The Open University of Sri Lanka

Advanced Certificates in Science

Physics 04 (PHF2526)-2023/2024

Final Examination

Duration: One (03) hour **Index Number:.....**

03rd February 2024 **Time: 01.30 p.m. -04.30 p.m.**

- Question Paper is consisting Part I and Part II
- Answer **25 MCQ's** in **Part I**
- In each of the questions **1-25**, pick one of the alternatives from (1), (2), (3), (4), (5) which is **correct** or **most appropriate**, and **underline your response**
- **Part II** is consisting of essay questions.
- At the end of the examination, you should submit the question paper

Part I

- Answer all **25 MCQ's** in section A

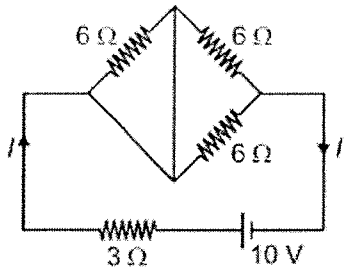
1. Kirchhoff's first law, i. e. $\sum I = 0$ at a junction, deals with the conservation of
   (i) Charge (ii) Energy (iii) Angular momentum
   (iv) Momentum (v) None of above

2. The temperature coefficient of resistance of a wire is 12.5×10^{-4} / ^{0}C. The resistance of the wire is 1 Ω at 300 K. Calculate the temperature at which resistance will be 2 Ω

   (i)1154 K (ii) 1100 K (iii)1400 K (iv) 1127 K (v) 827 K

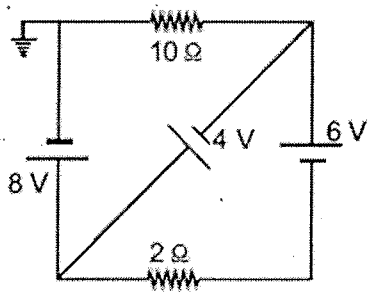
3. In series combination of n cells, we obtain
   (i) more voltage (ii) No changes (iii) more current
   (iv) less voltage (v) less current

4. The current I through the circuit is



(i) 5 A (ii) 1 A (iii) 5/3 A (iv) 0 A (v) 6 A

5. In the circuit shown in following figure, all cells are ideal. The current through 2 Ω resistor is



(i) 5 A (ii) 1 A (iii) 4 A (iv) Zero (v) None of above

6. Give the SI unit of the magnetic flux
(i) Ampere (A) (ii) Tesla (T) (iii) Weber (Wb) (iv) Gauss (G)
(v) Newton (N)

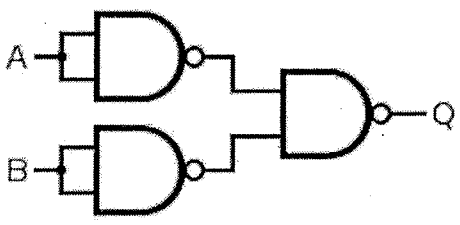
7. How many OR gates are required to realize the following Boolean expression.

$$Z = A.B + A.C + B$$

(i) 4 (ii) 5 (iii) 3 (iv) 2 (v) 1

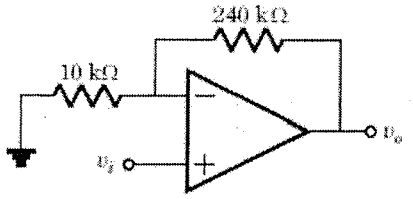
8. Which of the following are known as universal gates?
(i) NAND (ii) OR (iii) X-OR (iv) AND (v) NOT

9. The output (Q) of the logic circuit shown in the figure will be



(i) A.B (ii) A+B (iii) 0 (iv) 1 (v) A⊕B

10. Calculate the gain for the following Op-amp circuit.



(i) 24 (ii) 11 (iii) 240 (iv) 10 (v) 2400

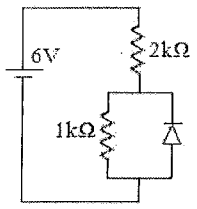
11. If an Op-amp comparator has a gain of 100 000. an input difference of 0.2 mV above reference and a supply of 12 V. The output will be

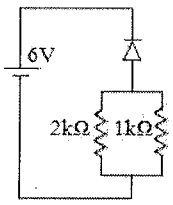
(i)20 V (ii)12 V (iii)10 V (iv)15 V (v)100 V

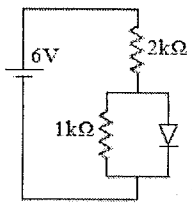
12. A transistor has a typical value of current gain (β) is 200. if the collector current is 15 mA, Then base current will be

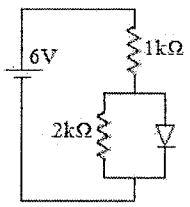
(i) 0.75 mA (ii) 0.3 mA (iii) 0.075 mA (iv)7.35 mA (v)15 mA

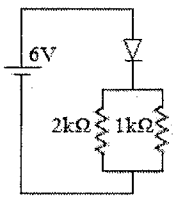
13. Which one of the following circuits draws the smallest current from the 6 V cell?

