Ministry of Education
General Secondary Education Certificate Examination, 2015
[New System – First Session]

Physics	**Time: 3 hours**

تنبيه مهم : ١ ـ يسلم الطالب ورقة امتحانية باللغة العربية مع الورقة المترجمة .　[الأسئلة فى أربع صفحات]

٢ـ الإجابات المتكررة عن أسئلة الاختيار من متعدد لن تقدر ويتم تقدير الإجابة الأولى فقط .

Answer FOUR questions only from the following:

Question[1] (15 marks)

(A) Mention one application only for each of the following:

1- Isothermal and adiabatic changes of gases.

2- Eddy currents.

3- Mutual induction between two coils.

4- Wave nature of the electron.

5- Magnetic torque.

(B) First: What is meant by...?

1- Resonant cavity.

2- Critical frequency for a metal.

3- The electromotive force of a source.

Second: How do you explain each of the following?

1- Selection of Helium and Neon elements as active medium in (He – Ne) laser.

2- The wavelength of the wave accompanying the electron motion decreases by increasing its velocity.

3- The ohmmeter scale is opposite to that of the ammeter.

(C) The potential difference across the primary coil of an ideal transformer is 240V. If the number of turns of its secondary coil is double that of the primary coil and the intensity of current flowing through the primary coil is 3A.

1- Mention the type of such transformer.

2- **Calculate each of the following:**

a) The potential difference across the secondary coil.

b) The intensity of current flowing through the secondary coil.

C) The produced electric power.

[بقية الأسئلة فى الصفحة الثانية]

Question[2] (15 marks)

(A) Write the scientific term for each of the following statements:

1- The induced current must be in a direction such that to oppose the change producing it.

2- The wavelength of the maximum intensity of radiation (λ_m) is inversely proportional to the temperature of the radiating source.

3- The temperature at which electrical conductivity of some metals becomes very high.

4- The magnetic flux density which exerts a force of one Newton on a current carrying wire of one meter length perpendicular to the magnetic field when the current is 1 ampere.

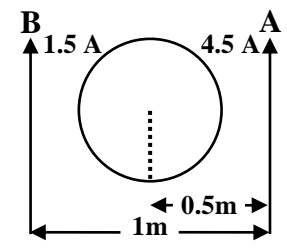5- The spectrum that consists of all wavelengths or frequencies in a definite range.

(B) First: What is the mathematical relation for...?

1- Ohm's law for closed circuit.

2- Calculation of wavelength of the characteristic X- ray.

3- law of mass action in semiconductors.

Second: Compare between each of the following:

1- Leyman series and Balmer series, concerning the range where each of them lies.

2- Shunt and multiplier resistors, concerning the way of connection to the galvanometer.

3- Right screw rule and Fleming right hand rule, concerning the use.

(C) Two straight wires (A) and (B) are placed (1m) apart from each other. The intensity of current flowing through wire A is (4.5 A) and that flowing through wire B is (1.5 A) in the same direction. A circular coil of **one turn** and radius = (10 π cm) is placed between the 2 wires in the same plane and its center is at a distance of (0.5 m) from wire (A) as shown in the figure. What are the **intensity** and **direction** of the current passing through the circular coil such that the magnetic flux density at its center = zero?

Question[3] (15 marks)

(A) Mention one use for each of the following:

1- P-N junction.	2- Thermal imaging.
3- Dewar's flask.	4- The spectrometer.

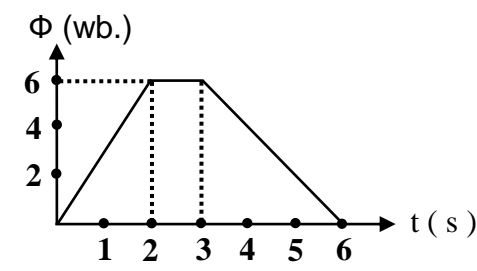5- Microwaves.
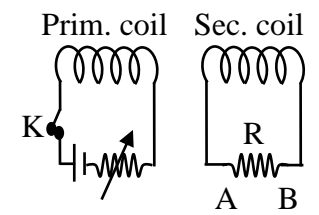
[بقية الأسئلة فى الصفحة الثالثة]

(B) <u>First</u>: The opposite figure shows two adjacent solenoids, one of them is movable. Determine **six** ways that generate an induced current through the secondary coil across the resistance R.

Prim. coil   Sec. coil

K   R

A   B

<u>Second</u>: When …?

1- are the atoms of the active medium in the state of population inversion.

2- does viscosity of helium vanish.

3- is a crystal of a semiconducting material in a state of dynamic equilibrium.

(C) The magnetic flux that passes through a coil of 200 turns changes during 6 seconds. Using the shown graph, calculate the induced electromotive force during:

1- The first two seconds.

2- The third second.

3- The last 3 seconds.

