00052

The Open University of Sri Lanka

Advanced Certificates in Science

Physics 04 (TAF2524)-2020/2021

Final Examination

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

22nd January 2023 **Time: 09.30 p.m. -12.30 p.m.**

Part -A

- **The Question paper (Part A) consists of 25 multiple choice questions.**
- **Answer all the questions.**
- **In each of the questions 1-25, pick one of the alternatives from (1), (2), (3), (4) and (5) which is correct or most appropriate and underline your response.**
- **At the end of the examination you should submit the answered question paper.**
- **Maximum marks for this part is 40%.**

$(g = 10\ m\ s^{-2})$
$1/4\pi\varepsilon_0 = 9 \times 10^9\ NmC^{-2}$

01). SI unit of the amount of heat,

(1) °C (2) °F (3) K (4) J (5) A

02). Why on hot days white clothes become worn it is due to they are

(1)Reflectors (2) Radiators (3) Emitters (4) Absorbers (5) None of these

03). A vessel contains 4 mole of O_2 (relative molar mass 32) at temperature T. The pressure is P. An identical vessel contains 1 mole of nitrogen of temperature 2T. Find the pressure of N_2 container.

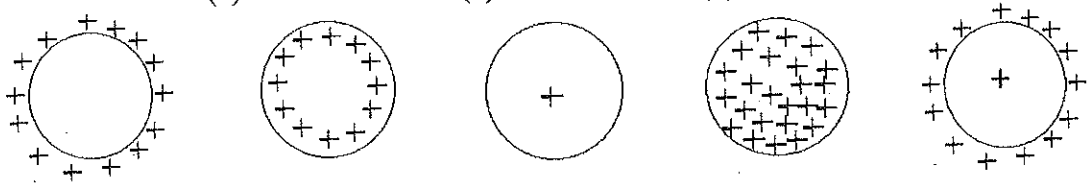
(1) P/2 (2) 2P (3) 8P (4) P (5) 3P

04). Approximate Celsius temperature corresponding to 1500 K will be,

(1) 1227 °C (2) 927 °C (3) 1007 °C (4) 1773 °C (5) 807 °C

05). Which one of the following is the correct diagram of charge distribution in a hollow sphere?

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



06). Resistances of a platinum wire at 0 °C and 100 °C are 3 Ohms and 7 Ohms respectively. What will be the temperature at a particular place when its resistance becomes 5 Ohms?

(1) 50 °C (2) 25 °C (3) 65 °C (4) 75 °C (5) 125 °C

07). What will be the most suitable thermometer to measure the temperature of a liquid drop accurately?

(1) Mercury-Glass thermometer.
(2) Alcohol-Glass thermometer.
(3) Platinum resistance thermometer.
(4) Constant volume gas thermometer.
(5) Thermocouple.

08). What is the relation between coefficient of area expansion (α) and coefficient of volume expansion (β)?

(1) $\alpha = \beta$ (2) $\alpha = 2\beta$ (3) $\alpha = 3\beta$ (4) $\alpha = \beta/2$ (5) $3\alpha = \beta$

09). A metal bar having linear expansivity $10 \times 10^{-6}\ K^{-1}$ and young's modulus (Y) 10^{10} Pa is just fixed between two non-expanding walls at 20 °C. The Compressive force generated in the rod at 120 °C will be, (Cross-sectional area of the rod is $2 \times 10^{-4}\ m^2$)

(1) 1080 N (2) 1000 N (3) 218 N (4) 2160 N (5) 2000 N

10) A uniform metal sheet has a hole in its centre. What happens to hole when the sheet is uniformly heated?

(1) Its size increases

(2) Its size decreases

(3) It changes shape

(4) Remains the same size

(5) Its size increases and then decreases

11). What will be the apparent expansivity of a liquid having real expansivity $8 \times 10^{-5}K^{-1}$, If it is placed in a container having linear expansivity $1 \times 10^{-5}K^{-1}$?

