D.C. Circuits TEST 3A

PHILIPS Chapters 8-10

Time allowed – 2 hours
18 Pages in this Question Booklet

TOTAL MARKS AVAILABLE

Aids to be supplied by College:

None

Aids to be supplied by Students:

Pen, pencil, eraser, rule, calculator

SECTION	Possible Marks	Actual Marks
A	20	
B	25	
C	28	
D	22	
TOTAL	95	

Instructions to Students:

- **Electronic devices are to be turned off and removed from your person.** You cannot access an electronic device during this examination.
- All questions are to be answered in the space provided in this Question Booklet. Answers to Section A – Multi-choice Questions, are to be recorded on the Answer Sheet attached to this Question Booklet.
- You are not to use any reference book in this examination.
- The whole of this Question Booklet is to be handed to the Supervisor upon completion.

Aids permitted where indicated:

Standard Dictionaries	Bilingual Dictionaries	Technical Dictionaries	Programmable Calculators	Non-programmable Calculators	Mobile Phones	MP3 Players
No	**Yes**	**No**	**No**	**Yes**	**No**	**No**

SECTION A – MULTIPLE CHOICE

(1 mark per question = 20 marks)

For each question in Section A, identify the response you consider to be the best answer by placing its identifying letter in the space provided at the end of each question.

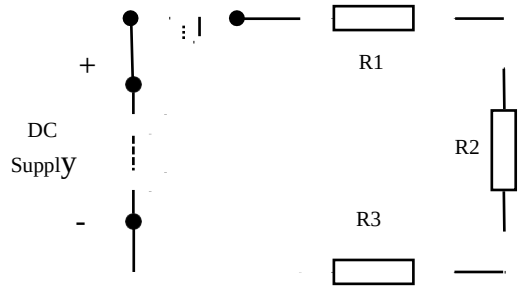


Figure 1

1. For the circuit in Figure 1, the voltage drops across R1, R2 and R3:

   A. are equal in every resistor
   B. sum to equal to the supply voltage
   C. are inversely proportional to the resistor values
   D. are inversely proportional to the value of circuit current

   (1 Mark)

2. For the circuit of Figure 1, if R1 is a 220 Ω resistor, R2 a 110 Ω and R3 a 470 Ω, the resistor which would have the largest voltage drop would be:

   A. the 220 Ω resistor
   B. the 470 Ω resistor
   C. the 110 Ω resistor
   D. they would all have the same voltage drop

   (1 Mark)

3. If resistor R1 in the circuit of Figure 1 becomes short circuited, the equivalent circuit resistance would

   A. increase
   B. remain the same
   C. zero ohms
   D. decrease

   (1 Mark)

4. The equivalent resistance (R_{EQ}) of the resistors in the circuit of Figure 1 is:

A. always less than the smallest value of resistance
B. only obtainable by measuring with an ohmmeter
C. equal to the sum of the individual resistance values
D. only obtainable by applying Ohm's Law.

(1 Mark)

5. When an analog needle moves to its furthest point this is called:

A. full scale deflection
B. maximum deflection
C. moving coil
D. fixed coil.

(1 Mark)

6. Ammeters use what to allow them to measure high currents:

A. moving iron
B. series resistor
C. capacitor
D. shunt resistor.

(1 Mark)

7. To increase the capacitance of a circuit you would:

A. use an iron core in the existing capacitor
B. connect a second capacitor in series with the existing capacitor
C. reverse the polarity of the existing capacitor
D. connect a second capacitor in parallel with the existing capacitor

(1 Mark)

8. What factor ***does not*** determine the capacitance of the capacitor

A. time constant
B. dielectric thickness
C. dielectric type
D. plate surface area

(1 Mark)

9. The thinner the dielectric of a capacitor the greater the:

A. capacitance
B. voltage rating
C. size
D. surface area

(1 Mark)

10. The symbol for a variable capacitor is a standard capacitor symbol:

A. with a cross through it
B. with a circle around it
C. with an arrow diagonally through it
D. does not exist

(1 Mark)

11. A parallel circuit is different from a series circuit as it has:

A. fewer current paths
B. more than one current path
C. only one current path
D. no current paths

(1 Mark)

12. Measuring instruments are specified by their sensitivity, resolution and:

A. size
B. accuracy
C. calibration
D. power

(1 Mark)

13. Two resistors R_A and R_B are connected in parallel. If resistor R_A has twice the resistance of resistor R_B, the current taken by resistor R_A is:

A. two thirds of the supply current
B. twice that taken by resistor R_B
C. one third of the supply current
D. one half of the supply current

(1 Mark)

