

The Open University of Sri Lanka

Advanced Certificates in Science

Physics 04 (PHF2526/ TAF2526)-2021/2022

Final Examination



Duration: One (03) hour

Index Number:.....

22nd January 2023

Time: 01.30 p.m. -04.30 p.m.

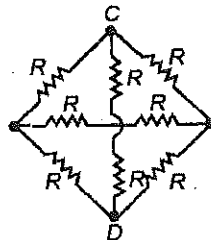
- Question Paper is consisting section A, B, C and D
- Answer 25 MCQ's in section A and B or section A and C
- In each of the questions 1-25, pick one of the alternatives from (1), (2), (3), (4), (5) which is correct or most appropriate, and underline your response
- Section D is consisting essay questions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

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Section A

- Answer all 20 MCQ's in section A

1. The effective resistance between C & D in the given circuit is



- (1) R (2) 3R (3) $2R/3$ (4) $R/3$ (5) $R/2$

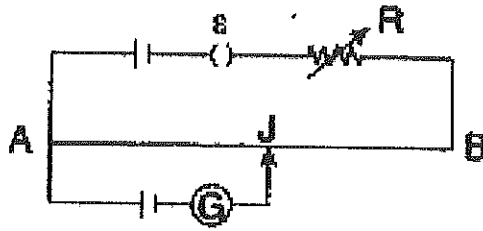
2. Constantan wire is used for making standard resistance, because it has

- (1) high melting point
 (2) low specific resistance
 (3) high specific resistance
 (4) negligible temperature coefficient of resistance
 (5) High coefficient of linear expansion

3. In parallel combination of n cells, we obtain

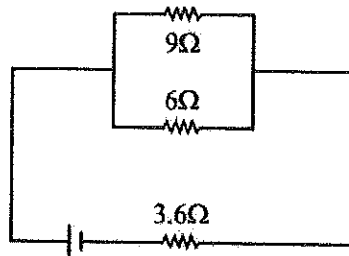
- (1) more voltage (2) No changes (3) more current
 (4) less voltage (5) less current

4. AB is a wire of potentiometer with the increase in the value of resistance R, the shift in the balance point J will be



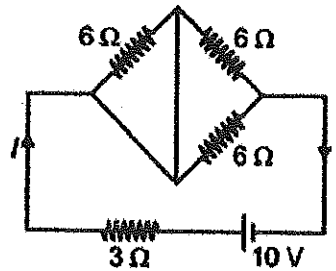
- (1) towards B (2) towards A (3) remains constant
 (4) first towards B then back towards A (5) first towards A then back towards B.

5. In the circuit shown in the figure in power dissipated in $9\ \Omega$ resistor is $144\ \text{W}$ then the potential difference across the $3.6\ \Omega$ resistor is



- (1) $36\ \text{V}$ (2) $18\ \text{V}$ (3) $9\ \text{V}$ (4) $0\ \text{V}$ (5) $6\ \text{V}$

6. The current I through the circuit is

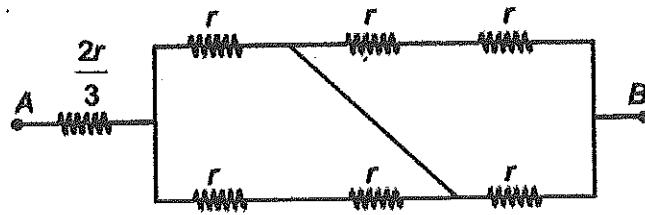


- (1) $5\ \text{A}$ (2) $1\ \text{A}$ (3) $5/3\ \text{A}$ (4) $0\ \text{A}$ (5) $6\ \text{A}$

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

- (1) 6.25×10^{19} (2) 6.25×10^{20} (3) 6.25×10^{15} (4) 6.25×10^{31} (5) 6.25×10^8

08. The effective resistance between A and B



- (1) $2r$ (2) $3r$ (3) $3r/3$ (4) $5r$ (5) $r/3$

09. An electron moving with a velocity of 15 ms^{-1} enters a uniform magnetic field of 0.2 T , along direction parallel to the field. What would be its trajectory in this field?

- (1) Elliptical path (2) Straight path (3) Helical path
 (4) Circular path (5) Parabolic Path

10 A proton enters a magnetic field of flux density 5 T with a velocity of $5 \times 10^7 \text{ ms}^{-1}$ at an angle of 30° with the field. Find the force on the proton.