(1) $1 \times 10^{-5}K^{-1}$ (2) $3 \times 10^{-5}K^{-1}$ (3) $7 \times 10^{-5}K^{-1}$ (4) $5 \times 10^{-5}K^{-1}$ (5) $6 \times 10^{-5}K^{-1}$

12) In liquids and gases, heat transmission is primarily caused by

(1) Convection (2) Radiation (3) Conduction (4) Conduction as well as convection (5) Reflection

13). 1 μC charge is placed in an electric field with field intensity 400 N C^{-1}. The magnitude of the electrostatic force act on the charge will be,

(1) 1×10^{-3} N (2) 2×10^{-6} N (3) 1×10^{-4} N (4) 5×10^{-6} N (5) 4×10^{-6} N

14). Energy stored in 2000 mF capacitor charged to a potential difference of 10V is?

(1) 100 J (2) 200 J (3) 300 J (4) 400 J (5) 500J

15). Two charges are placed at a certain distance. If the magnitude of each charge is doubled the force will become

(1) 1/4th of its original value (2) 1/8th of its original value (3) 4 times of its original value

(4) 8 times of its original value (5) 2 times of its original value.

16). Consider the following statements regarding the electric charges,

(A) Electric Insulator can be charge by contact or by induction.

(B) Electric charges can frely travel in a conductor.

(C) Electric charges tend to collect at the sharp edges of a conductor.

True statement/s,

(1) Only A is correct. (2) Only B is correct. (3) Only C is correct. (4) Only B and C are correct.

(5) All A,B and C are correct.

17) A capacitor holds 0.03 C of charge when fully charged by a 6 V battery. To hold 2 C of charge, voltage required would be

(1) 150 V (2) 100V (3) 300V (4) 400V (5)150 V

18) 2. 1 kWh is equal to

(1) 3.6×10^6 J (2) 3.6×10^5 J (3) 0.36×10^6 J (4) 0.36×10^5 J (5)) 36×10^6 J

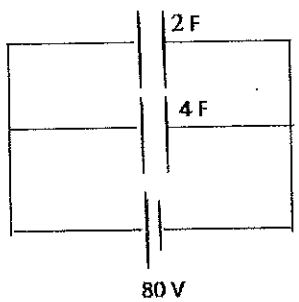
19) 5 μC charge is placed in an electric field with field intensity 200 N C^{-1}. The magnitude of the electrostatic force act on the charge will be,

(1) 1×10^{-3} N (2) 2×10^{-6} N (3) 1×10^{-4} N (4) 5×10^{-6} N (5) 4×10^{-6} N

20). If a parallel plate capacitor of plate area 2 m^2 and plate separation 1m store the charge of $1.77*10^{-11}$ C. What is the voltage across the capacitor?

(1) 1V (2) 2 V (3) 3 V (4) 4 V (5) 5 V

21). Calculate the energy in the 2F capacitor.

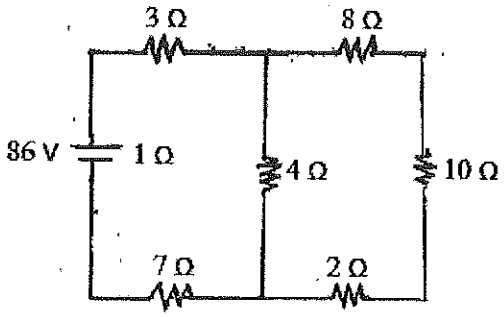


(1) 8.6 kJ (2) 64kJ (3) 64J (4) 6.4kJ (5) 3.0 kJ

22). A potentiometer wire of length 100 cm has a resistance of 30 ohms. It is connected in series with a resistance of 20 ohms and accumulator of emf 8V having negligible internal resistance. A source of 1.2V is balanced against a length L of the potentiometer wire. What is the value of L?

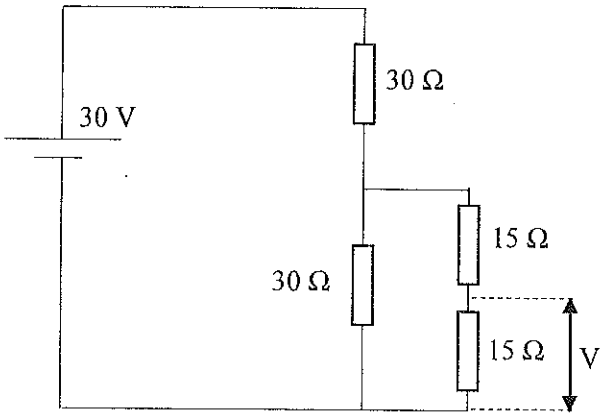
(1) 20 (2) 25 (3) 30 (4) 35 (5) 40

23) The emf of a battery is 86V and internal resistance 1 ohms in the figure shown below. Calculate the current drawn from the battery.



