In Young's double slit experiment, the central maximum is bright in the interference pattern obtained on a screen. What will happen when light waves emitted out of slits S_1 and S_2 have an initial phase difference of π radian ? Justify your answers.

21(b). In Young's double slit experiment, the central maximum is bright in the interference pattern obtained on a screen. What will happen when one of the slits is closed ? Justify your answers.

Section C

22(a). Depict the variation of electric field ($\vec{E}$) and magnetic field ($\vec{B}$) with respect to the direction of propagation of an electromagnetic wave. Write their two important characteristics.

22(b). Show that $\frac{1}{\sqrt{\varepsilon_0 \mu_0}}$ gives the velocity of an electromagnetic wave in free space.

23(a). A ray of light is incident at angle of 45° on one face of a prism with an equilateral triangular base. If it passes symmetrically through the prism, find the angle of minimum deviation for the prism

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23(b). A ray of light is incident at angle of 45° on one face of a prism with an equilateral triangular base. If it passes symmetrically through the prism, find the refractive index of the material of the prism.

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24. With the help of circuit diagrams, briefly explain the forward biasing and the reverse biasing of a p-n junction diode.

25(a). Establish the relation between drift velocity of electrons (v_d) and electric current (I) in a conductor.

25(b). How is v_d affected when the length of the conductor is doubled, keeping the voltage applied across the conductor constant ?

26(a). A circular coil of 30 turns and radius 8.0 cm carrying a current of 6 A is suspended vertically in a uniform horizontal magnetic field of 1.0 T. The field lines make an angle of 30° with the plane of the coil. Calculate the magnitude of the external torque that must be applied to prevent the coil from turning. What would happen if the circular coil is replaced by a planar coil of irregular shape that encloses the same area, keeping other parameters unchanged ?

OR

26(b). An alpha particle (mass 6.4×10^{-27} kg and charge 3.2×10^{-19} C) having 8.0 MeV energy, enters a region of a uniform magnetic field of 0.5 T. If the field is directed perpendicular to the velocity of the particle, find the radius of the circular path described by the particle. Mention the condition under which the particle in this region (i) describes a helical path, and (ii) goes straight undeviated.

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27. State Faraday's law of electromagnetic induction. Briefly describe two methods for producing induced emf.

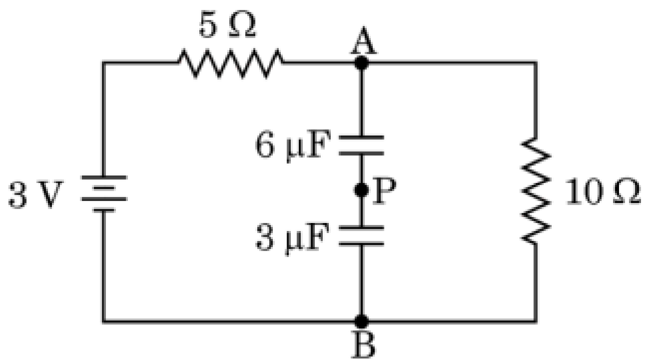
28(a). A deuterium nucleus and an alpha particle approach a target nucleus separately in head-on position. Find the ratio of their distance of closest approach to the nucleus, when both have the same velocity.

28(b). A deuterium nucleus and an alpha particle approach a target nucleus separately in head-on position. Find the ratio of their distance of closest approach to the nucleus, when both have the same momentum.

Section D

Question number 29 and 30 are Case Study-based questions. Read the following paragraphs and answer the questions that follow.

29. Capacitors are manufactured with certain standard capacitances and working voltages. However, these standard values may not be the ones that are actually needed in a particular application. Two or more capacitors can be grouped in series or in parallel to achieve desired capacitance and voltage. When connected in series, the total capacitance decreases while the voltage rating increases, whereas in parallel connections, the total capacitance increases and maintains the same voltage rating. A capacitor stores energy in the electric field between its plates and stored energy is proportional to the square of the voltage and capacitance $U = \frac{1}{2}CV^2$, where symbols have their usual meanings.
Two capacitors, one of $3\ \mu$F and the other of $6\ \mu$F, are connected in series in the circuit as shown in the figure, for a long time.