- (1) $0.2 \times 10^{-11} \text{ N}$ (2) $2 \times 10^{-11} \text{ N}$ (3) $20 \times 10^{-11} \text{ N}$
 (4) $200 \times 10^{-11} \text{ N}$ (5) $1 \times 10^{-11} \text{ N}$

11 Give the SI unit of the magnetic field intensity

- (1) Ampere (2) Tesla (3) Weber (4) Gauss (5) Newton

12. A wire of resistance 3Ω is stretched to twice its original length. The resistance of the new wire will be ,

- (1) 1.5Ω (2) 3Ω (3) 6Ω (4) 12Ω (5) 2Ω

13. The leakage current in a diode is due to

- (1) Minority carriers (2) Majority carriers (3) Junction capacitance
 (4) Minority and Majority carriers (5) None of the above

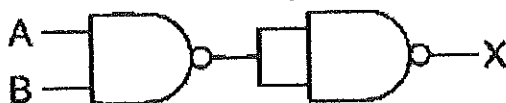
14. How many AND gates are required to realize $Y = CD + EF + G$?

- (1) 4 (2) 5 (3) 3 (4) 2 (5) 1

15. Which of the following are known as universal gates?

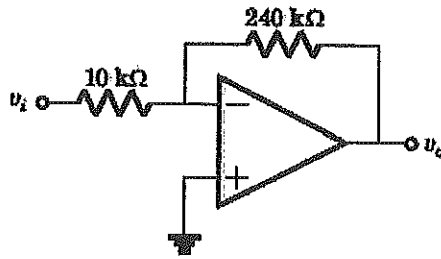
- (1) NAND, NOR (2) AND, OR (3) XOR, OR
 (4) X-NOR, XOR (5) NOT, OR

16. The output of the logic circuit shown in the figure will be



- (1) $A \cdot B$ (2) $A + B$ (3) 0 (4) 1 (5) $A \oplus B$

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

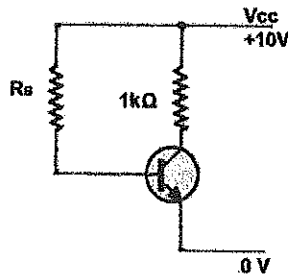


- (1) 24 (2) -24 (3) 240 (4) 10 (5) 2400

18. Which of the following is true

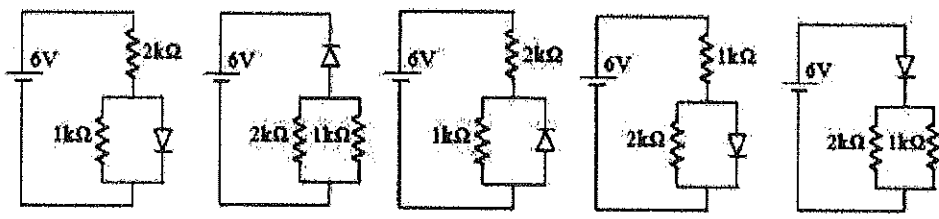
- (a) Common base transistor is commonly used because current gain is maximum
- (b) Common emitter is commonly used because current gain is maximum
- (c) Common collector is commonly used because current gain is maximum
- (d) Common emitter is the least used transistor
- (e) None of above

19. In the circuit shown here the transistor has a current gain $\beta = 100$. What would be the resistor R_B so that $V_{ce} = 5V$ (assume $V_{BE} = 0$)



- (1) $2 \times 10^3 \Omega$ (2) $200 \times 10^3 \Omega$ (3) $1 \times 10^6 \Omega$ (4) 500Ω (5) $4 \times 10^3 \Omega$

20. Which one of the following circuits draws the largest current from the 6 V cell?



- (1) (2) (3) (4) (5)

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Section B - PHF2526

- Answer all 05 MCQ's in Section B

21. Which of the following factors in an electromagnetic induction independent of?

- (1) Time (2) Resistance of the coil (3) Change of flux
 (4) Resistivity of the coil (5) None of the above

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

- (1) Lenz's Law (2) Ohm's Law (3) Faraday's Law of Electromagnetic Induction
 (4) Coulomb law (5) None of the above

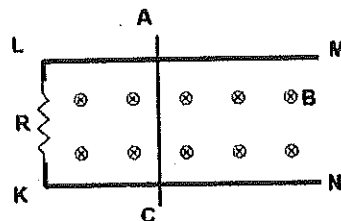
23. Which of the following gives the polarity of the induced emf?

