St John Baptist De La Salle Catholic School, Addis Ababa

Grade 10 Physics Final Examination

3rd Quarter

April, 2022

Notes, and use of other aids is **NOT** allowed. Read all directions carefully and write your answers in the space provided. To receive full credit, you must show all of your work. You can use a calculator.

Useful Constants

- $\mathbf{e} = 1.6 \times 10^{-19}$C - elementary charge $\mathbf{m}_e = 9.11 \times 10^{-31}$kg - mass of an electron
- $\mathbf{m}_p = 1.673 \times 10^{-27}$kg - mass of a proton $\mu_0 = 4\pi \times 10^{-7}\frac{H}{m}$ - permeability of free space
- $\epsilon_0 = 8.85 \times 10^{-12}\frac{F}{m}$ - permitivitty of free space $\mathbf{G} = 6.672 \times 10^{-12}\frac{Nm^2}{kg^2}$ - gravitational constant
- $\mathbf{N}_A = 6.022 \times 10^{23}\frac{1}{mol}$ - Avogadro's number $\mathbf{a}_g = 10m/s^2$ - acceleration due to gravity

Name:____________________________ Roll Number:_______ Section:____Time Allowed: **2:00 hr**

Multiple Choice Questions

1. (1 point) In a household, we are using a complex circuit to run several electrical devices. In one specific room, there is an outlet and a bulb where both are connected in series. The circuit inside that room is connected in parallel to the source and other rooms. Let's say the bulb is defected, what do we expect to happen?
   A. The transformer in the neighborhood will explode.
   B. The circuit will short itself and the breaker will turn the switch off.
   C. **(Correct Answer)** The outlet will stop working but other devices in the house will continue working per usual.
   D. The electrical system in the house will burn and incur a large amount of electrical cost to the household.

2. (1 point) If the length and area of an object stay the same, how does temperature affect the resistance of a conducting wire?
   A. The temperature coefficient of resistance(α) increases as temperature increases.
   B. **(Correct Answer)** The increase in resistance is proportional to the initial resistance of the wire.
   C. The resistance decreases in an amount proportional to the increase in temperature.
   D. Temperature does not affect the resistance, it just affects the resistivity of the wire.

3. (1 point) What is the electron density of copper in $(\frac{e^{-1}}{m^3})$ if there two free conduction electrons per atom?(ρ=8.8g/cm^3, M=63.54g/mol)

A. 8.342×10^{28}

B. 8.342×10^{26}

C. **(Correct Answer)** 1.668×10^{29}

D. 6.022×10^{23}

4. (1 point) It is known that the magnetic field of a solenoid is maximum inside the solenoid. If we put a hypothetical magnetic pole at some point and the pole does not feel the magnetic force from the solenoid, what can we say about the point where the magnetic pole is found?

   A. There is another type of force acting on the magnetic pole so that the forces cancel out.

   B. **(Correct Answer)** The magnetic pole is infinitely far from the solenoid.

   C. The magnetic pole induces a magnetic force of its own and then the force on it becomes 0.

   D. The point where the force felt is 0 is non-existent.

5. (1 point) A proton is put in a magnetic field of $\mathbf{B} = -(1.046 \times 10^{-8}\hat{\boldsymbol{k}})$T, if the proton was initially shot to the right of the field and after it gets into the field. If it is floating on air against gravity, what should the entry velocity of the proton be?

   A. 1 m/s

   B. 1.06×10^{8} m/s

   C. 1.673×10^{-8} m/s

   D. **(Correct Answer)** 10 m/s

6. (1 point) If there are two current carrying wires in vacuum each with 1A of current flowing through them and each of them 1m long, how do we expect the wires to behave?

   A. The magnitude of the force between the two wires is $F = 1 \times 10^{-7}$N.

   B. **(Correct Answer)** The wires attract one another if the current is going in the same direction in both wires.

   C. The magnetic field of a straight current carrying wire acts on itself, so we expect the total force to be twice.

   D. The net magnetic field of the wires is maximum when we are as far away as possible from the wires.

7. (1 point) To what direction should an electron be shot so that when it is put in a magnetic field in the direction of the negative X-axis, the force acting on it is in the positive Y-axis?

