

Trial Ministry Exam (3)

Read the questions carefully then answer according the instructions given in each question:

1. **Choose to answer (A) or (B): Define one of the following terms:**

- A. Effective value of AC current.
- B. Lenz's law

2. **Choose to answer (A) or (B): Write down the mathematical expression for one of the following equations:**

- A. De Broglie equation.
- B. The relation between mass and energy.

3. **Choose to answer (A) or (B): Compare a pair of the following:**

- A. Electric resistance and specific resistance in terms of the measuring unit.
- B. Connecting a number of identical resistors in series and in parallel in terms of the equivalent resistance

4. **Give reason for:** The existence of a constant and known voltage in the ohmmeter circuit.

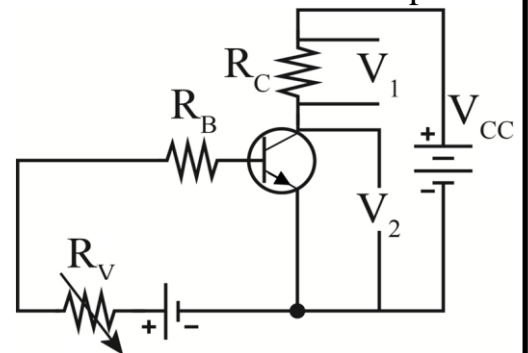
5. **Express** the decimal value (11) in the binary code.

6. **Compare between:** Line spectrum and Continuous spectrum in terms of an example of their source.

7. Study the given circuit diagram:

First: What is the type of the transistor shown in this diagram?

Second: What is the effect of increasing the variable resistance (R_V) on the value of voltage (V_2)?



8. A solenoid is connected to an AC supply. **What** is the effect of the following modifications on its inductive reactance?

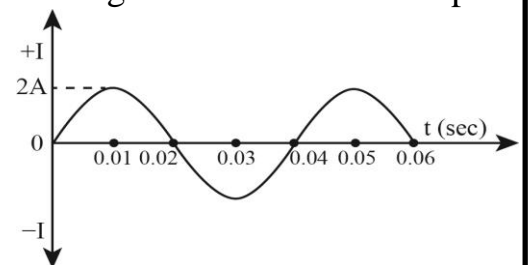
First: Inserting a soft iron rod inside it.

Second: Stretching its turns slightly away from each other.

9. The given graph shows the change in the value of current generated from a simple dynamo as its coil rotates, **Find:**

First: The angular velocity of the coil rotation.

Second: The average value of the generated current during 0.04 seconds.



10. **Choose to answer (A) or (B): Mention the role of:**

- A. The soft iron cylinder in the moving coil galvanometer.
- B. The shunt resistance in the ammeter.

11. **Choose the correct answer:**

The form of energy used to excite the atoms of the active medium in the liquid dye laser is:

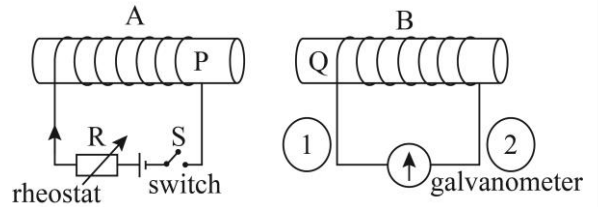
- (A) Optical (B) Electrical (C) Thermal (D) Chemical

12. **Mention** one factor that affects the direction of the magnetic dipole moment of a coil.

13. **Give reason for:** Laser is used in the operation of the reconnection of retinal detachment.

14. **Choose the correct answer:**

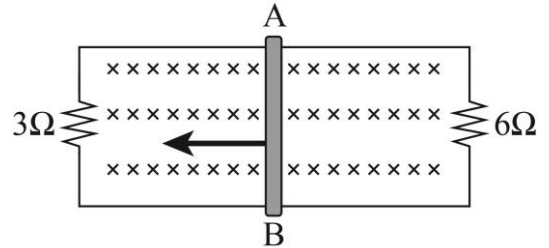
In the given figure, it is noticed that an induced current passes through the galvanometer from terminal (2) to terminal (1) when ...