(1) 

(2) 

(3) 

(4) 

(5) 

14. The phase shift between input to output waveform of the BJT amplifier in common emitter configuration is.

(i) 0^o (ii) 90^0 (iii) 180^o (iv) 220^o (v) 270^o

15. Which of the following are majority charge carriers in npn Bipolar Junction transistor?

(i) Holes (ii) Electrons (iii)Neutrons (iv)Both Holes and Electrons
(v) Both Neutrons and Electrons

16. Which of the following states that an emf is induced whenever there is a change in the magnetic field linked with electric circuits?

(i) Lenz's Law (ii) Ohm's Law (iv) Coulomb law
(iii) Faraday's Law of Electromagnetic Induction (v) None of the above

17. The current through a Copper wire is 1 mA. How many electrons will pass a given point in 1 second? ($e = 1.6 \times 10^{-19}$ C)

(i) 6.25×10^{19} (ii) 6.25×10^{20} (iii) 6.25×10^{15}
(iv) 6.25×10^{31} (v) 6.25×10^{8}

18. A coil of an area 2 m^2 is placed in a magnetic field which changes from 4 Wb/ m^2 in 2 Seconds. Find the induced e.m.f in the coil

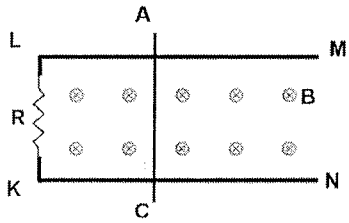
(i) 4 V (ii) 5 V (iii) 6V (iv) 7 V (v) 8 V

19. Which of the following is related to the magnitude of the induced emf?

(i) Biot-Savart law (ii) Lenz's law

(iii) Ampere's law (iv) Fleming's right-hand rule (v) Faraday's law

20. A 'L' long metal rod AC can slide on the wires LM and KN which are connected by a resistance R. The magnetic field B is pointing into the paper. If the rod AC moving with the speed V, what would be the **current** at through the rod?



(i) BL V (ii) B LV /R (iii) B^2L^2 V (iv) B^2L^2 V / R (v) B^2L^2 V^2/ R

21. A battery of an emf 1.5 V is connected across 5 Ω resistor, the current through it is 0.2 A. The internal resistance of the battery is,

(i) 0.5 Ω (ii) 1.25 Ω (iii) 2.0 Ω (iv) 2.5 Ω (v) 3.0 Ω

22. A voltmeter of range 1 V has a resistance 1000 Ω. To extend the range to 10 V, The additional series resistance required is,

(i) 9000 Ω (ii) 10,000 Ω (iii) 5000 Ω (iv) 1000/9 Ω (v) 2000 Ω

23. A wire has resistance 24 Ω. It is bent in the form of a circle. The effective resistance between two points across a diameter is,

(i)3 Ω (ii) 6 Ω (iii)12 Ω (iv) 24 Ω (v) 30 Ω

24. The sensitivity of a potentiometer can be increased by,

(i) Connecting a resistance in series with the wire
(ii) Increasing the emf of the cell connected across the wire
(iii) Reducing the area of the cross-section of the wire
(iv)Decreasing the length of the wire
(v) Sensitivity cannot be changed

25. A flow of 10^7 electrons per second in a conductor. The current is,

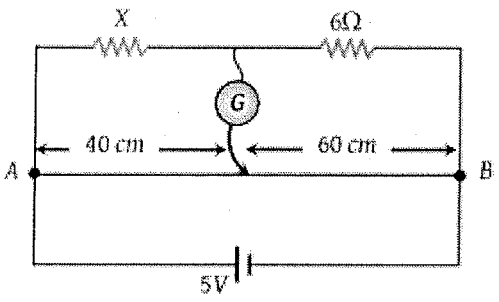
(i)1.6 x 10^{-26} A (ii) 1.6 x 10^{12} A (iii) 1.6 x 10^{-12} (iv) 1.6 x 10^{26} A (v) 1 A

Part II

- **Answer Four (4) Questions only.**

Question 01

A. In the circuit shown below, a meter bridge is in its balanced state. The meter bridge wire has a resistance of 1 Ω/cm.



(i) Calculate the value of the resistance X **(04 Marks)**

(ii) Calculate the current drawn from the battery (internal resistance of the battery can be negligible). **(04 Marks)**

B.