   A. In the direction of the positive Z-axis.

   B. **(Correct Answer)** In the direction of the negative Z-axis.

   C. In the direction of the negative Y-axis.

   D. In the direction of the positive X-axis.

8. (1 point) If both an electron and a proton are shot into the same magnetic field with the same speed, in which case is the radius of the trajectory of the particles larger?

   A. **(Correct Answer)** The radius by the proton's trajectory is larger

   B. The radius by the electron's trajectory is larger

   C. The radius by the proton's trajectory is equal to the radius by the electron's trajectory.

   D. None

9. (1 point) What happens when a loop of rectangular current carrying wire is placed in a magnetic field?

   A. Equal and opposite forces act on the loop with the loop not moving at all.

B. The loop experiences a magnetic torque due to the force from the field.

C. A potential difference is induced in the wire.

D. **(Correct Answer)** B and C

10. (1 point) What is resistivity in terms of current density(**J**) and electric field(**E**)?

A. $\rho = \frac{J}{E}$

B. **(Correct Answer)** $\rho = \frac{E}{J}$

C. $\rho = \frac{Rl}{A}$

D. $J = \frac{I}{A}$

11. (1 point) The internal resistance of a battery is 0.02Ω. If the battery is a source of potential difference in a circuit where the load resistance is 500 times larger the internal resistance, what is the potential difference across the terminals of the battery if the EMF is 12V?

A. 12V

B. **(Correct Answer)** 11.97V

C. 1.197A

D. 10 A

12. (1 point) When a loop of wire is placed into a magnetic field, a voltage is generated. This voltage is called the Hall voltage, the idea is that the voltage is a result of an equilibrium between the electric force and magnetic force. Which of the following is a correct expression of the Hall voltage in terms of current, magnetic field, electron density, charge and area of the conductor?

A. **(Correct Answer)** $V_H = \frac{IBd}{nqA}$

B. $V_H = \frac{IBq}{dnA}$

C. $V_H = \frac{nqA}{IBd}$

D. None

13. (1 point) There are 5 capacitors in a circuit and we want the effective capacitance of the circuit to be as little as possible. What is the ideal connection?

A. Connect two capacitors in series and the rest in parallel.

B. Connect two capacitors in parallel and the rest in series.

C. **(Correct Answer)** Connect all the capacitors in series.

D. Connect all the capacitors in parallel.

14. (1 point) Which of the following is true?

A. The EMF of a battery is the potential difference across the terminals of the battery.

B. Batteries have 0 resistance.

C. Both Ammeter and Voltmeter should be connected in series to the circuit element we are measuring.

D. **(Correct Answer)** The EMF of a battery is the ideal potential difference across the terminals of the battery had there not been internal resistance.

15. (1 point) What is the resistance of a copper cable if it has a cross-sectional area of $1cm^2$ and a length of 2km?(The resistivity of copper is $2 \times 10^{-8}\Omega m$)

A. 0.0004Ω

B. 0.004Ω

C. 0.04Ω.

D. **(Correct Answer)** 0.4Ω

16. (1 point) If the terminals of a battery with zero internal resistance are connected across two identical resistors in series, the total power delivered by the battery is 8 W. If the same battery is connected across the same resistors in parallel, what is the total power delivered by the battery?

A. 2 W

B. 4 W

C. 16 W

D. **(Correct Answer)** 32 W

17. (1 point) Wire B has twice the length and twice the radius of wire A. Both wires are made from the same material. If wire A has a resistance of R, what is the resistance of wire B?

A. 4R

B. 2R

C. **(Correct Answer)** $\frac{R}{2}$

D. $\frac{R}{4}$

18. (1 point) A wire carries a steady current of 2.4A. A straight section of the wire is 0.75m long and lies in the XY plane along the X-axis within a uniform magnetic field, B=1.6$\hat{\boldsymbol{k}}$T. If the current is in the positive X direction, what is the magnetic force on the section of the wire?

A. **(Correct Answer)** 2.88 N, in the negative Y direction

B. 2.88 N, in the positive Y direction

C. 3.84 N, in the negative Y direction

D. 3.84 N, in the positive Y direction

19. (1 point) Two different capacitors of capacitance $C_1 = 2\mu F$ and $C_2 = 3\mu F$ are connected in series across a 120V supply line. The charged capacitors are disconnected from the line and from each other, and reconnected with terminals of like sign(that is, positive-positive and negative-negative) together, what will be the final charges on C_1 and C_2?