- (A) The switch (S) is turned on.
- (B) The resistance of the rheostat (R) is increased.
- (C) The coil (B) is moved nearer towards the coil (A).
- (D) The coil (A) is moved nearer towards the coil (B).

15. **Compare** between: Holography and Ordinary photography in terms of the recorded information on the photographic plate.

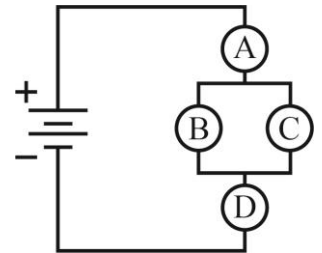
16. The figure shows a metal rod (AB) of length 0.2m is moving at a uniform velocity 8m/s perpendicular to a magnetic field of flux density 2.5T whose direction is inward perpendicular to the paper plane. **Calculate** the intensity of the current in the resistance 6Ω (neglecting the rod resistance).



17. **Calculate** the longest wavelength of the visible spectrum emitted by the hydrogen atom. **Knowing that:** ($h = 6.625 \times 10^{-34}$ J.s, $c = 3 \times 10^8$ m/s).

18. **Choose the correct answer:**

Four identical electric bulbs A, B, C and D are connected with a battery of negligible internal resistance as shown in figure. If the potential difference between the terminals of the bulb (C) is 3V, the electromotive force of the battery would be ...



- (A) 6V
- (B) 9V
- (C) 12V
- (D) 15V

19. **Choose to answer (A) or (B): Write down the mathematical formula that is used to calculate:**

- A. The resonance frequency in a LCR circuit.
- B. The quantity of charge accumulating on a capacitor when connected to DC supply.

20. **Choose to answer (A) or (B): Compare one pair of the following:**

- A. Ampere's right hand rule and Fleming's right hand rule in terms of their use.
- B. Digital measuring instruments and analog measuring instruments in terms of the way they display the value of the measured quantity.

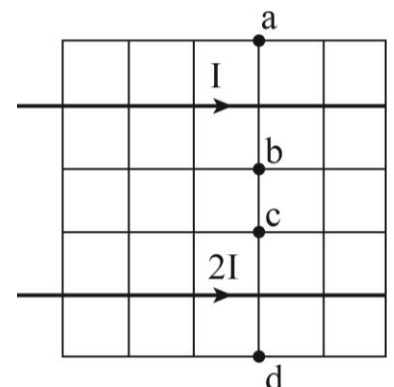
21. **Choose to answer (A) or (B): Give reason for of the following phenomena:**

- A. Natural resources underground can be detected remotely.
- B. Visible light can not penetrate through your hand.

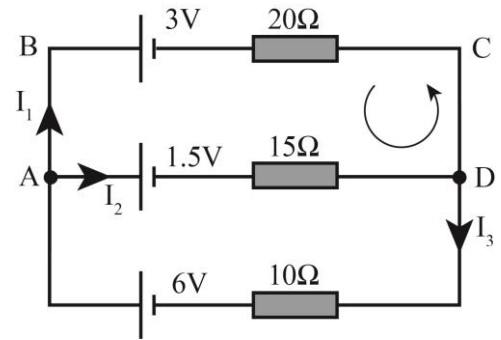
22. **Choose the correct answer:**

The figure shows two parallel wires. Points a, b, c, d are drawn due to scale. At which point the magnetic flux density is zero?

- (A) a
- (B) b
- (C) c
- (D) d

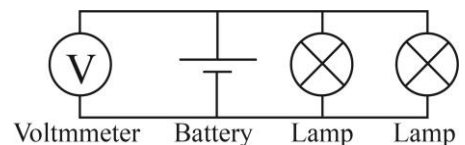


23. In Compton effect, **why** does the scattered photon always have a longer wavelength than the incident photon?
24. **What** is meant by the depletion region in pn junction?
25. For the electric circuit shown in the figure, **calculate** the current intensity (I_2).