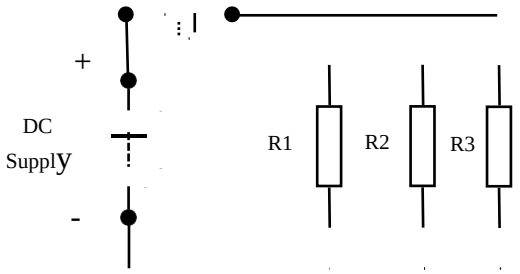


Figure 2

14. The equivalent resistance (R_{EQ}) of the resistors connected in the circuit of Figure 2 is:

    A. always less than the smallest value of resistance
    B. only obtainable by measuring with an ohmmeter
    C. equal to the sum of the individual resistance values
    D. only obtainable by applying Ohm's Law

    (1 Mark)

15. If an open circuit occurs in resistor R1 of the circuit of Figure 2, the equivalent resistance will:

    A. Decrease
    B. remain the same
    C. Increase
    D. cannot tell without knowing circuit values

    (1 Mark)

16. If an extra resistor R4 is connected in parallel to resistor R3 in the circuit of Figure 2, the equivalent resistance will:

    A. Increase
    B. Decrease
    C. remain the same
    D. cannot tell without knowing circuit values

    (1 Mark)

17. In the circuit of Figure 2, the current taken from the supply is:

    A. the same as the currents in resistor R1, R2 and R3
    B. the difference of the currents in resistor R1, R2 and R3
    C. only able to be determined by Ohm's Law
    D. the sum of the currents in resistor R1, R2 and R3

    (1 Mark)

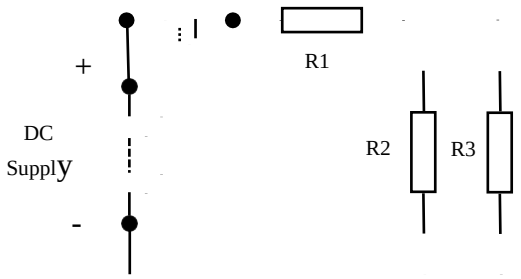


Figure 3

18. The resistor configuration of the circuit of Figure 3 is:

    A. R1 in series with R2
    B. R1 in series with R3
    C. R1 in series with parallel resistors R2 & R3
    D. R1, R2 & R3 all connected in parallel.

(1 Mark)

19. If the value of the series connected resistor in the circuit of Figure 3 is increased, the equivalent circuit resistance will:

    A. increase
    B. decrease
    C. remain the same
    D. cannot tell without knowing circuit values

(1 Mark)

20. If the resistor R2 of Figure 3 was bypassed by a short circuit connection, the overall power consumed by the circuit will:

    A. increase
    B. decrease
    C. remain the same
    D. cannot tell without knowing circuit values

(1 Mark)

SECTION B – Short Answer (25 Marks)

INSTRUCTIONS:
Blank spaces in the following statements represent omissions. Complete the statements with the word phrase or answer that you think fits best in the blank spaces.

1 What essential precaution must be taken before measuring resistance on a suspected live circuit?

_____

_____ (2)

2. Name two types of capacitors

_____

_____ (2)

3 What category of meter would be suitable for use on the load side of the service fuse in a domestic installation

_____ (1)

4. What type of capacitor must be connected with the correct polarity:

_____ (2)

5. Analog meters use magnetism to measure values. True or False

_____ (1)

6. What two functions are performed by the hair springs in a moving coil meter:

(A) _____

(B) _____ (2)

7. How many time constants does it take for a capacitor to be fully charged or discharged?

_____ (1)

8. If a conductor has a PTC characteristic, its resistance _____ with an increase in_____.

(2)

9. The resistance of a light dependent resistor will _____ with an increase in_____falling on the resistor.

(2)

10. When reading an anolog meter what type of error can occur by incorrectly aligning your eye with the pointer? _____ (2)

11 Total resistance in a series-parallel circuit can be calculated by just adding up the values. True or False

_____ (1)

12 Capacitance of a capacitor is_____proportional to the distance between the plates.

_____ (1)

13 How would you safely discharge a capacitor?

_____ (2)

14 What effect does a capacitor have on a D.C. current?

_____ (2)

15 If three 15Ω Resistors are connected in parallel what is the equivalent resistance?

_____ (2)

SECTION C – CALCULATIONS - (28 Marks)

The following questions are to be answered in the spaces provided on the question sheet. The marks are shown for each question.