A. **(Correct Answer)** $57.6\mu C$ and $86.4\mu C$

B. $115.2\mu C$ and $127.57.6\mu C$

C. $144\mu C$ across each

D. $288\mu C$ across each

20. (1 point) A magnet brought near an old-fashioned TV screen (TV sets with cathode ray tubes instead of LCD screens) severely distorts its picture by altering the path of the electrons that make its phosphorus glow. To illustrate this, what is the radius of curvature of the path of an electron having a velocity of 6.00×10^7 **m/s** perpendicular to a magnetic field of strength $B = 0.500$ **T**?

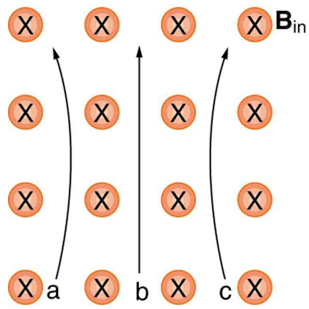
A. 0.683 m

B. **(Correct Answer)** 0.683 mm

C. 0.683 cm

D. $6.83 \times 10^4 m$

21. (1 point) Which of the following is true about the figure below?



A. **a** is a negatively charged particle.

B. **b** is a neutral(non-charged) particle.

C. **c** is a positively charged particle.

D. **a** is a positively charged particle.

E. **(Correct Answer)** B and D

22. (1 point) Assume a charge in a magnetic field on Earth is floating on air. What can we say about the charge?

    A. **(Correct Answer)** The net force on it is zero since the force due to the magnetic field and the force due to the gravitational field cancel out.

    B. The magnetic field gives the charge a super power, so the charge stays afloat.

    C. Newton's Second Law is also called the Law of Inertia.

    D. A body moving with a constant speed around a circle does not accelerate.

23. (1 point) What causes the rotation of current carrying loops of conducting wire to rotate as explained by the motor effect?

    A. The current causes an electric force to be exerted which act in opposite directions and cause a rotational effect.

    B. **(Correct Answer)** As the current carrying loop passes through an external magnetic field by a magnet, a force is exerted on opposite directions on opposite loops causing a turning effect.

    C. Since current carrying wires are magnets themselves, the wire experiences a magnetic force.

    D. None

24. (1 point) There are two straight current carrying wires in vacuum that are 1 m long each. If the force of attraction between them is $2 \times 10^{-7} N$, which of the following is true?

    A. If they both carry the same current of 1A, it is in opposite directions.

    B. **(Correct Answer)** If one carries a current of 2 A, the other carries a current of 0.5A and they both run in the same direction.

    C. The current in each is 2A and runs in opposite directions.

    D. The wires are grounded so no current runs through the wires.

25. (1 point) A proton and an electron are shot into the same magnetic field with the same speed so that both of them would go about a trajectory of a similar path. Which of the following is true?

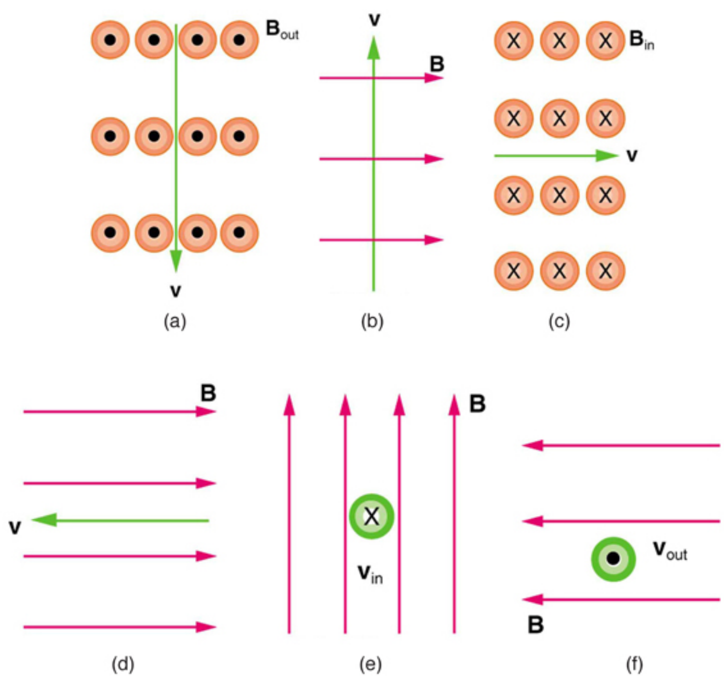
    A. The electron and proton are shot from opposite directions and the radius of the electron's path is larger than the radius of the proton's path.