(i) Draw a labeled circuit diagram of a potentiometer arranged to measure emf of a cell **(04 Marks)**

(ii) Explain the reason for zero current in the galvanometer at the balanced condition **(04 Marks)**

(iii) Describe, how a potentiometer is used to compare the two resistances **(04 Marks)**

(iv) The Potentiometer circuit consists of a cell of emf 2.0 V and a potentiometer wire of length 100 cm. Calculate the balance length of the potentiometer wire for a cell of emf 1.5 V **(05 Marks)**

Question 02

A. (i) State the Ohm's law with the relevant graph **(03 Marks)**

(ii) A 100 W headlamp bulb lights up using a 12 V car battery. Determine the current flowing and the resistance of the bulb (assume the resistance of the connecting wires of the circuit is negligible) **(04 Marks)**

B.

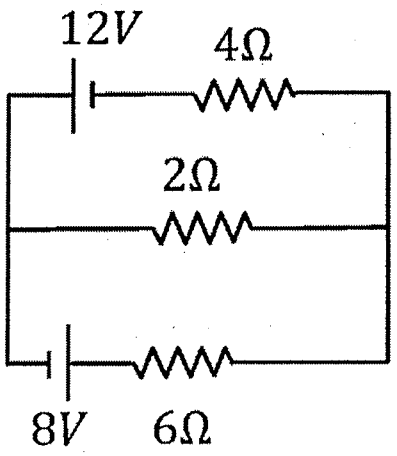
A voltmenter has an internal resistance of 1000 Ω and indicates full scale deflection of 100 V. This meter is converted to a voltmeter having a full-scale deflection of 450 V.

(i) Determine the resistor connected in series in order to convert the scale **(03 Marks)**

(ii) Determine the reading of the new instrument when it measured 380 V **(03 Marks)**

(iii) Determine the measured voltage if the reading is 25 V **(03 Marks)**

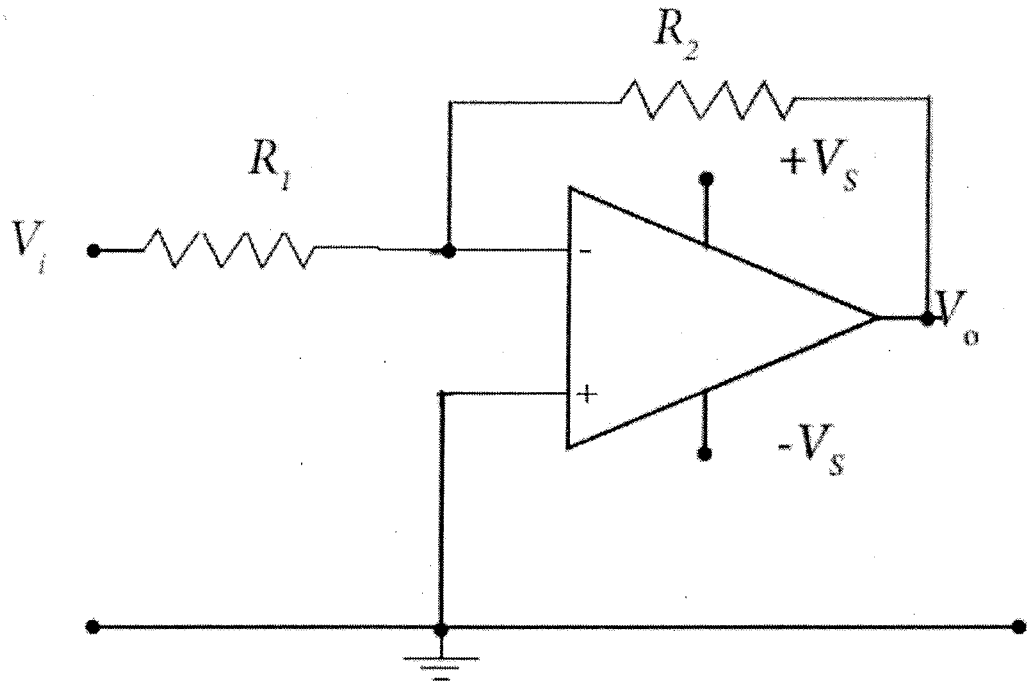
C. Calculate the current through 2 Ω, 4 Ω and 6 Ω resistors using Kirchhoff laws. **(09 Marks)**



Question 03

The OPAMP circuit shown here is provided with Vs=±15 V using dual voltage supply.

Consider that the magnitude of the output voltage at saturation is equal to the magnitude of the supply voltage.



(i) Select the suitable resistance value for R_1 and R_2 from the values given below, So that the voltage gain of this OPAMP becomes 12.