(1) 2 A (2) 3 A (3) 5 A (4) 6 A (5) 7 A

24). What will be the potential difference V in the following resistor network under supply voltage 30 V.



(1) 1.5 V

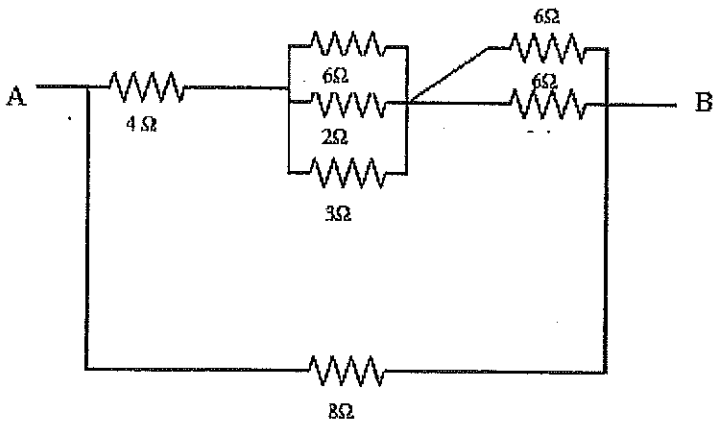
(2) 5 V

(3) 7.5 V

(4) 12.5 V

(5) 20.5 V

25). Calculate the resistance between A and B.



(1) 1Ω (2) 4 Ω (3) 12 Ω (4) 4 Ω (4) 2 Ω

Part - B

- **Answer any four (04) questions only.**
- **If more than (04) questions are answered only the first four will be marked.**
- **Each question earns fifteen (15) marks, amounting to total of 60% marks.**
- **You have to show the steps involved in solving problems. No marks are awarded for the mere final answer without proper steps.**

1. (a) Write down the expression for the force acting on two point charges. (02 Marks)

   (b) Draw the electric field lines around the charges in the following situations

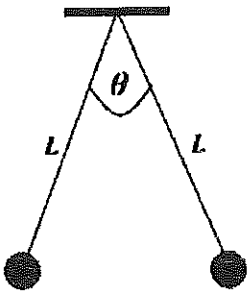
   (i) Around negative point charges kept close to each other. (02 Marks)

   (ii)Around two opposite point charges kept close to each other. (02 Marks)

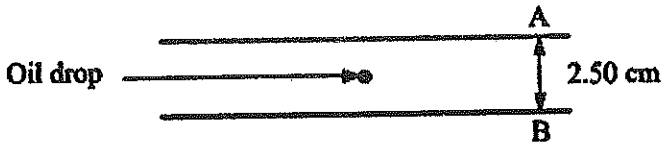
   (c) Three point charges are placed along the x-axis. A charge of 3.00 μC is at the origin. A charge of -5.00 μC is at 20.0 cm, and a charge of 8.00 μC is at 35.0 cm from the origin. Whatis the resultant force exerted on the charge 3.00 μC? (04 Marks)

   (d) Two balls with the same mass m= 9.0 x 10^{-8} kg and the same positive charge Q are suspended from the same point by insulating threads of length L= 0.98 m as shown in the figure. Determine the magnitude of the charge Q?

   Assume the angle between the thread θ is 30^0. (05 Marks)



2. The diagram shows a positively charged oil drop held at rest between two parallel conducting plates A and B.



   (a) The oil drop has a mass 9.79 x 10^{-15} kg. The potential difference between the plates is 5000 V and plate B is at a potential of 0 V. Is the plate A positive or negative? Explain your answer. (02 Marks)

   (b) Draw a labelled free-body force diagram which shows the forces acting on the oil drop. (You may ignore upthrust). (02 Marks)

   (c) Calculate the electric field strength between the plates. (03 Marks)

   (d) Calculate the magnitude of the charge Q on the oil drop. (05 Marks)