- (1) Biot-Savart law (2) Lenz's law (3) Ampere's circuital law
 (4) Fleming's right-hand rule (5) Fleming's left-hand rule

24. A coil of an area 2m^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

- (1) 4 V (2) 5 V (3) 6V (4) 7 V (5) 8 V

25. 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 rate at which the work done?



- (1) BLV (2) BLV/R (3) B^2L^2V (4) B^2L^2V/R (5) $B^2L^2V^2/R$

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Section C- TAF2526

- Answer all **05 MCQ's** in Section C

21. The final image in an astronomical telescope is
(1) virtual and erect (2) real and erect
(3) real and inverted (4) virtual and inverted
(5) Depend on the size of the object
22. What focal length should the reading spectacles have for a person whose near point is 50 cm?
(1) 25 cm (2) -50 cm (3) 50 cm (4) -25 cm (5) -20cm
23. An astronomical telescope has a magnifying power of 10. In normal adjustment, distance between the objective and eye piece is 22 cm. The focal length of objective lens is
(1) 10 cm (2) 22 cm (3) 20 cm (4) 2 cm (5) 4 cm
24. If a particular sound S_1 is 55 times more intense than another sound S_2 , then what is the difference in sound intensity levels in dB for these two sounds?
(1) 5 dB (2) 6 dB (3) 7 dB (4) 8 dB (5) 1 dB
25. A steel rod 100 cm long is clamped at its middle. The fundamental frequency of longitudinal vibrations of the rod are given to be 2.5 kHz. What is the speed of sound in steel?
(1) 2 km s^{-1} (2) 10 km s^{-1} (3) 15 kms^{-1} (4) 5 km s^{-1} (5) 12 km s^{-1}
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Section D

- Answer Four (4) Questions only.
- Question No: 05 and 06 are consisting two parts (Part A and Part B)
- Part A for PHF 2526 and Part B for TAF2526. You can answer either Part A or Part B

Question 01

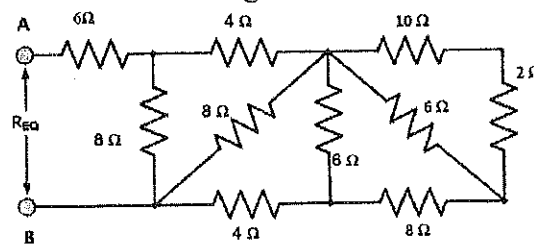
(i) A cell is balanced with a potentiometer and the equilibrium length is 60 cm. A resistance of $40\ \Omega$ is connected between the ends of the cell and the balanced length is 58 cm. Calculate the internal resistance of the cell. **[15 Marks]**

(ii) A moving coil meter has an internal resistance of $2\ \Omega$ and indicates full scale deflection when a current of 300 mA flows through it. This meter is converted to an ammeter having a full-scale deflection for a current of 1.5A. **[10 Marks]**

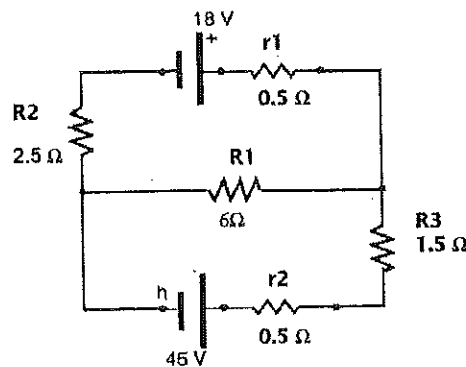
- Determine the resistor connected in parallel series in order to convert the scale
- Determine the reading of the new instrument when it measured 0.9 A
- Determine the measured current if the reading is 80 mA

Question 02

(i). Find the equatorial resistance of the following resistor network **[10 Marks]**

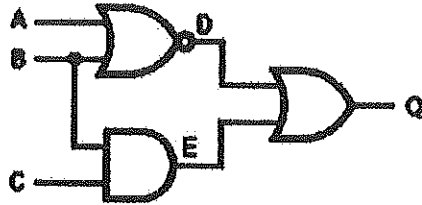


(ii). Calculate the current through R_1 , R_2 and R_3 resistors using Kirchoff laws **[15 Marks]**



Question 03

(i) (a) Draw the truth table and write the Boolean Expression for following circuits components [05 Marks]



b. Draw the logic circuit diagrams for following Logic expressions [05 Marks]

$$Z = A + B.C$$

(ii). An alarm sounds when certain conditions occur in a nuclear reactor. The output, X of logic circuit that drives the alarm must have a value of 1 if;

