**REVISION 2013**

**ELECTRICITY AND MAGNETISM: ELECTRIC CIRCUITS - MEMORANDUM**

**MULTIPLE CHOICE QUESTIONS**

1[[1]](#footnote-1) A 🗸🗸

2[[2]](#footnote-2) A 🗸🗸

32 C 🗸🗸

4[[3]](#footnote-3) B ✓✓

5[[4]](#footnote-4) A ✓✓

6[[5]](#footnote-5) D ✓✓

7[[6]](#footnote-6) C ✓✓

**STRUCTURED QUESTIONS**

**QUESTION 1[[7]](#footnote-7)**

1.1 🗸

= 🗸

Rp = 30 Ω 🗸

1.2 Rext = 30 + 25 = 55 Ω 🗸

Emf = I(R + r) 🗸

12 ✓= I(55 + 1,5) 🗸

I = 0,21 A 🗸

1.3 V = IR 🗸

= (0,21)(30) 🗸

= 6,3 V 🗸

**QUESTION 2**7

2.1 1,5 V 🗸

2.2 gradient/m = 

🗸

= 

🗸

= - 0,85 Ω 🗸

2.3 Internal resistance 🗸🗸

2.4 Decreases🗸

When I increase*:*

“Lost volts”/ Ir increases*.* 🗸

Vext = emf – Ir decreases. 🗸

**QUESTION 3[[8]](#footnote-8)**

3.1 12 V 🗸

3.2

|  |  |  |
| --- | --- | --- |
| 3.2.1 | **Option 1**  I =  🗸 =  🗸 = 4 A | **Option 2**  emf = IR + Ir🗸  12 = I(2,4) + 2,4🗸 I = 4 A🗸 |

3.2.2 emf = IR + Ir 🗸

12 = 9,6 + 4r 🗸

r = 0,6 Ω 🗸

|  |  |  |
| --- | --- | --- |
| 2.3 | **Option 1**  emf = I(R + r) 🗸  12 = 6(R + 0,6) 🗸  Rext = 1,4 Ω  =  +  🗸  =  🗸  R = 3,36 Ω  Each tail lamp  : R = 1,68 Ω 🗸 | **Option 2**  Emf = Vterminal + Ir 🗸  12 = Vterminal + 6(0,6) 🗸  Vterminal = 8,4 V  I2,4 Ω =  =  = 3,5 A  I tail lamps = 6 – 3,5 = 2,5 A  Rtail lamps  = 🗸 = 🗸 = 3,36 Ω  Rtail lamp  = 1,68 Ω 🗸 |
|  | **Option 3**  V = IR 🗸  12 = (6)R 🗸  Rext = 2 Ω  ∴Rparallel = 2 – 0,6 = 1,4 Ω  =  +  🗸  =  🗸  R = 3,36 Ω  Each tail lamp R = 1,68 Ω 🗸 | **Option 4**  For parallel combination:  I1 + I2 = 6 A  ∴  + 🗸 = 6 🗸  8,4🗸 ( + )🗸 = 6  ∴ Rtail lamps = 3,36  Rtail lamp = 1,68 Ω 🗸 |

3.4 Increases 🗸

Resistance increases, current decreases 🗸

Ir (lost volts) decreases 🗸

**QUESTION 4[[9]](#footnote-9)**

4.1 The current in a conductor is directly proportional to the potential difference ✓

across its ends at constant temperature. ✓

OR

The ratio of potential difference to current is constant✓ at constant temperature. ✓

# 4.2

# 4.2.1 ✓ = ✓ Rp = 0,7 Ω ✓

# OR

Rp = ✓ =  ✓= 0,7 Ω ✓

4.2.2

# emf = I(R + r)

12 = Vexternal + (15)(0,1)✓

# Vexternal = 12 – (15)(0,1)

# = 10,5 V ✓

# OPTION 1:

# emf = I(R + r) ✓

# 12 = I(0,7 + 0, 1) ✓

# I = 15 A

R = 

# 0,7 = ✓

# ∴V = 10,5 V ✓

# OPTION 3

# Voltage divides 0,7: 0,1 / 7:1

# ∴Vheadlight = ✓✓x 12 ✓

# = 10,5 V ✓

# = 11,83 V ✓

# V”lost”= Ir = (15)(0,1) ✓= 1,5 V

Vexternal = 12 – 1,5 V = 10,5 V✓

Iheadlight = = 7,5 A✓

V = IR = (7,5)(1,4) = 10,5 V✓

# OPTION 2:

# I = ✓ = ✓ = 15 A

# V = IR

# = (15)(0,7) ✓

# = 10,5 V ✓

4.2.3

# OPTION 1

# P = ✓

# = ✓

# = 78,75 W ✓

# OPTION 2

# I(light) = 7,5 A

# P = VI ✓

# = (10,5)(7,5) ✓

# = 78,75 W ✓

# OPTION 3

# I(light) = 7,5 A

# P = I2R ✓

# = (7,5)2(1,4) ✓

# = 78,75 W ✓

# 4.3 Decreases ✓

-

# (Effective/ total ) resistance decreases. ✓

# (Total) current increases. ✓

# “Lost volts” / Vinternal / Ir increases, thus potential difference / V (across headlights) decreases.✓

P =  decreases.