    B. The electron and proton are shot from the same direction and the radius of the proton's path is larger than the radius of the electron's path.

C. **(Correct Answer)** The electron and proton are shot from opposite directions and the radius of the proton's path is larger than the radius of the electron's path.

D. The electron and proton are shot from same directions and the radius of the proton's path is larger than the radius of the electron's path.

Consider the figure shown below for the questions 26-28:



26. (1 point) What is the direction of the magnetic force on a positive charge that moves as shown in case **a**?

    A. Right(East)
    B. **(Correct Answer)** Left(West)
    C. 0
    D. Out of the page

27. (1 point) What is the direction of the magnetic force on a positive charge that moves as shown in case **b**?

    A. Right(East)
    B. Left(West)
    C. Out of the page
    D. **(Correct Answer)** Into of the page

28. (1 point) What is the direction of the magnetic force on a negative charge that moves as shown in case **d**?

    A. Right(East)
    B. **(Correct Answer)** 0
    C. Out of the page

D. Into of the page

29. (1 point) What is the force and torque(respectively) on a square-shaped 6A current carrying loop of conducting wire that has an area of 0.0025m^2 and surrounded by a permanent magnet with a field strength of $B=2 \times 10^{-2}$T that is tilted at 37^0 to the loop?
All Options Will be Considered Correct:

Correct Answers:
F = 0 N and τ=1.8×10^{-4} Nm

A. 6.02×10^{-4} N and 3.00×10^{-5} Nm

B. 3.00×10^{-5} N and 6.02×10^{-4} Nm

C. 0 N and 3.00×10^{-5} Nm

D. 3.00×10^{-5} N and 0 Nm

30. (1 point) The hot resistance of a flashlight bulb is 2.30 Ω, and it is run by a 1.58-V alkaline cell having a 0.100– Ω internal resistance. What current flows? and what is the power supplied to the bulb?

A. 0.997 A and 0.658 W

B. **(Correct Answer)** 0.658 A and 0.997 W

C. 0.687 A and 1.085 W

D. None

Workout Problems

31. (3 points) A 1.0μF parallel-plate capacitor is connected to a constant voltage source. If the distance between the plates of this capacitor is 3mm and the capacitor holds a charge of 13.6μC.

(i) What is the strength of the electric field between the plates of this capacitor?
First, we need to find the potential difference across the plates.

$$V = \frac{Q}{C}$$

$$V = \frac{13.6\mu C}{1.0\mu F}$$

$$V = 13.6V$$

But we know that $V = Ed$, thus:

$$E = \frac{V}{d}$$

$$E = \frac{13.6V}{3 \times 10^{-3}m}$$

$$E = 4.53 \times 10^3 \text{N/C}$$

(ii) If an electron was to be placed in between the plates of the capacitor, how much force would it experience?

$$F = qE$$

$$F = 1.6 \times 10^{-19}C \times 4.53 \times 10^3 N/C$$

$$F = 7.25 \times 10^{-16}N$$

(iii) What is the electric energy stored in the capacitor when it is fully charged?

$$E = \frac{QV}{2}$$

$$E = \frac{13.6\mu C \times 4.5 \times 10^3 N/C}{2}$$

$$E = 0.0612J$$

32. (2 points) For a conductor made of iron, assume that there are 2 free electrons per atom of Iron. If the density of iron is 7.874g/cm^3 and its molar mass is 55.845, find

(i) Find the electron density of a conducting wire made of iron.

