This is a Class 1 exam

Lebanon Evangelical School
for Boys and Girls
Loueizeh - Baabda

Stage Exam 04

27MAR2023

Do NOT write in this box. Your MARK will be placed here.

Subject :	A Level : Physics 1 : RB
Class :	11A and 12A
Teacher :	Dr Ruth Brett
Duration :	30 minutes
You should have a physics formula booklet	

Your name :		*Time taken to complete exam*
Your Class :		
Exam Room :		
How many sheets, including cover sheet :		

- Do not open this paper until the teacher in charge instructs you to do so.
- The most important thing to remember in taking an exam is NEVER PANIC.
- If you are caught cheating in this exam, you will be awarded zero for ALL exams that are taken on this day.

Q1. The definitions for current and potential difference both include:

- ☐ **A** charge.
- ☐ **B** resistance.
- ☐ **C** time.
- ☐ **D** work done.

(Total for question = 1 mark)

Q2. The unit of resistance is the ohm.

Which of the following is equivalent to the ohm?

- ☐ **A** $J\,C^{-2}\,s$
- ☐ **B** $J\,C^{2}\,s^{-1}$
- ☐ **C** $J\,C^{-1}\,s^{-1}$
- ☐ **D** $J\,C\,s$

(Total for question = 1 mark)

Q3. Which row in the table shows the total resistance if two 5 Ω resistors are connected in series and in parallel?

	Series	Parallel
☐ A	2.5 Ω	10 Ω
☐ B	2.5 Ω	2.5 Ω
☐ C	10 Ω	10 Ω
☐ D	10 Ω	2.5 Ω

(Total for question = 1 mark)

Q4.

In a series circuit, 3.1×10^{19} electrons pass a particular point in a time of 30 seconds.

Which of the following gives the magnitude of the current in amperes in this circuit?

☐ A $\frac{(3.1 \times 10^{19}) \times (1.6 \times 10^{-19})}{30}$

☐ B $\frac{3.1 \times 10^{19}}{(1.6 \times 10^{-19}) \times 30}$

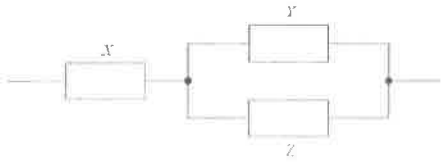
☐ C $(3.1 \times 10^{19}) \times (1.6 \times 10^{-19}) \times 30$

☐ D $\frac{(3.1 \times 10^{19}) \times 30}{1.6 \times 10^{-19}}$

(Total for question = 1 mark)

Q5.

The diagram shows a combination of three resistors of resistance X, Y and Z.



Which of the following gives the total resistance of this combination?

☐ A $X + \frac{1}{Y} + \frac{1}{Z}$

☐ B $\frac{1}{X} + Y + Z$

☐ C $X + \frac{YZ}{Y + Z}$

☐ D $\frac{1}{X} + \frac{Y + Z}{YZ}$

(Total for question = 1 mark)

Q6.

Which of the following statements about physical quantities or units is correct?

- ☐ **A** Current is a derived quantity.
- ☐ **B** Power is a derived quantity.
- ☐ **C** The coulomb is a base unit.
- ☐ **D** The volt is a base unit.

(Total for question = 1 mark)

Q7.

An electric skateboard uses an electric motor connected to a 22 V rechargeable lithium-ion battery. A fully-charged battery is able to pass 36,000 C of charge through the circuit and will allow continuous operation of the skateboard for 40 minutes.

(a) Calculate the total energy stored in a fully-charged lithium-ion battery.

(2)

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Total energy stored = ...

(b) The electric skateboard takes 0.45 s to travel 2.0 m. Calculate the number of electrons that flow past a point in the circuit during this time. Assume the battery provides a constant current.

(3)

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Number of electrons = ...

(Total for question = 5 marks)

Q8.

(a) Two resistors of resistance R_1 and R_2 are connected in parallel in a circuit.

Derive a formula for the total resistance R_T of the combination.

(3)

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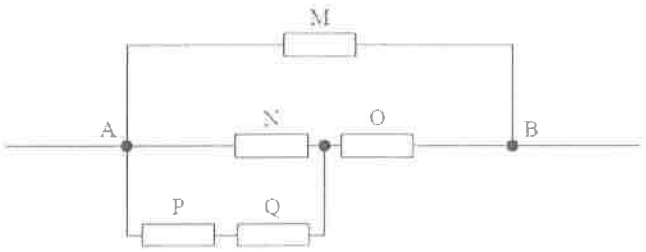
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(b) The diagram shows a combination of five resistors, M, N, O, P and Q. Each resistor has a resistance of 5.0 Ω.