Either carbon dioxide **pressure (P)** too low and **temperature (T)** ≤ 300 C

or **water pressure (W)** > 10 bar and **temperature (T)** > 300 C

The inputs to the system are

Input	Binary	Condition
P	0	carbon dioxide pressure too low
	1	carbon dioxide pressure acceptable
T	0	temperature > 300 C
	1	temperature ≤ 300 C
W	0	water pressure > 10 bar
	1	water pressure ≤ 10 bar

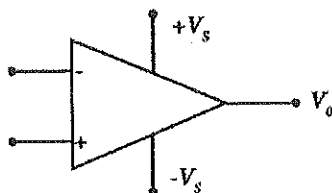
(a). Complete the truth table for the above system [10 marks]

P	T	W	X
0			
0			
0			
0			
1			
1			
1			
1			

(b). Draw the required logic circuit using AND, OR, NOT gates [05 marks]

Question 04

The open-loop voltage gain of the op-amp shown in the following figure is 10^5 . It is powered with a ± 15 V dual voltage supply. Consider that the output voltage of the op-amp at saturation is ± 15 V.



- (i) What is the magnitude of the difference in input at the moment the output becomes saturated? **[08 Marks]**
- (ii) If + input is provided with a constant voltage of 2.0 V
- (a) What is the voltage applied to - input when the op-amp becomes saturated at positive voltage? **[06 Marks]**
- (b) What is the voltage applied to - input when the op-amp becomes saturated at negative voltage? **[06 Marks]**
- (c) What is the range of voltage that can be applied to input so that the op-amp operates in the linear region? **[05 Marks]**

Question 05 (Answer only Part A or Part B)

05-Part (A)

State Lenz's law and Faraday's law of electromagnetic induction **[10 Marks]**

A coil of 20 turns covering an area of 4 cm^2 is placed over the field of an electromagnet. The magnetic field is increased from zero to 0.5 T in 2 S by varying the current of the electromagnet.

- (i) Calculate Induced EMF of the coil. **[07 Marks]**
- (ii) Explain what happens if the above coil is placed parallel to the magnetic field and the field intensity is increased **[08 Marks]**

05-Part (B)

- 1) (a) Explain the followings **[09 Marks]**
- (i) Waves are means of transferring energy from one point to another.
- (ii) The velocity of sound is greater in solids than in gases.
- (iii) Distinguish between longitudinal and transverse waves.
- (b) A boy plucks at the center of a stretched string of length 1 m and observes a wave pattern.

- i. Which type of wave is produced on the string? [03 Marks]
- ii. What are the conditions for the formation of the above-mentioned wave? [03 Marks]
- iii. The distance between consecutive nodes [03 Marks]

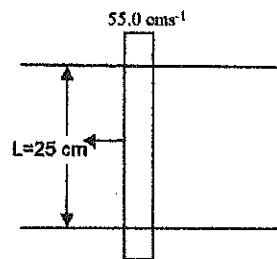
(c) A wire stretched between two rigid supports vibrates in its fundamental mode with a frequency of 45 Hz. The mass of the wire is 3.5×10^{-2} kg and its linear mass density is 4.0×10^{-2} kgm⁻¹.

- i. What is the speed of a transverse wave on the string? [04 Marks]
- ii. Determine the tension in the string? [03 Marks]

Question 06 (Answer only Part A or Part B)

06- Part (A)

A metal rod is forced to move with constant velocity V long two parallel metal rail, connected with a strip of metal at one end. A magnetic field of magnetic magnitude $B = 0.350$ T points out of the page.



- (a). If the rails are separated by $L = 25.0$ cm and the speed of the rod is 55.0 cm/s⁻¹, what emf is generated? [10 Marks]
- (b). If the resistance of the rod 18Ω and the rails and connector have negligible resistance, what is the current in the rod? [10 Marks]
- (c). At what rate is energy being transferred to thermal energy? [05 Marks]

Part (B)

- (a) What is meant by the following terms of a telescope [10 Marks]
- (i) Magnifying power (ii) Eye ring
- (b) (i) Draw a ray diagram to show how the formation of the final image by an astronomical telescope in normal use. [05 Marks]
- (ii) With the aid of the diagram in (b)(i), derive an expression for the magnifying power of astronomical telescope in normal use. [05 Marks]
- (c) Find the separation of eyepiece and objective of astronomical telescope with magnifying power of 20 in its normal adjustment. Eyepiece has a focal length of 5 cm [05 Marks]