10 kΩ, 12 kΩ, 15 kΩ, 68 kΩ, 100 kΩ, 120 kΩ **(05 Marks)**

(ii) what is the magnitude of the output voltage V_0, if the voltage gain of the amplifier is 12 and the voltage applied as V_i input is 0.75 V **(05 Marks)**

(iii) Is this output voltage inverted or non-inverted with respective to the input voltage **(05 Marks)**

(iv) What is this output voltage when a voltage of 1.5 V is applied for Vi? **(05 Marks)**

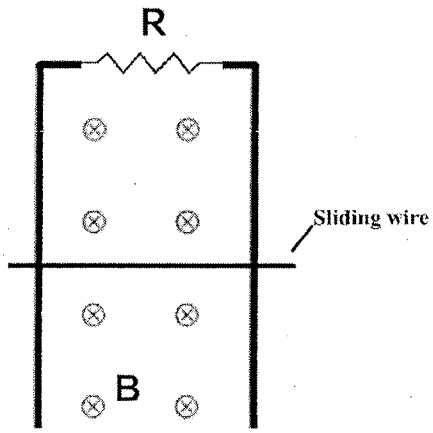
(v) What is the value of vi when the output of this amplifier just reaches saturation? **(05 Marks)**

Question 04

A. State the "Faraday Law" and "Lenz Law" in electromagnetic induction.

(06 Marks)

B. As shown in the following figure, A siding wire circuit is mounted on a board whose plane is vertical. Assume that the resistance of the circuit is R and the wire slides with negligible friction. (Mass and the length of the sliding wire is m and l respectively)



A uniform magnetic field B is perpendicular to the plane of the circuit.

(i) Show that the sliding wire is attaining a terminal velocity (V) **(07 Marks)**

(ii) Show that the terminal velocity is given by $v = \frac{mg\,R}{B^2 l^2}$ **(05 Marks)**

(iii) Draw a velocity-time graph for the motion of the rod **(07 Marks)**

Question 05

A.

(i) What is a step-down transformer? **(03 Marks)**

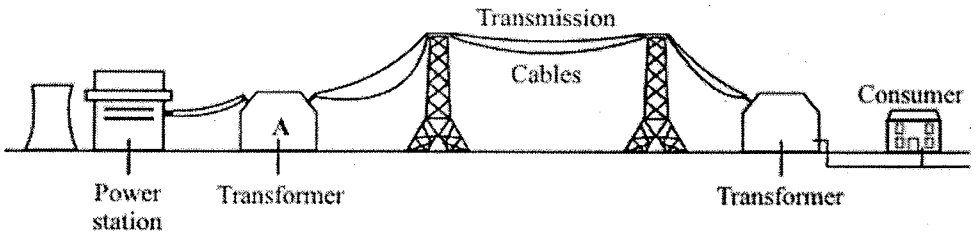
(ii) One purpose of having an iron core in a transformer is to wrap the wires around. What other important purpose does it serve? **(03 Marks)**

(iii) In transformers laminated core is used. Explain why? **(03 Marks)**

(iv) A step-down transformer having two coils with 1000 turns and 500 turns is connected to a 240V mains supply. What is the output voltage of the transformer? **(03 Marks)**

(v) Describe how energy is loss in a transformer. **(03 Marks)**

B. Electrical energy of the power station is distributed around the country by a network of high voltage cables as shown in the following figure.



(i) Give a reason in brief for using **alternating current (AC)** instead of **direct current (DC)** for generating and distributing electricity. **(05 Marks)**

(ii) Explain the importance of transformers in the distribution system. **(05 Marks)**

Question 06

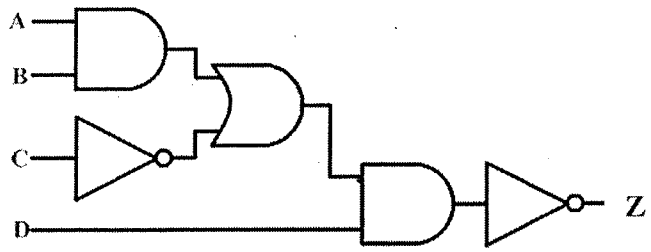
A.

(i) **Simplify** the following Boolean expression using DeMorgan's theorem.

$$F = (\overline{\overline{X} + \overline{Y}})$$

(05 Marks)

(ii) Draw the truth table and **write** the Boolean Expression for following circuits components **(05 Marks)**



B. Consider an emergency lighting system installed in a house.

- This system must turn lights on when electricity board power fails.
- However, it should not turn lights on if it is daytime

The existence of power and the light condition of the daytime and the night can be checked by appropriate sensors. Suppose that two digital out puts A and B from sensors indicate these conditions as follows.

A=1 when power exists and A=0 in a power failure

B=1 at daytime (Light Conditions) and B= 0 at night (Dark Conditions)

(i) **Complete** the truth table for the above system **(10 marks)**

A	B	Z
0		
0		
1		
1		

(ii) **Draw** the suitable logic circuit using AND, OR, NOT gates to control the lights **(05 marks)**