   (e) How many electrons would have to be removed from a neutral oil drop for it to acquire this charge? (Charge of the electron is 1.6 x 10^{-19} C) (03 Marks)

03). (a) What is the ideal gas equation? Write down the properties of ideal gas. (04 Marks)

(b) Show how Boyle's law can be derived from the ideal gas equation. (02 Marks)

(c) Show how Charles's law can be derived from the ideal gas law. (02 Marks)

(d) A diver works in the sea on a day when the atmospheric pressure is 101 kPa. The diver uses compressed air to breathe under water. 1700 liter of air from the atmosphere is compressed into a 12-litre gas cylinder. The compressed air quickly cools to its original temperature. Calculate the pressure of the air in the cylinder. (4 Marks)

(e) The gas in a cylinder has a pressure of 210kPa at a temperature of 27°C. Calculate the new pressure when the temperature of the gas rises to 81°C. (03 Marks)

04). (a) State Ohm's law and describe with aid of a diagram. (02 Marks)

(b) Write down the Kirchhoff laws of current elasticity. (03Marks)

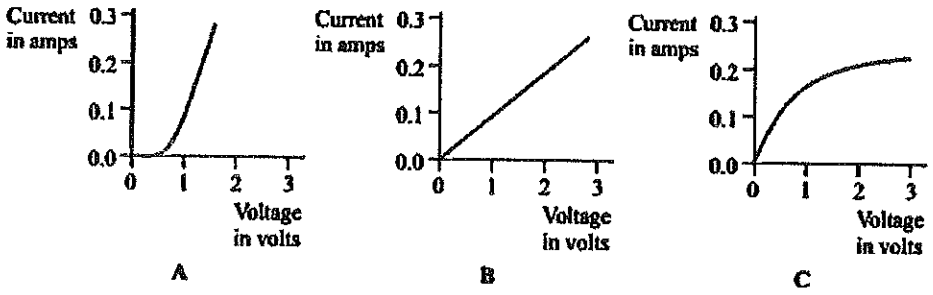
(c) Two resistors R_1 and R_2 are connected in series to a 10V battery. The current flowing then is 0.5A. When R_1 only is connected to the battery the current flowing is 0.8A.

(i)Find the value of R_2 (03 Marks)

(ii)Find the current flowing when R1 and R2 are connected in parallel with the same batter. (03 Marks)

(d) Determine the electrical power consumption of R_1 when it is connected in series and parallel with R_2. (04 Marks)

05).The diagram shows the voltage-current graphs for three different electrical components.



(a) Which one of the components A, B or C could be a 3 V filament lamp? Explain the reason for your choice. (02 Marks)

(b) Using the correct symbols draw a circuit diagram to show how a battery, ammeter and voltmeter can be used to find the resistance of the wire. (04 Marks)

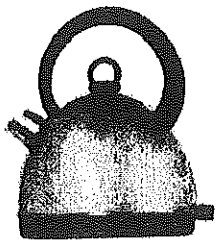
(c) When the 9 V battery with internal resistance is connected to the bulb with the filament resistance of 3 Ω. The current through the circuit is 2 A.

i) Draw the circuit diagram and write down the equation that links current, resistance and voltage. (04 Marks)

ii) Calculate the internal resistance of the battery. (02 Marks)

iii) When the bulb is heated, the current goes down to 1.6 A. Determine the new value of the resistance the filament of bulb resistance if the internal resistance of the battery is fixed.

06) The electric kettle shown below is used to boil water.



(a) After water has boiled, the temperature of the water decreases by 22 °C. The mass of water in the kettle is 0.50 kg. The specific heat capacity of water is 4200 J/kg °C. Calculate the energy transferred to the surroundings from the water. (05 Marks)

(b)Why is the total energy input to the kettle higher than the energy used to heat the water? (03 Marks)

(c) Define the latent heat fusion of ice. (02 Marks)

(d) In a container, 1000 g of water and 200 g of ice are in thermal equilibrium. A piece of metal with a specific heat capacity of 400 J $kg^{-1}.K^{-1}$ and a temperature of 250°C is dropped into the mixture. How much should the minimum mass of the metal be to melt down all of the ice? (Latent heat of fusion of ice is L_f=336 kJ kg^{-1})

(05 Marks)

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