$$n = \frac{n_e}{v}$$

$$n = \frac{2e^- \times n_a}{v}, \text{ because we have 2 electrons per atom and } n_a \text{ is number of atoms.}$$

$$n = \frac{2e^- \times n_{mol} \times N_A}{v}$$

$$n = 2e^- \times \frac{m}{M} \times \frac{N_A}{v}$$

$$n = 2e^- \times \frac{m}{v} \times \frac{N_A}{M}$$

$$n = \frac{2e^- \times \rho \times N_A}{M}$$

$$n = \frac{2e^- \times (7.874g/cm^3) \times 6.022 \times 10^{23} e^-/mol}{55.845g/mol}$$

$$n = 1.698 \times 10^{23} e^-/cm^3$$

$$n = 1.698 \times 10^{26} e^-/m^3$$

(ii) What is the drift speed of electrons in the conducting wire if the cross-sectional radius of the wire is 0.5642cm^2, it is 2m long, and current is allowed to run for 1 minute. First, we need to find the volume of the wire.

$$V = Al$$

$$A = \pi r^2 = \pi \times (.5642cm)^2 = 1cm^2$$

$$V = (1 \times 10^{-4} m^2 \times 2m)$$

$$V = 2 \times 10^{-4} m^3$$

Then, we should find the number of electrons.

$$n = \frac{n_e}{V}, \text{ thus:}$$

$$n_e = n \times V$$

$$n_e = 1.698 \times 10^{26} e^-/m^3 \times 2 \times 10^{-4} m^3$$

$$n = 3.396 \times 10^{22} e^-$$

Then, we should find the charge:

$$q = n_e e^-$$

$$q = 3.396 \times 10^{22} e^- \times 1.6 \times 10^{-19} C/e^-$$

$$q = 5433.6C$$

Then, we use the given time to calculate the current:

$$I = \frac{q}{t}$$

$$I = \frac{5433.6C}{60s}$$

$$I = 90.56A$$

33. (2 points) The force per meter between the two wires of a jumper cable being used to start a stalled car is 0.225 N/m.

    (i) What is the current in the wires, given they are separated by 2.00 cm?

    $$F = BI^2L$$

    Where $B = \frac{\mu_0 I}{2\pi a}$

    $$\frac{F}{L} = BI$$

    $$\frac{F}{L} = (\frac{\mu_0}{2\pi a})I^2$$

    $$\frac{F}{L} \times \frac{2\pi a}{\mu_0} = I^2$$

    $$I = \sqrt{(\frac{F}{L})\frac{2\pi a}{\mu_0}}$$

    $$I = \sqrt{(0.225N/m)\frac{2\pi \times (1.00 \times 10^{-2}m)}{4\pi \times 10^{-7}H/m}}$$

    $$I = 106.09A$$

    (ii) Is the force attractive or repulsive(*the current carrying wires in a jumper cable run in opposite directions*)?

    It is **repulsive** because the currents go in opposite directions.

34. (1 point) A cosmic ray electron moves at 7.50×10^6 **m/s** perpendicular to the Earth's magnetic field at an altitude where field strength is 1.00×10^{-5} **T**. What is the radius of the circular path the electron follows?

    $$\frac{mv^2}{r} = Bqv$$

    $$r = \frac{mv}{Bq}$$

    $$r = \frac{(9.11 \times 10^{-31}kg) \times (7.50 \times 10^6 m/s)}{(1.00 \times 10^{-5}T) \times (1.6 \times 10^{-19}C)}$$

    $$r = 4.27m$$

35. (4 points) A certain battery has a 12.0-V emf and an internal resistance of 0.100 Ω.

(i) Calculate its terminal voltage when connected to a 10.0– Ω load.

First, we need to find the current through the circuit.

$$E = I(R + r)$$
$$I = \frac{E}{R + r}$$
$$I = \frac{12V}{10\Omega + 0.100\Omega}$$
$$I = 1.189A$$

Then, V = IR

$$V = 1.189A \times 10.0\Omega$$
$$V = 11.89V$$

(ii) What is the terminal voltage when connected to a 0.500– Ω load?