26. The midpoint of the scale of an ohmmeter between $(0 - \infty)$ marked as 1500Ω . If the ohmmeter is composed of a galvanometer of resistance 250Ω , a fixed resistance $1 \text{ k}\Omega$, a rheostat and a cell of negligible internal resistance. **Find** the resistance value taken from the rheostat to make the pointer deflect to zero position of the ohmmeter.
27. An ideal transformer has 500 turns in the primary coil and 10 turns in the secondary coil. **First: Calculate** the secondary voltage if the secondary circuit is open and the primary voltage is 120 V.
Second: Determine the current in the primary coil, given that the secondary coil is connected to a resistance 15Ω ?
28. **Choose to answer (A) or (B): Define:**
A. The electromotive force of a battery. B. The electric conductivity of a material.
29. **Choose to answer (A) or (B): Give one use of one device:**
A. Spectrometer. B. Coolidge tube.
30. **Mention one factor** that affects the wavelength that has maximum intensity in the radiation emitted by a hot body.
31. **Choose to answer (A) or (B): Which part of the galvanometer acts to fulfill the following condition?**
A. The galvanometer coil is influenced by a constant magnetic field.
B. Restoring its pointer to zero position after turning its circuit off.
32. **Choose the correct answer:**
In AC circuit, an inductive coil of inductive reactance 40Ω and ohmic resistance 30Ω is connected to an AC supply of effective voltage 60 V. The dissipated power in the circuit equals
(A) 43.2W (B) 51.4W (C) 72W (D) 120W

33. **Give reasons for:** The voltmeter reading increases when one of the two bulbs is blown out.



34. **Explain** the role of electric transformers in transportation of the electric energy from power plants to the areas where it is distributed for domestic use.
35. A galvanometer has coil resistance of 200Ω . Its pointer deflects to full scale as a current of 10 mA passes through its coil.
First: Calculate the maximum voltage measured by the galvanometer.
Second: What is the value of the multiplier resistance required to increase its scale range to 20 V?

36. A resistor, an inductor and a capacitor are connected in series across an AC voltage source. A voltmeter measures 12.0 V, 15.5 V and 10.5 V respectively, when placed across each element separately. **What** is the magnitude of the voltage of the source?

37. **Choose to answer (A) or (B): Give one application of one of the two following phenomena:**

- (A) Electromagnetic induction.
- (B) Eddy currents.

38. **Compare** between: The cathode ray tube and the photoelectric cell in terms of the reason of electron emission from the cathode.

39. **Mention** two effects of X-rays make it suitable for imaging bone fractures.

40. **Choose the correct answer:**

The magnetic flux density increases at the center of a circular coil carrying an electric current by decreasing:

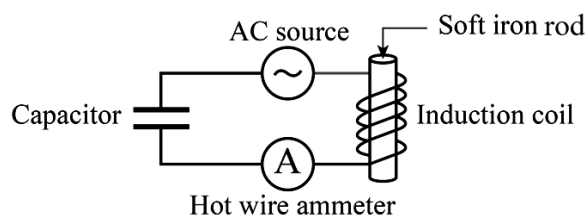
- (A) Cross sectional area of the coil.
- (B) The number of the coil turns.
- (C) The current intensity in the coil
- (D) The permeability of the coil core.

41. **What** is meant by Coherency of laser photons?

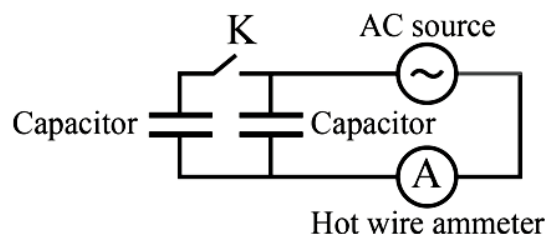
42. **What** is the scientific principle on which the operation of the electric motor based?

43. **Choose to answer (A) or (B):**

A. The circuit shown in the diagram is in a state of resonance. **What** would happen to the reading of the hot wire ammeter when the soft iron rod is removed from the inductive coil? **Explain** your answer.