(i) Show that the resistance between points A and B is about 3 Ω.

(3)

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(ii) A student is told to modify the combination of resistors so that the combined resistance between A and B is greater than 5.0 Ω. She cannot change the arrangement of the resistors, but she can replace one of the 5.0 Ω resistors with a 20.0 Ω resistor.

Explain, without further calculations, which of the five resistors should be replaced.

(2)

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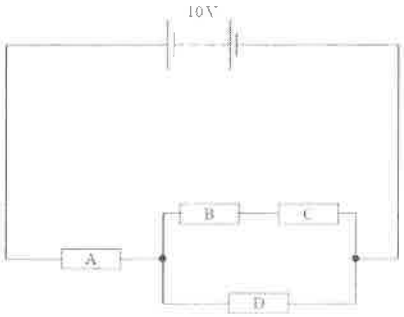
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(Total for question = 8 marks)

Q9. Four identical resistors, A, B, C and D, are placed in a circuit as shown.



(a) Determine the power dissipated in each of the resistors.

resistance of each resistor = 2.0 Ω

(6)

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(Total for question = 6 marks)

Q1. The definitions for current and potential difference both include:

(1) ☒ **A** charge.

☐ **B** resistance.

☐ **C** time.

☐ **D** work done.

(Total for question = 1 mark)

Q2. The unit of resistance is the ohm.

Which of the following is equivalent to the ohm?

(1) ☒ **A** $J C^{-2} s$ $V = RI$ $R = \frac{V}{I}$ $\frac{J C^{-1}}{C s^{-1}} \rightarrow J C^{-2} s$

☐ **B** $J C^{2} s^{-1}$

☐ **C** $J C^{-1} s^{-1}$

☐ **D** $J C s$

(Total for question = 1 mark)

Q3. Which row in the table shows the total resistance if two 5 Ω resistors are connected in series and in parallel?

	Series	Parallel
☐ **A**	2.5 Ω	10 Ω
☐ **B**	2.5 Ω	2.5 Ω
☐ **C**	10 Ω	10 Ω
(1) ☒ **D**	10 Ω	2.5 Ω

(Total for question = 1 mark)

Q4.

In a series circuit, 3.1×10^{19} electrons pass a particular point in a time of 30 seconds.

Which of the following gives the magnitude of the current in amperes in this circuit?

(1) ☒ **A** $\dfrac{(3.1 \times 10^{19}) \times (1.6 \times 10^{-19})}{30}$

☐ **B** $\dfrac{3.1 \times 10^{19}}{(1.6 \times 10^{-19}) \times 30}$

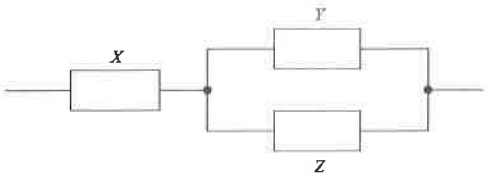
☐ **C** $(3.1 \times 10^{19}) \times (1.6 \times 10^{-19}) \times 30$

☐ **D** $\dfrac{(3.1 \times 10^{19}) \times 30}{1.6 \times 10^{-19}}$

(Total for question = 1 mark)

Q5.

The diagram shows a combination of three resistors of resistance X, Y and Z.



Which of the following gives the total resistance of this combination?

☐ **A** $X + \frac{1}{Y} + \frac{1}{Z}$

☐ **B** $\frac{1}{X} + Y + Z$

(1) ☒ **C** $X + \dfrac{YZ}{Y+Z}$

☐ **D** $\frac{1}{X} + \dfrac{Y+Z}{YZ}$

$\frac{1}{R_{ZY}} = \frac{1}{Y} + \frac{1}{Z} = \frac{Z+Y}{ZY}$

So $R_{ZY} = \dfrac{ZY}{Z+Y}$

(Total for question = 1 mark)

Q6.

Which of the following statements about physical quantities or units is correct?

- ☐ **A** Current is a derived quantity.
- ☒ **B** Power is a derived quantity. (1)
- ☐ **C** The coulomb is a base unit.
- ☐ **D** The volt is a base unit.

(Total for question = 1 mark)

Q7.

An electric skateboard uses an electric motor connected to a 22 V rechargeable lithium-ion battery. A fully-charged battery is able to pass 36,000 C of charge through the circuit and will allow continuous operation of the skateboard for 40 minutes.

(a) Calculate the total energy stored in a fully-charged lithium-ion battery.