First, we need to find the current through the circuit.

$$E = I(R + r)$$
$$I = \frac{E}{R + r}$$
$$I = \frac{12V}{0.5\Omega + 0.100\Omega}$$
$$I = 20A$$

Then, V = IR

$$V = 20A \times 0.5\Omega$$
$$V = 10V$$

(iii) What power does the 0.500– Ω load dissipate?

$$P = I^2R$$
$$P = (20A)^2(0.5\Omega)$$
$$P = 200W$$

(iv) If the internal resistance grows to 0.500 Ω, find the current, terminal voltage, and power dissipated by a 0.500– Ω load.

First, we need to find the current through the circuit.

$$E = I(R + r)$$
$$I = \frac{E}{R + r}$$
$$I = \frac{12V}{0.500\Omega + 0.500\Omega}$$
$$I = 12A$$

Then, V = IR

$$V = 12A \times 0.5\Omega$$
$$V = 6V$$

And P=I^2R

$$P = (12A)^2 \times 0.5\Omega$$
$$P = 72W$$

36. (2 points) Find the magnetic force(both the magnitude and direction) acting on a proton if its velocity is V=$1.6 \times 10^6 \hat{\boldsymbol{j}}$ m/s and it is in a magnetic field of B=$2\hat{\boldsymbol{i}} + 8\hat{\boldsymbol{j}} + 72\hat{\boldsymbol{k}}$T

$$\mathbf{F} = \mathbf{qv} \times \mathbf{B}$$

First, we need to find **qV**.

$$\mathbf{qV} = 1.6 \times 10^{-19}C \times (1.6 \times 10^6 \hat{\boldsymbol{j}})m/s$$
$$\mathbf{qv} = 2.56 \times 10^{-13} \hat{\boldsymbol{j}} \text{ Cm/s}$$
$$\mathbf{F} = 2.56 \times 10^{-13} \hat{\boldsymbol{j}} \text{ Cm/s} \times (2\hat{\boldsymbol{i}} + 8\hat{\boldsymbol{j}} + 72\hat{\boldsymbol{k}})$$
$$\mathbf{F} = -5.12 \times 10^{-13} \hat{\boldsymbol{k}} + 1.843 \times 10^{-11} \hat{\boldsymbol{i}} T$$
$$\mathbf{F} = (1.843 \times 10^{-11} \hat{\boldsymbol{i}} - 5.12 \times 10^{-13} \hat{\boldsymbol{k}})N$$

To find the magnitude, we do the following;

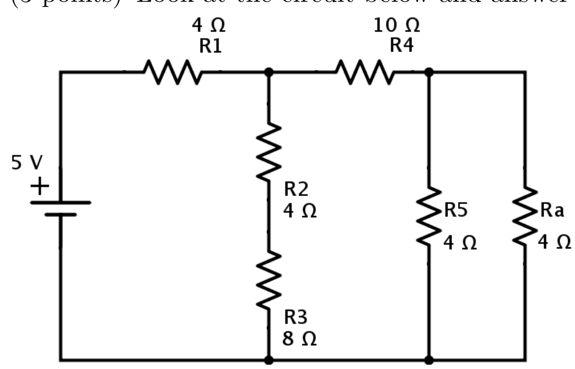
$$\text{F} = \sqrt{(1.843 \times 10^{-11})^2 + (-5.12 \times 10^{-13})^2}\text{N}$$
$$\text{F} = 1.844 \times 10^{-11}\text{N}$$

To find the direction of the force, we divide **F** by F.

Thus, we get:

$$\frac{\mathbf{F}}{\text{F}} = \frac{(1.843 \times 10^{-11} \hat{\boldsymbol{i}} - 5.12 \times 10^{-13} \hat{\boldsymbol{k}})N}{1.844 \times 10^{-11}\text{N}}$$
$$\frac{\mathbf{F}}{\text{F}} = 0.999\hat{\boldsymbol{i}} + 0.0278\hat{\boldsymbol{k}}$$

37. (3 points) Look at the circuit below and answer the questions that follow.



(i) Find the effective resistance of the circuit.