B. **What** would happen to the reading of the hot wire ammeter when the switch (K) is closed? **Explain** your answer.



44. **First: Draw** a labeled diagram for a silicon crystal doped with phosphorus atoms.

Second: Explain why the crystal is electrically neutral in spite of having different concentrations of the types of charge carriers inside it.

45. The table below records the values of the electromotive force generated in a dynamo coil and sine the angle between the normal to the coil plane and the direction of the magnetic flux.

Emf induced (Volts)	0	20	40	60	80	100
Sinθ	0	0.1	0.2	0.3	0.4	0.5

First: Plot the graph that represents these data where the electromotive force is on the vertical axis and sine the angle on the horizontal axis.

Second: From the graph, **find** the maximum electromotive force generated in the dynamo.

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- Choose to answer (A) or (B): Write down the scientific concept that expresses:**
 - It is the value of the direct current which generates same rate of thermal effect in resistance (or same power) as that generated by the considered AC current.
 - The induced current must be in a direction such as to oppose the change producing it.
- Choose to answer (A) or (B): Write down the mathematical expression for one of the following equations:** A. $\lambda = \frac{h}{P_L} = \frac{h}{mv}$ B. $E = mc^2$
- Choose to answer (A) or (B): Compare a pair of the following:**

No	Point of comparison	Electric resistance	Specific resistance
A.	Measuring unit	Ω	$\Omega.m$

No	Point of comparison	Connecting a number of identical resistors in series	Connecting a number of identical resistors in Parallel
B.	Equivalent resistance	$R_{eq} = nR$ (Large)	$R_{eq} = R/n$ (Small)

4. **Give reason for:** Because the electric current intensity is inversely proportional to the total resistance with constant potential difference according to ohm's law, so we may calibrate the device to give the value of the resistance directly.

5. $(11)_{10} = (1011)_2$

$11 \div 2 = 5$	1	↑ (1011) ₂
$5 \div 2 = 2$	1	
$2 \div 2 = 1$	0	
$1 \div 2 = 0$	1	

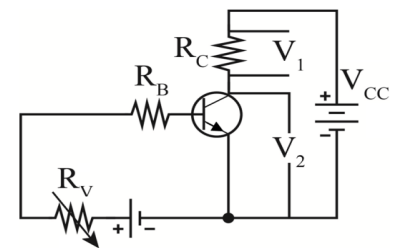
6. **Compare between:**

Point of comparison	Line spectrum	Continuous spectrum
Example of their source	Hot gas	White light

7. **First:** The type of transistor: npn

Second: If $R_V \uparrow$ increase, so $I_B \downarrow$ will decrease, then $I_C \downarrow$ decreases. $V_{CC} = V_{CE} \uparrow + I_C \downarrow R_C$

$V_2 = V_{CE}$ So (V_2) will increase



8. **First:** The inductive reactance (X_L) will increase.

Because $L_{self} = (\mu N^2 A) / L_{sol}$, as the iron core has higher permeability (μ), so the self-inductance increases (L_{Self}), as $X_L = 2\pi fL$ so ($X_L \propto L$).

Second: The inductive reactance (X_L) will decrease.

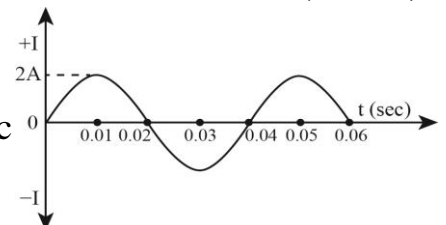
Because $L_{self} = (\mu N^2 A) / L_{sol}$, when stretching its turns slightly away from each other, the length of solenoid increase, so the self-inductance decreases (L_{Self}), as $X_L = 2\pi fL$ so ($X_L \propto L$).