For all questions the following is required:

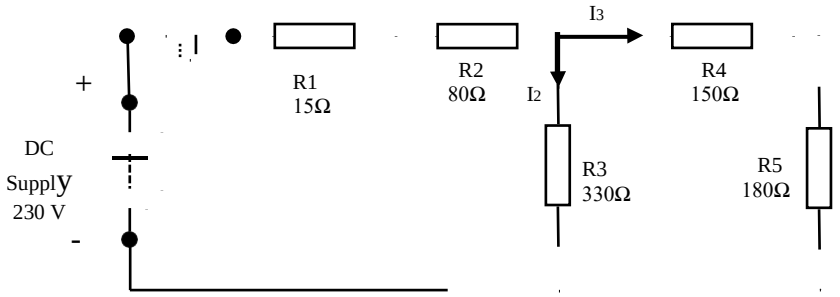


Figure 5

1. Determine the equivalent resistance (R_{EQ}) of the circuit of Figure 5.

(3)

2. In the circuit Figure 5, determine the current $I_{T,}$

(2)

3. In the circuit of Figure 5, determine the current I_3.

(2)

4. A simple circuit which contains three capacitors of values C_1, 25µf, C_2, 50µF and C_3, 75µF are connected in series to an 85 Volt supply determine,

a). the equivalent circuit capacitance.

(2)

b). the total charged stored by your circuit.

(2)

c). the voltage drops across each capacitor.

(3)

5. A simple circuit which contains three capacitors of values C_1, 15µf, C_2, 35µF and C_3, 45µF are connected in parallel to an 60 Volt supply, determine;

a). The equivalent circuit capacitance.

(2)

b). Calculate the total charged stored by your circuit.

(2)

c). the charge across each capacitor.

(3)

6 An RC circuit consists of a resistance of 120kΩ and a capacitance of 36μF. Determine the:

a) time constant of the circuit. (2)
b) time taken for the capacitor to fully charge. (1)

(3)

7. An RC circuit has an applied voltage of 30V. What is the voltage across the capacitor after 1 time constant?

(2)

8. How much energy is stored in a 22μF capacitor charges to 400V.

(2)

SECTION D – Drawings & Symbols - (22 Marks)

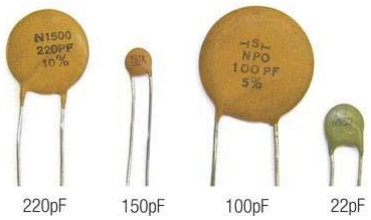
1. Identify the symbols below from the selection given in table 1.

variable	
trimmer	
fixed non-polarised	
fixed polarised	
thermister	
varistor	

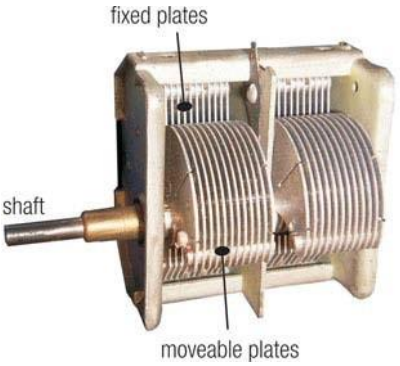
A B C D

(4 marks)

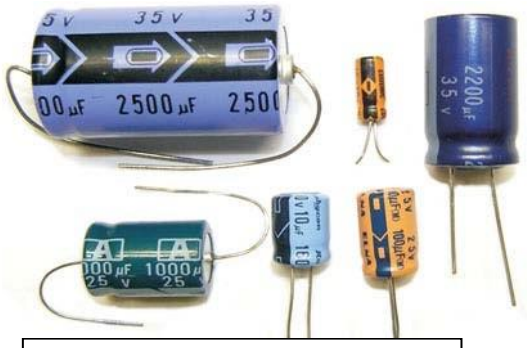
2. Identify the following capacitor types



a)



b)



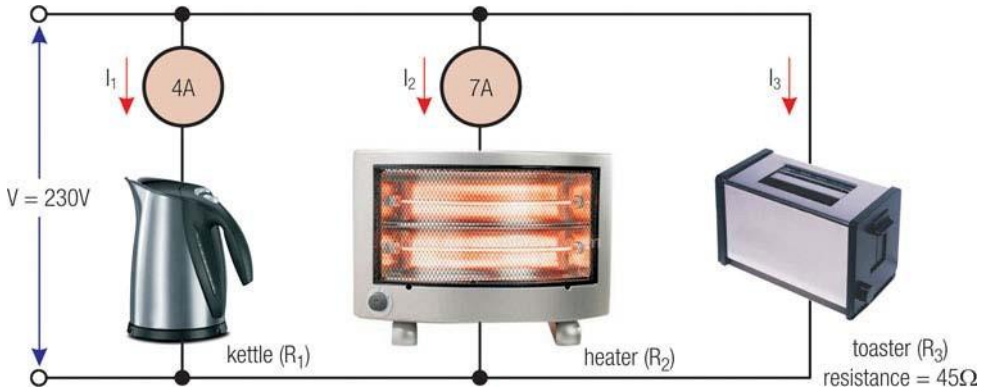
c)

(6 marks)

3. In reference to the diagram below answer the following;

a) Are the appliances connected in series or parallel_____(1)

b) Determine the power drawn by the toaster._____(3)



4. From the following description sketch a circuit containing series resistors, R_1 & R_2 connected to a parallel branch containing R_3 and R_4. The supply voltage is 30V.