We see that R_5 and R_a are connected in parallel: Thus, $R_{5a} = \dfrac{R_5 \times R_a}{R_5 + R_a}$

$$R_{5a} = 2\Omega$$

Then, R_{5a} and R_4 are in series: $R_{45a} = R_{5a} + R_4$

$$R_{45a} = 2\Omega + 10\Omega$$

$$R_{45a} = 12\Omega$$

We can then see R_2 and R_3 are connected in series:

$$R_{23} = R_2 + R_3 = 4\Omega + 8\Omega = 12\Omega$$

We can then see that R_{23} and R_{45a} are connected in parallel:

$$R_{2345a} = \frac{R_{23} \times R_{45a}}{R_{23} + R_{45a}}$$

$$R_{2345a} = \frac{12\Omega \times 12\Omega}{12\Omega + 12\Omega}$$

$$R_{2345a} = 6\Omega$$

And then, R_{2345a} is in series with R_1. Thus, the effective resistance of the circuit is:

$$R_T = 6\Omega + 4\Omega$$

$$R_T = 10\Omega$$

(ii) Find the current and potential difference across each resistor.

To attempt this, we first need to find the the total current in the circuit.

$$I_T = \frac{V_T}{R_T}$$

$$I_T = \frac{5V}{10\Omega} = \frac{1}{2}A$$

This means, the current for the elements connected in series to the battery are the same:

$$I_1 = I_T$$

$$I_1 = \frac{1}{2}A$$

$$V_1 = I_1 R_1 = \frac{1}{2}A \times 4\Omega$$

$$V_1 = 2V$$

That means:

$$V_{2345a} = V_T - V_1 = 5V - 2V$$

$$V_{2345a} = 3V$$

We have seen that R_{23} and R_{45a} are parallel; thus:

$$V_{2345a} = V_{23} = V_{45a} = 3V$$

Since R_2 and R_3 are connected in series, the total current in the section:

$$I_{23} = \frac{V_{23}}{R_{23}}$$

$$I_{23} = \frac{3V}{12\Omega} = \frac{1}{4}A$$

$$I_{23} = \frac{1}{4}A$$

$$I_2 = I_3 = I_{23} = \frac{1}{4}A$$

Thus,

$$V_2 = I_2 R_2 = \frac{1}{4}A \times 4\Omega = 1V$$

$$V_3 = I_3 R_3 = \frac{1}{4}A \times 8\Omega = 2V$$

At the **45a** section, we have seen that

$$V_{45a} = 3V$$

We have seen $R_{45a} = 12\Omega$.

Thus:

$$I_{45a} = \frac{V_{45a}}{R_{45a}}$$

$$I_{45a} = \frac{3V}{12\Omega} = \frac{1}{4}A$$

$$I_{45a} = I_4 = I_{5a} = \frac{1}{4}A$$

That means, we can find the voltages along the **45a** loop of wire.

$$V_4 = I_4 R_4 = \frac{1}{4}A \times 10\Omega = \frac{5}{2}V$$

$$V_{5a} = I_{5a} R_{5a} = \frac{1}{4}A \times 2\Omega = \frac{1}{2}V$$

Since R_5 and R_a are connected in parallel, we have the following:

$$V_{5a} = V_5 = V_a = \frac{1}{2}V$$

Thus:

$$I_5 = \frac{V_5}{R_5} = \frac{\frac{1}{2}V}{4\Omega} = \frac{1}{8}A$$

$$I_a = \frac{V_a}{R_a} = \frac{\frac{1}{2}V}{4\Omega} = \frac{1}{8}A$$

(iii) Find the total power dissipated by the battery and the power dissipated by each resistor.

$$P_T = I_T V_T$$

$$P_T = \frac{1}{2}A \times 5V$$

$$P_T = \frac{5}{2}W$$

$$P_1 = I_1 V_1 = \frac{1}{2}A \times 2V = 1W$$

$$P_2 = I_2 V_2 = \frac{1}{4}A \times 1V = \frac{1}{4}W$$

$$P_3 = I_3 V_3 = \frac{1}{4}A \times 2V = \frac{1}{2}W$$

$$P_4 = I_4 V_4 = \frac{1}{4}A \times \frac{5}{2}V = \frac{5}{8}W$$

$$P_5 = I_5 V_5 = \frac{1}{8}A \times \frac{1}{2}V = \frac{1}{16}W$$

$$P_a = I_a V_a = \frac{1}{8}A \times \frac{1}{2}V = \frac{1}{16}W$$