9. **First:** $T = 0.04 \text{ sec}$ $\therefore f = \frac{1}{T}$ $\therefore f = \frac{1}{0.04} = 25 \text{ Hz}$

$\therefore \omega = 2\pi f$ $\therefore \omega = 2 \times \pi \times 25$ $\omega = 50\pi = 157 \text{ rad/sec}$

Second: $\text{emf}_{av(1)} = 0$, so $I = 0$

(Where at time 0.04 the current makes a complete cycle)



10. **Choose to answer (A) or (B): Mention the role of:**

- (A) It is used to increase the permeability of medium and concentrate the magnetic lines.
 (B) 1. Extend the galvanometer range into ammeter.
 2. Makes the whole ammeter resistance very small. (R_s parallel with R_g)
 3. Makes the ammeter does not change markedly the measured current.

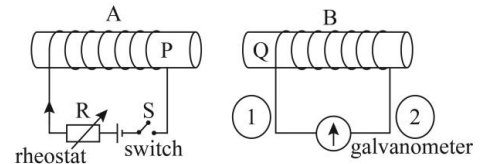
11. **Choose the correct answer: (A) Optical**

12. **Mention one factor:** The direction of current intensity passing through the coil.

13. **Give reason for:** Because the thermal heat from the laser cauterizes (burn) the points of detachment (endothermy).

14. **Choose the correct answer: (B) The resistance of the rheostat (R) is increased.**

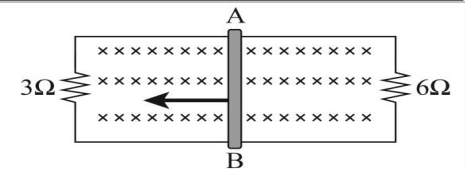
Where: when the current passes from terminal (2) to (1), will be in the same direction to the direction of current of battery so the induced current is forward).



15. **Compare between:**

Point of comparison	Holography	Ordinary photography
The recorded information on the photographic plate.	All the information which are carried by the reflected rays from the surface of the object (Intensity and phase)	Part of the information which are carried by the reflected rays from the surface of the object (Intensity)

16. $emf = Blv$ $emf = 2.5 \times 0.2 \times 8$ $emf = 4 \text{ Volt}$
 $emf = I_{6\Omega} R$ $4 = 6I_{6\Omega}$ $I_{6\Omega} = 2/3 A = 0.667 A$



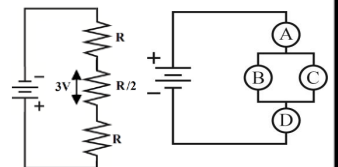
17. $\frac{1}{\lambda} = \frac{-13.6 \times e}{hc} \left(\frac{1}{n_{\text{higher}}^2} - \frac{1}{n_{\text{lower}}^2} \right)$ $\frac{1}{\lambda} = \frac{-13.6 \times 1.6 \times 10^{-19}}{6.625 \times 10^{-34} \times 3 \times 10^8} \left(\frac{1}{3^2} - \frac{1}{2^2} \right)$ $\lambda = 6.576 \times 10^{-7} \text{ m}$

The electron moves from level (3) to level (2) to emitted photon of longest wavelength.

18. **Choose the correct answer: (D) 15V**

Where: $I_t = V/R = 3/(R/2) = 6/R$ $R_{eq} = R + 0.5R + R = 2.5R$

$\therefore V_B = I (R_{eq} + r) = (6/R) \times (2.5R + 0) = 15V$



OR $V_R = 2V_{0.5R}$ so $V_R = 6V$ as $r = 0$ so $V_B = V_T = 6 + 3 + 6 = 15V$

19. **Choose to answer (A) or (B): Write down the mathematical formula that is used to calculate:** A. $f = 1/(2\pi\sqrt{LC})$ B. $C = Q/V$

20. **Choose to answer (A) or (B): Compare one pair of the following:**

No	Point of comparison	Ampere's Right hand rule	Fleming's right hand rule
A.	Their use	Determine the direction of the magnetic field when passing electric current in a conductor.	Determine the direction of the induced current in a straight wire moved normal to a magnetic field

No	Point of comparison	Digital measuring instruments	Analog measuring instruments
B.	The way they display the value of the measured quantity.	These instruments depend on reading numerals.	These instruments use pointers.