29(i). The total capacitance of the circuit is :

(A) $6\ \mu$F
(B) $3\ \mu$F
(C) $9\ \mu$F
(D) $2\ \mu$F

29(ii). The current in the $10\ \Omega$ resistor is :

(A) 0.3 A
(B) 0.6 A
(C) 0.2 A
(D) 0

29(iii). The potential difference between point A and B is :

(A) 2 V
(B) 0.3 V
(C) 0.2 V
(D) 3 V

29(iv)(a). The value of charge on the plates of the $6\ \mu$F capacitor is :

(A) $6\ \mu$C
(B) $4\ \mu$C
(C) $12\ \mu$C
(D) $8\ \mu$C

OR

29(iv)(b). The wire between two capacitors is cut at point P. The current in the circuit will :

(A) increase
(B) decrease
(C) remain the same
(D) first increase then become stable

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30. A charged particle $+q$ in an electric field $\vec{E}$ experiences a force in the direction of the electric field. As a result, its kinetic energy changes. Similarly, the charged particle also experiences a force when it moves in a magnetic field $\vec{B}$. But this magnetic force is perpendicular to both velocity $\vec{v}$ of the charged particle and the magnetic field $\vec{B}$, so it cannot change the kinetic energy of the charged particle. Consider two charged particles 1 and 2 of masses m and $\frac{m}{2}$ having charges $-q$ and $+2q$ respectively. They are accelerated from rest through the same potential difference V and acquire kinetic energy K_1 and K_2. Then they enter in a region of uniform magnetic field $\vec{B}$ perpendicular to their velocities.

30(i). The ratio of their kinetic energies $\left(\frac{K_1}{K_2}\right)$ is :

(A) $\frac{1}{2}$
(B) $\frac{1}{4}$
(C) 4
(D) 1

30(ii). The ratio of the radii of the circular paths described by them $\left(\frac{r_1}{r_2}\right)$ is :

(A) $\frac{1}{\sqrt{2}}$
(B) $\sqrt{2}$
(C) $\frac{1}{2}$
(D) 2

30(iii). Suppose particles 1 and 2 enter the magnetic field $\vec{B} = B_0\hat{k}$ with velocities $\vec{v}_1 = v_1\hat{i}$ and $\vec{v}_2 = v_2\hat{i}$. Then :

(A) both particles revolve clockwise
(B) both particles revolve anticlockwise
(C) particle 1 revolves clockwise while particle 2 revolves anticlockwise
(D) particle 1 revolves anticlockwise while particle 2 revolves clockwise

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30(iv)(a). If period of revolution for particle 1 is 4 s, then for particle 2, the period will be :

(A) 1 s
(B) 2 s
(C) 4 s
(D) 8 s

OR

30(iv)(b). If the value of momentum for particles 1 and 2 are p_1 and p_2, then :

(A) $p_1 = \frac{p_2}{2}$
(B) $p_1 = p_2$
(C) $p_1 = 2p_2$
(D) $p_1 = 4p_2$

Section E

31(a)(i). A point object is kept in front of a convex spherical surface of radius of curvature R. Draw the ray diagram to show the formation of image and derive the relation between the object and image distance (u and v) in terms of refractive index n of the medium and R.

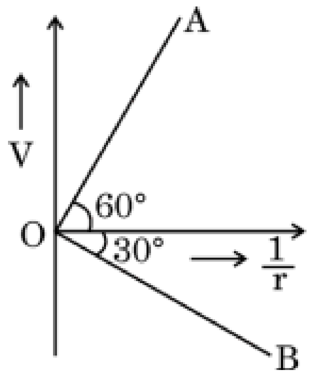
31(a)(ii). A convex lens of focal length of 20 cm is used to form the image of an object placed 30 cm away from the lens. Find the position and nature of the image formed.

OR

31(b)(i). Two thin converging lenses of focal length f_1 and f_2 are placed coaxially in contact. Derive expression for the focal length of the combination.