**QUESTION 5[[10]](#footnote-10)**

5.1 9 V ✓

Potential difference measured when:

switch is open / no current flows / circuit is open/no work done is in external circuit ✓

5.2

Emf = IR + Ir ✓

9 ✓= Vext + (3)(0,3) ✓Vext = 8,1 V

Vext = I(R1 + R2)

8,1 = 3(3R) ✓  R1 = 0,9  ✓

5.3 Decreases ✓

5.4 Increases✓

Resistance decreases. ✓

Current increases. ✓

Ir increases.

**QUESTION 6[[11]](#footnote-11)**

6.1 Any two:

Temperature ✓

Cross sectional area (thickness) of material ✓

Length

6.2

Conductor Q✓

For the same potential difference, ✓ wire Q has a higher current than wire P. ✓ Therefore wire Q has a lower resistance than wire P. ✓

OR

Conductor Q✓

The gradient of the graph for wire Q is bigger than that for wire P. ✓

Gradient =  is bigger ✓, thus  = R is smaller. ✓

**QUESTION 7[[12]](#footnote-12)**

7.1 Vint = 45 – 43,5 = 1,5 V ✓

I = ✓ =  = 3 A

✓

V12 Ω = IR12 Ω  = 3 x 12 ✓= 36 V

✓

✓

V// = 43,5 – 36 = 7,5 V

(If only V// = 7,5 V: 2 marks)

I =  =  = 0,75 A ✓

✓

7.2 IR = 3 – 0,75 = 2,25 A ✓

✓

R=  =  = 3,33  ✓

7.3 Increases✓

The total resistance increases, ✓

therefore the current decreases✓ therefore Vinternal decrease ✓ therefore reading on V increases.

**QUESTION 8**

A

V

rheostat

resistor

8.1

|  |  |
| --- | --- |
| **Criteria for circuit diagram** | **Mark** |
| Battery connected to the resistor as shown – correct symbols used. | ✓ |
| Rheostat connected in series with resistor – correct symbols used. | ✓ |
| Ammeter connected in series so that it measures the current through resistor – correct symbols used. | ✓ |
| Voltmeter connected in parallel across resistor – correct symbols used. | ✓ |

8.2 Temperature✓

8.3 B ✓

The ratio  is greater than that of A. ✓✓

**QUESTION 9**

9.1  ✓= ✓

∴ R = 3,2 Ω

Reffective = 3,2 Ω + 2 Ω + 0,8 Ω✓

= 6 Ω ✓

|  |  |  |
| --- | --- | --- |
| 9.2 | **Option 1*:***  V = IR ✓  12 = I(6) ✓  I = 2 A ✓ | **Option 2:**  emf = I(R + r) ✓  12 = I(5,2 + 0,8) ✓  I = 2 A ✓ |

9.3 Vparallel = IR ✓

= (2)(3,2) ✓

= 6,4 V

V8Ω =  ✓= 3,2 V ✓

**QUESTION 10**

10.1 **Option 1**

✓ =  +  ✓  R = 6,47 Ω

Rtot = 6,47 + 2 + 0,2 ✓= 8,67 Ω

 ✓=  = 1,38 A ✓

✓

**Option 2**

✓ =  +  ✓  R = 6,47 Ω

Rext = 6,47 + 2 ✓= 8,47 Ω

Emf = I(R + r) ✓ 12 = I(8,47 + 0,2) ✓ I = 1,38 A ✓

10.2 Decreases ✓

(Effective) resistance of circuit decreases ✓ (No current through 15 Ω and 8 Ω resistances)

Current (I) increases ✓

Ir (lost volts) increases ✓

Vexternal decreases

**QUESTION 11[[13]](#footnote-13)**

11.1 The current through a conductor is directly proportional to

the potential difference across its ends at constant

temperature. ✓✓

11.2 Equal ✓

2 A divides equally at T (and since IM = 1 A it follows that IN = 1 A) ✓

11.3 emf = IR + Ir ✓ 17 = 14 + Ir ✓ Ir = 3 V

r =  ✓= ✓ = 1,5 Ω ✓

11.4 VN = IRN  ✓= (1)(2) ✓= 2 V ✓

11.5 VY = 14 – 2 = 12 V ✓

VY = IRY  ✓ 12 = (2)RY ✓

 RY = 6 Ω ✓

1. Nov 2012 [↑](#footnote-ref-1)
2. Nov 2011 [↑](#footnote-ref-2)
3. Nov 2008 [↑](#footnote-ref-3)
4. Mrch 2012 [↑](#footnote-ref-4)
5. Mrch 2011 [↑](#footnote-ref-5)
6. Mrch 2010 [↑](#footnote-ref-6)
7. Nov 2012 [↑](#footnote-ref-7)
8. Nov 2011 [↑](#footnote-ref-8)
9. Nov 2010 [↑](#footnote-ref-9)
10. Nov 2009 [↑](#footnote-ref-10)
11. Nov 2008 [↑](#footnote-ref-11)
12. Nov 2008 [↑](#footnote-ref-12)
13. March 2010 [↑](#footnote-ref-13)