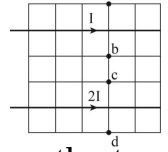
21. Choose to answer (A) or (B): Give reason for of the following phenomena:

(A) As photographing bodies using heat radiation (infrared) which the scientists analyze such images to determine possible natural earth resources.

(B) As the visible light has small energy and long wavelength (low penetrating power).

22. Choose the correct answer: (B) b

$$\frac{I_1}{d_1} = \frac{I_2}{d_2} \qquad \frac{I}{d_1} = \frac{2I}{d_2} \qquad d_2 = 2d_1$$



As the current are in the same direction so the neutral point will be in between the two wires, and the neutral point will be near to the weaker current so the point is (b).

23. Because when the photon collide with a free electron, the photon frequency decreased and according the relation: $c = \lambda \nu$ so the wavelength is inversely proportional with the frequency so the scattered photon always have a longer wavelength than the incident photon.

24. It is a middle region in pn junction composed of positive ions and negative ions, while no electrons or holes exist in this region.

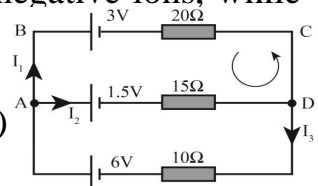
25. **Using KCL:** $I_1 + I_2 = I_3$ $II_1 + II_2 - II_3 = 0 \rightarrow (1)$

Using KVL: $3 + 20I_1 - 15I_2 - 1.5 = 0$ $20I_1 - 15I_2 + 0I_3 = -1.5 \rightarrow (2)$

Using KVL: $1.5 + 15I_2 + 10I_3 - 6 = 0$ $0I_1 + 15I_2 + 10I_3 = 4.5 \rightarrow (3)$

By solving equations: $I_1 = 3/65A = 0.046A$ $I_2 = 21/130 = 0.16A$ $I_3 = 27/130 = 0.21A$

So $I_2 = 21/130 = 0.16A$



26. $I_{max} = \frac{V_B}{R_d}$ $V_B = I_{max} R_d \rightarrow (1)$ $V_B = I(R_d + R_x)$ $V_B = 0.5I_{max} (R_d + 1500) \rightarrow (2)$

By equating the two equations $I_{max} R_d = 0.5I_{max} (R_d + 1500)$ $\therefore R_d = 1500\Omega$

OR $I = \frac{1}{2} I_{max}$ $I = \frac{1}{n} I_{max}$ **so** $n = 2$ $R_x = (n - 1)R_d$ $R_d = R_x = 1500$

$R_d = R_g + R_{st} + R_v + r$ $1500 = 250 + 1000 + R_v + 0$ $\therefore R_v = 250\Omega$

27. **First:** $\frac{\eta V_p}{V_s} = \frac{N_p}{N_s}$ $\frac{1 \times 120}{V_s} = \frac{500}{10}$ $V_s = 2.4 \text{ Volt}$

Second: $V_s = I_s R_s$ $2.4 = 15I_s$ $I_s = 0.16A$

$\frac{\eta V_p}{V_s} = \frac{I_s}{I_p}$ $\frac{1 \times 120}{2.4} = \frac{0.16}{I_p}$ $I_p = 3.2 \times 10^{-3} A$

28. Choose to answer (A) or (B): Define:

A. The total work done to transfer unit charge throughout the circuit outside and inside the source.

OR The voltage difference across the source when the current ceases ($I = 0$) to flow in the circuit.

B. It is the reciprocal of resistance of a piece of material of length 1meter and cross section area $1m^2$ at certain temperature. **OR** It is the reciprocal of the resistivity.

29. Choose to answer (A) or (B): Give one use of one device:

A. – To obtain a pure spectrum.

– To measure the temperature of the stars and their gases ($\lambda \propto 1/\text{Temperature}$).

– To decompose (analyze) light into visible and invisible components.