(2)

$V = \frac{W}{Q}$ (1) $W = VQ = 22 \times 36000 = 792000$

Total energy stored = 792000 C (1)

(b) The electric skateboard takes 0.45 s to travel 2.0 m. Calculate the number of electrons that flow past a point in the circuit during this time. Assume the battery provides a constant current.

(3)

Find average current:-

$Q = It$

$I = \frac{36000}{40 \times 60} = 15A$ (1)

Charge in 0.45s

$Q = It = 15 \times 0.45 = 6.75C$ (1)

Find number of electrons:

$n = \frac{6.75}{1.6 \times 10^{-19}} = 4.22 \times 10^{19}$

Number of electrons = 4.22×10^{19} (1)

(Total for question = 5 marks)

Q8.

(a) Two resistors of resistance R_1 and R_2 are connected in parallel in a circuit.

Derive a formula for the total resistance R_T of the combination.

(3)

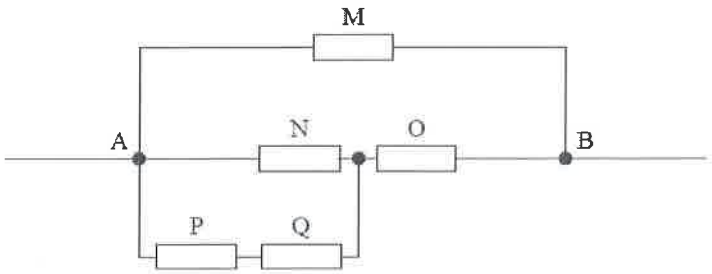
Conservation of charge: $I_T = I_1 + I_2$ (1)

Using $V = RI$ $\quad I = \frac{V}{R}$ so $\frac{V_T}{R_T} = \frac{V_1}{R_1} + \frac{V_2}{R_2}$ (1)

But $V_T = V_1 = V_2$ so divide through by V (1)

so $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

(b) The diagram shows a combination of five resistors, M, N, O, P and Q. Each resistor has a resistance of 5.0 Ω.



(i) Show that the resistance between points A and B is about 3 Ω.

(3)

Consider N, P, Q $\quad \frac{1}{R_{NPQ}} = \frac{1}{5} + \frac{1}{10} = \frac{3}{10}$ $\quad R_{NPQ} = \frac{10}{3} = 3.33$ (1)

P + Q = 10Ω

Consider N, P, Q, O ⇒ O is in series with 3.33Ω so this is

$3.33 + 5 = 8.33\,\Omega$ (1)

Now we have 8.33Ω in parallel with M

So total resistance $\frac{1}{R_T} = \frac{1}{8.33} + \frac{1}{5} = \frac{3}{25} + \frac{1}{5} = \frac{8}{25}$

$R_T = \frac{25}{8} = 3.125\,\Omega$ (1)

(ii) A student is told to modify the combination of resistors so that the combined resistance between A and B is greater than 5.0 Ω. She cannot change the arrangement of the resistors, but she can replace one of the 5.0 Ω resistors with a 20.0 Ω resistor.

Explain, without further calculations, which of the five resistors should be replaced.

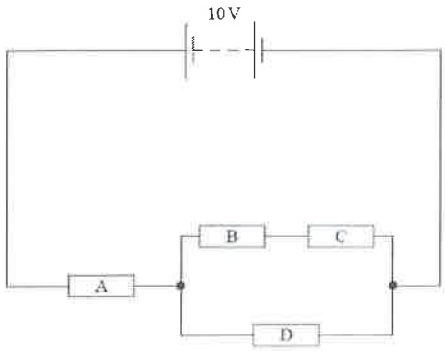
(2)

Replace M (1)

If M is not replaced, that branch of the parallel circuit will have a resistance of 5Ω and the combined resistance will be less than 5Ω (1)

(Total for question = 8 marks)

Q9. Four identical resistors, A, B, C and D, are placed in a circuit as shown.



(a) Determine the power dissipated in each of the resistors.

resistance of each resistor = 2.0 Ω

(6)

$R_{BC} = 4\Omega$ $\frac{1}{R_{BCD}} = \frac{1}{4} + \frac{1}{2} = \frac{3}{4}$ (1)

$R_{BCD} = \frac{4}{3}\Omega$ (1)

$R_{ABCD} = 2 + \frac{4}{3} = \frac{10}{3} = 3.33\Omega$ (1)

Total current $V = RI$ $I = \frac{V}{R} = \frac{10}{10/3} = 3A$ (1)

$P_A = I^2R = 3^2(2) = 18W$ (1)

$I_B = I_C = 1A$ $P_B = P_C = I^2R = 1^2(2) = 2W$

$I_D = 2A$ $P_D = I^2R = 2^2(2) = 8W$

(1) All correct values

(Total for question = 6 marks)