31(b)(ii). A beam of coherent light of wavelength 550 nm is incident normal to the plane of a pair of two slits S_1 and S_2 each of width $1 \cdot 2 \times 10^{-6}$ m separated by 1.1 mm. Dark and bright fringes are observed on a screen 2.2 m away from the plane of the slits. Calculate: (I) fringe width. (II) distance of the second dark fringe from the central maximum. (III) what will happen when the entire apparatus is immersed in water.

32(a)(i)(I). In the figure, OA and OB show the variation of electric potential V at a point due to two point charges Q_1 and Q_2 with $1/r$ respectively. Here r represents the distance of the point from the two point charges. Identify the nature of the two charges Q_1 and Q_2.



32(a)(i)(II). In the figure, OA and OB show the variation of electric potential V at a point due to two point charges Q_1 and Q_2 with $1/r$ respectively. Here r represents the distance of the point from the two point charges. What is the value of Q_1/Q_2? Justify your answer.

32(a)(ii). Two point charges $-2\mu C$ and $5\mu C$ are placed at $(-30\,\text{cm}, 0)$ and $(30\,\text{cm}, 0)$ respectively in an external electric field $\vec{E} = \frac{A}{x^2}\hat{i}$, where $A = 9 \times 10^5$ Nm^{2}C^{-1}. Find the electrostatic potential energy of this configuration.

OR

32(b)(i). Two infinitely long straight wires having linear charge densities $-\lambda$ and 3λ are held vertically parallel to each other, distance r apart in free space. Find the nature and magnitude of the force/length exerted by one wire on the other.

32(b)(ii)(I). A small hollow conducting sphere of radius r_1 is given a charge Q. It is surrounded by a concentric conducting spherical shell of inner radius r_2 and outer radius r_3, having charge $-3q$. If a point charge 2q were kept at the centre, find the electric flux through a concentric spherical Gaussian surface of radius x for (1) $x < r_1$, and (2) $r_1 < x < r_2$.

32(b)(ii)(II). A small hollow conducting sphere of radius r_1 is given a charge Q. It is surrounded by a concentric conducting spherical shell of inner radius r_2 and outer radius r_3, having charge $-3q$. If a point charge 2q were kept at the centre, find electric field at a point distant x from the centre for (1) $x > r_3$, and (2) $r_1 < x < r_2$.

32(b)(ii)(III). A small hollow conducting sphere of radius r_1 is given a charge Q. It is surrounded by a concentric conducting spherical shell of inner radius r_2 and outer radius r_3, having charge $-3q$. If a point charge 2q were kept at the centre, find surface charge density on the inner surface of (1) sphere, and (2) shell.

33(a)(i)(I). A light bulb and an open coil inductor are connected in series across an ac source of variable frequency. How will the glow of the bulb be affected when an iron bar is inserted inside the coil ? Justify your answer. Assume that other factors remain unchanged.

33(a)(i)(II). A light bulb and an open coil inductor are connected in series across an ac source of variable frequency. How will the glow of the bulb be affected when the frequency of the source is decreased ? Justify your answer. Assume that other factors remain unchanged.

33(a)(ii)(I). An ac voltage $V = 280\sin(100\pi t)$ volt is connected across a series LCR circuit in which $R = 400\Omega$, $L = 5/\pi$ H and $C = 50/\pi\mu$F. Taking $\sqrt{2} = 1.4$, calculate impedance of the circuit.

33(a)(ii)(II). An ac voltage $V = 280\sin(100\pi t)$ volt is connected across a series LCR circuit in which $R = 400\Omega$, $L = 5/\pi$ H and $C = 50/\pi\mu$F. Taking $\sqrt{2} = 1.4$, calculate rms value of current that flows in the circuit.

33(a)(ii)(III). An ac voltage $V = 280\sin(100\pi t)$ volt is connected across a series LCR circuit in which $R = 400\Omega$, $L = 5/\pi$ H and $C = 50/\pi\mu$F. Taking $\sqrt{2} = 1.4$, calculate power factor of the circuit.

OR

33(b)(i). State Lenz's law and explain that it follows the law of conservation of energy.

33(b)(ii). Write the dimensional formula for self-inductance. The current in a coil changes from 8.0 A to 2.0 A in 0.6 s. If an average emf induced in the coil is 50 V, calculate the self-inductance of the coil.