B. It used to produce X-rays.

30. Temperature (according to Wien's law $\lambda \propto 1/\text{Temperature}$).

31. Choose to answer (A) or (B): Which part of the galvanometer acts to fulfill the following condition?

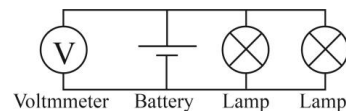
A. Concave magnetic poles B. Two spiral springs

32. **Choose the correct answer: (A) 43.2W**

$$Z = \sqrt{(X_L)^2 + (R)^2} = \sqrt{(40)^2 + (30)^2} = 50\Omega \quad I = V / Z = 60 / 50 = 1.2A$$

$$P = I^2R = (1.2)^2 \times 30 = 43.2W$$

33. Because the equivalent resistance increases when one of the two bulbs is burn out, so the total current will decrease and according to the relation $\uparrow V = V_B - \downarrow Ir$, so the reading of voltmeter increases.



34. Transfer electric energy from the generating power stations to zone of distribution across very long distances in metallic wires with no considerable loss in energy. Step up transformers are used at the stations while step down transformers are used at distribution regions.

35. **Frist:** $V_g = I_g R_g \quad V_g = 10 \times 10^{-3} \times 200 \quad V_g = 2V$
Second: $R_m = (V - V_g) / I_g \quad R_m = (20 - 2) / (10 \times 10^{-3}) \quad R_m = 1800\Omega$

36. $V_T = \sqrt{V_R^2 - (V_L - V_C)^2} \quad V_T = \sqrt{(12)^2 + (15.5 - 10.5)^2} \quad V_T = 13Volt$

37. **Choose to answer (A) or (B): Give one application of one of the two following phenomena:** A. Dynamo B. Induction furnaces for melting metals

38. **Choose to answer (A) or (B): Compare between:**

Point of comparison	The cathode ray tube	The photoelectric cell
Reason of electron emission from the cathode	Thermionic effect (Heat)	Photoelectric effect (Light)

39. Penetrate the medium easily and affecting sensitive photographic plate.

40. **Choose the correct answer: (A) Cross sectional area of the coil.**

Where: $B = \mu NI / 2r \quad B \propto (1/r) \quad \therefore B \propto (1/A) \quad \text{as} \quad A = \pi r^2$

41. The laser photon come out together at the same time sequence and maintains same phase difference during propagation over long distances. This makes radiation intense and focused.

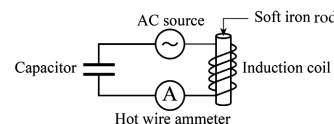
42. The torque that is generated on a coil carrying current placed in a magnetic field.

43. **Choose to answer (A) or (B):**

(A) The reading of the hot wire ammeter will **decrease**.

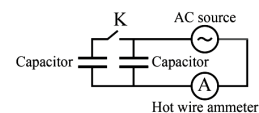
Because $L_{self} = (\mu N^2 A) / L_{Sol}$, as the permeability (μ) of air is smaller than the permeability (μ) of iron, so the self-inductance decreases (L_{self}), as $X_L = 2\pi fL$ so ($X_L \propto L$).

As (X_L) changes, inductive reactance will not be equal the capacitive reactance. The circuit will not be at resonance and the current will not be maximum so current will **decrease**.

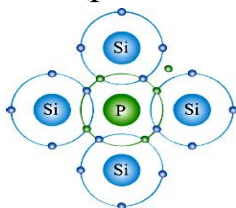


(B) The reading of ammeter will **increase**.

Because when (K) is closed, the total capacitive reactance will **decrease** (parallel connection) so the current will **increase**.



44. **Frist:**



Second: Because we add atoms not ions, so they do not gain or lose any electrons ($No_{\cdot}electrons = No_{\cdot}protons$).

45. **First:** Drawing.

Second: Form the graph $emf_{max} = 200V$

OR Slope = $\frac{\Delta Y}{\Delta X} = \frac{40 - 20}{0.2 - 0.1} = 200$

Slope = $\frac{emf}{\sin \theta} = BA\omega N = emf_{max} \quad \therefore emf_{max} = 200V$