Φ (wb.)

6
4
2

1 2 3 4 5 6   t (s)

Question[4] (15 marks)

(A) Choose the correct answer from those between brackets:

1- A group of equal resistors when connected in series, its equivalent resistance = 100Ω and on connecting them in parallel, its equivalent resistance = 4Ω. The value of each resistor = ……. Ω

(20 - 50 - 100)

2- In the isothermal process, the …….

(acquired energy = 0 – acquired energy is transformed into mechanical work done by the gas – internal energy is negative and the gas cools down)

3- The decimal number that is equivalent to the binary number $(1010)_2$ is …….

(4 – 8 – 10)

4- Fraunhofer lines are examples of the ……. spectrum.

(continuous emission – linear emission – linear absorption)

5- Sensitivity of galvanometer is determined by the relation …….

($\dfrac{\theta^2}{I}$ – $\dfrac{\theta}{I}$ – $\dfrac{\theta}{I^2}$)
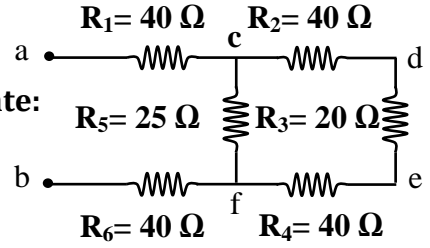
[بقية الأسئلة فى الصفحة الرابعة]

(B) <u>First</u>: **Mention two factors only on which each of the following depends:**

1- Magnetic flux density at a point on the axis of a solenoid carrying a current.

2- The induced electromotive force in a straight wire moving in a magnetic field.

3- Mutual inductance between two coils.

<u>Second</u>: Mention **three** properties of laser.

(C) In the shown electric circuit, if the potential difference V_{ab} = 200 volt, **calculate:**

1- The equivalent resistance of the circuit.

2- The current intensity through resistor (R_1).

3- The current intensity through resistor (R_5).

R_1= 40 Ω R_2= 40 Ω
a   c   d
R_5= 25 Ω R_3= 20 Ω
b   e
f
R_6= 40 Ω R_4= 40 Ω

Question[5] (15 marks)

(A) 1- The opposite table shows the characteristics of three Metallic conductors made of different materials x,y, z and They have the same cross- sectional area.

Deduce the ratio $\sigma_x : \sigma_y : \sigma_z$ knowing that σ is the electrical conductivity.

Then deduce which of these materials has highest electrical conductivity.

Conductor	Its length	Its resistance
x	2 m	1 Ω
y	3 m	4 Ω
z	3 m	6 Ω

2- Mention the role of the two insulated halves of the hollow metallic cylinder connected to the two ends of the coil in each of dynamo, and motor.

(B) <u>First</u>: Mention **three** applications of X-ray

<u>Second</u>: Explain without drawing how the sensitive galvanometer is converted to be used as a voltmeter. Deduce the required relation.

(C) The following table illustrates the relation between the collector current I_C and the base current I_B of a transistor pnp.

$I_{C\ (mA)}$	15	30	45	60	75
$I_{B\ (mA)}$	0.15	0.3	0.45	0.6	0.75

Draw the graphical relation between I_C on the Y-axis and I_B on the X- axis.

1- From the graph, find the current gain (β_e) of such transistor.

2- Find the value of each the following:

a) α_e **b)** I_E when I_C = 45 mA .

[انتهت الأسئلة]

Answer of the first question: (15 marks)

A) $1 \times 5 = 5$ marks

  1- Refrigerator.

  2- Induction furnace.

  3- Electric transformer.

  4- Electron microscope.

  5- Sensitive galvanometer. OR The motor. OR DC Ammeter.

B) 6 marks

Firstly: $1 \times 3 = 3$ marks

  1- Resonant cavity is the container and activating catalyst for amplification.
OR two parallel mirrors enclosing the active medium between them.

  2- Critical frequency is the minimum frequency of incident light required to free electrons from a metal surface without acquiring kinetic energy.

  2- It is the total work done inside and outside the cell to transfer an electric charge of one coulomb in the electric circuit.
OR the potential difference between the poles of the cell when no current passes through its circuit.

Secondly: $1 \times 3 = 3$ marks

  1- due to the near equality of the values of the same metastable excited energy levels in these two elements.

  2- as the wavelength of the wave accompanying the electron is inversely proportional to the electron momentum according to De Broglie relation : $\lambda = h/P_L = h/mv$

  3- as the current intensity is inversely proportional to the resistance at constant voltage.

C) 4 marks

  1- it is a step up transformer. (1 mark)

  2-

    a) potential difference across the secondary coil.

$$\frac{Vs}{Vp} = \frac{Ns}{Np} \quad \text{(½ mark)}$$

$$V_s = 240 \times \frac{2Np}{Np} = 480 \text{ V} \quad \text{(½ mark)}$$

    b) current intensity through secondary coil.

$$\frac{Is}{Ip} = \frac{Vp}{Vs} \quad \text{(½ mark)}$$

$$I_s = 3 \times \frac{240}{480} = 1.5 \text{ A} \quad \text{(½ mark)}$$

    c) the produced electric power .

$$W = I_s V_s \text{ (½ mark)}$$

$$W = 1.5 \times 480 = 720w \text{ (½ mark)}$$

<div dir="rtl">(أو أى إجابة أخرى صحيحة علمياً)</div>

Answer of the second question: : (15 marks)

A) $1 \times 5 = 5$ marks

    1- Lenz's rule.

    2 - Wien's law.

    3- Critical (transitional) temperature.

    4- Tesla.

    5- Continuous spectrum.

B) 6 marks

Firstly: $1 \times 3 = 3$ marks

    1- $I = V_B / R + r$

    2- $\Delta E = h \dfrac{c}{\lambda}$

    3- $n_p = n_i^2$

Secondly: $1 \times 3 = 3$ marks

    1-

Leyman's series	Balmer's series
It lies in the ultraviolet range.	It lies in the visible range.

    2-

Shunt	Multiplier
It is connected in parallel to the galvanometer coil.	It is connected in series to the galvanometer coil.

    3-

Right screw rule	Fleming right hand rule
To determine the direction of the magnetic field at the center of a coil due to a current flowing through it.	To determine the direction of the induced current in straight wire Moving in a magnetic field.

C) 4 marks

$$B = \frac{\mu}{2\pi} \left(\frac{IA}{d_1} - \frac{IB}{d_2} \right) \quad (\text{1 mark})$$

    d_1 is the distance of wire A from the center of the coil.

    d_2 is the distance of wire B from the center of the coil.

$$B = \frac{\mu}{2\pi} \left(\frac{4.5}{0.5} - \frac{1.5}{0.5} \right) = 3 \frac{\mu}{\pi} \quad (\text{1 mark})$$

    Its direction is perpendicular out of the page.

$$B = \frac{\mu I N}{2r} \quad (\text{½ mark})$$

$$ى \, I = \frac{B 2r}{\mu N}$$

$$I = \frac{3 \times \mu \times 2 \times 0.1 \times \pi}{\pi \times \mu \times 1} = 0.6A \quad (\text{½ mark})$$

    The direction of current in the coil is clockwise. (1 mark)

<div align="center">(أو أى إجابة أخرى صحيحة علمياً)</div>

Answer of the third question: : (15 marks)

A) 1 × 5 = 5 marks

1- It is used in rectification of alternating current. OR as a switch.

2- It is used in medicine in tumor detection and embryology and in criminology.

3- It is used to store liquid gases.

4- It is used to decompose light to its visible and invisible components.
   To obtain pure spectrum.

5- In radars. OR for military purposes, as night vision.

B) 6 marks

Firstly: ½ × 6 =3 marks

1- switching off the primary coil circuit.

2- bringing the primary coil close to the secondary coil.

3- increasing the intensity of the current in the primary coil.

4- switching on the primary coil circuit.

5- withdrawal of the primary coil away from the secondary coil.

6- decreasing the intensity of the current in the primary coil.

Secondly: 1 × 3 = 3 marks

1- when the number of atoms in the excited state exceeds the number of atoms in the lower state.

2- when it becomes in case of super fluidity at temperature close to absolute zero (0 K).

3- when the number of bonds broken is equal to the number of bonds mended per second.

C) 4 marks

   Note : The used mathematical relation in the answer has to be estimated by (1mark) only.

$$\text{e.m.f} = -N \frac{\Delta\varphi}{\Delta t} \quad \text{(1mark)}$$

1- through first two seconds :

$$\text{e.m.f} = -200 \times \frac{6-0}{2-0} = -600\text{V} \quad \text{(1mark)}$$

2- through the third second :

$$\text{e.m.f} = -200 \times \frac{6-6}{3-2} = 0\text{V} \quad \text{(1mark)}$$

3- through the last three seconds :

$$\text{e.m.f} = -200 \times \frac{0-6}{6-3} = 400\text{V} \quad \text{(1mark)}$$

(أو أى إجابة أخرى صحيحة علمياً)

Answer of the fourth question: : (15 marks)

A) $1 \times 5 = 5$ marks

1- 20 Ω

2- acquired energy is transformed into mechanical work done by the gas.

3- 10

4- linear absorption

5 - Ө/I

B) Firstly: $1 \times 3 = 3$ marks ($\frac{1}{2}$ mark for each factor) (2 factors only)

1- number of turns B ∝ N OR Length of solenoid B ∝ $\frac{1}{L}$

OR current intensity B ∝ I

2- magnetic flux density emf ∝ B

Length of wire emf ∝ l

velocity of the wire emf ∝ v

the angle between the direction of velocity and the direction of the magnetic flux

emf ∝ sinӨ.

3- the presence of iron core inside the coil.

the volume of the coil and the number of its turns.

the distance separating the two coils.

Secondly: $1 \times 3 = 3$ marks (3 properties only)

1- Monochromaticity.

2- Collimation.

3- Coherence.

4- Constant intensity.

C) 4 marks

1- calculation of equivalent resistance R_2 , R_3 , R_4 are connected in series (½ mark)

$$R^{/} = 40 + 20 + 40 = 100 \text{ Ω}$$

$R^{/}$, R_5 are connected in parallel

$$R^{//} = \frac{100 \times 25}{100 + 25} = \frac{2500}{125} = 20 \text{ Ω} \quad \text{(½ mark)}$$

The equivalent resistance R $_{(eq.)}$ = R_1+ $R^{//}$ + R_6 (½ mark)

$$R_{(eq.)} = 40 + 20 + 40 = 100 \text{ Ω (½ mark)}$$

2- The current flowing through R_1:

$$I_{(total)} = \frac{V}{R} \text{ (½ mark)}$$

$$I = \frac{200}{100} = 2A \text{ (½ mark)}$$

3- The current flowing through R_5 = $\frac{4}{5}$ of total current (½ mark)

The current in R_5 = $2 \times \frac{4}{5}$ = 1.6 A (½ mark)

(أو أى إجابة أخرى صحيحة علمياً)

Answer of the fifth question: : (15 marks)

A) 6 marks

1- 3 marks

$$\sigma = \frac{\ell}{AR} \text{ (1 mark)}$$

$$\sigma_x : \sigma_y : \sigma_z = \frac{2}{A} : \frac{3}{4A} : \frac{3}{6A} = 2 : 0.75 : 0.5 \text{ (1 mark)}$$

the wire (x) has higher electrical conductivity than that of (y)،(z) (1 mark)

2- $1 \times 2 = 2$ marks

- In dynamo ,to obtain a uni-directional current in the external circuit.
- In motor, the current in the coil will reverse direction each half cycle.

OR the obtained torque enables the coil to continue rotation in the same circular direction to complete one cycle.

B) Firstly: $1 \times 3 = 3$ marks

1- Studying the crystalline structure of materials.
2- X-rays have a great penetrating power; they are used to detect defects in metallic structure
3- X-rays are used in imaging bones and fractures.

Secondly: 3 marks

To convert the galvanometer into a voltmeter, a large multiplier resistor is connected in series to the galvanometer coil. (½ mark)

$$V = Vg + Vm \text{ (½ mark)}$$

$$V = Vg + IgRm \text{ (1 mark)}$$

$$V - Vg = IgRm$$

$$Rm = \frac{V - Vg}{Ig} \text{ (1 mark)}$$

C) 4 marks (graph drawing 1 mark)

1- slope = $\beta_e = \frac{\Delta Ic}{\Delta IB}$

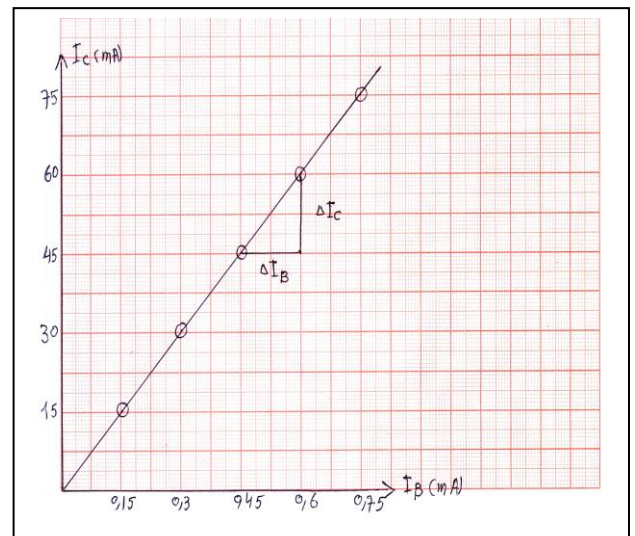$$\beta_e = \frac{60 - 45}{0.6 - 0.45} = 100 \text{ (1 mark)}$$

2- a) $\beta_e = \frac{\alpha_e}{1 - \alpha_e}$ (½ mark)

$$\alpha_e = 100(1 - \alpha_e)$$

$$\alpha_e = \frac{100}{101} = 0.99 \text{ (½ mark)}$$

b) $I_E = \frac{I_c}{\alpha_e}$ (½ mark)

$$= \frac{45}{0.99} = 45.45 \text{ mA (½ mark)}$$

(أو أى إجابة أخرى صحيحة علمياً)

انتهى نموذج الإجابة