Series / parallel circuit

(3 Marks)

5. Refer to the graph below and answer the following questions.

   a. What is the graph below commonly known as?

      _ _ _ _ _ _ _ _ _   _ _ _ _   _ _ _ _ _ _ _ _   _ _ _ _ _ (2)

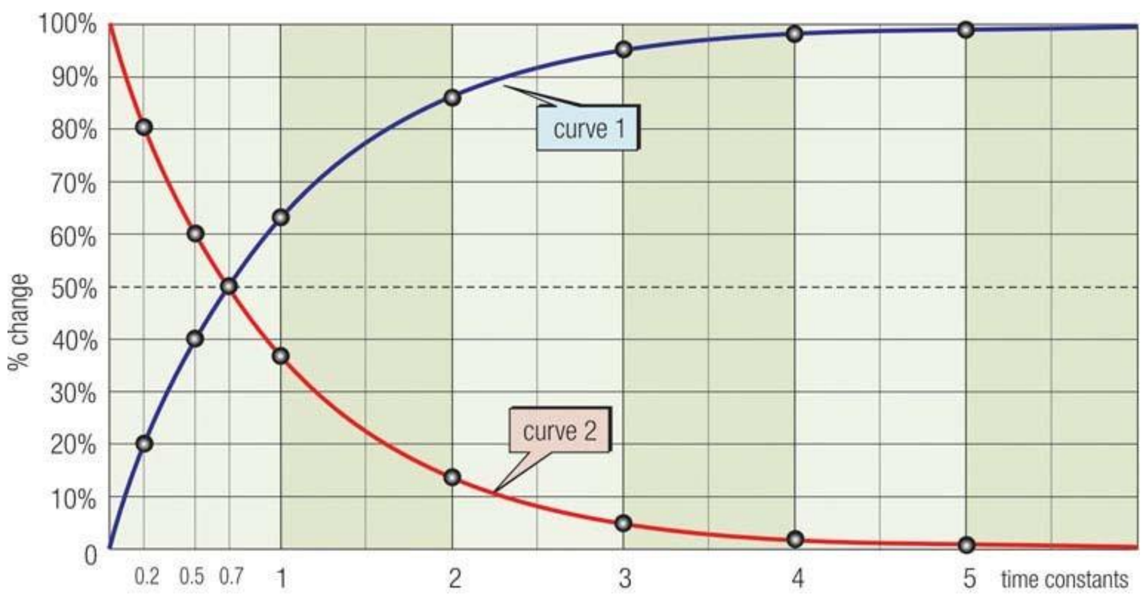
   b. Which curve represents the voltage *__discharging__*?

      ____ (1)

   c. Which curve represents the current *__discharging?__*

      ____ (1)

   d. Mark on the graph the percentage after two time constants for current *__CHARGING__* a capacitor. (1)



Note: The symbols used on this sheet follow AS1046 pt 1. There are alternate recognised symbols in use. The list does not contain every equation used in the course. Transposition of equations will be necessary to solve problems

$$Q = It \qquad v = \frac{s}{t} \qquad a = \frac{\Delta v}{t}$$

$$F = ma \qquad W = Fs \qquad W = mgh$$

$$W = Pt \qquad \eta\% = \frac{output}{input} \times \frac{100}{1} \qquad I = \frac{V}{R}$$

$$P = VI \qquad P = I^2R \qquad P = \frac{V^2}{R}$$

$$R_2 = \frac{R_1 A_1 l_2}{A_2 l_1} \qquad R_h = R_c(1 + \alpha \Delta t) \qquad R = \frac{\rho l}{A}$$

$$R_T = R_1 + R_2 + R_3 \qquad V_T = V_1 + V_2 + V_3 \qquad \frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

$$I_T = I_1 + I_2 + I_3 \qquad V_2 = V_T \frac{R_2}{R_1 + R_2} \qquad I_2 = I_T \frac{R_1}{R_1 + R_2}$$

$$R_x = \frac{R_A R}{R_B} \qquad C = \frac{Q}{V} \qquad \tau = RC$$

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \qquad C_T = C_1 + C_2 + C_3 \qquad C = \frac{A \varepsilon_o \varepsilon_r}{d}$$

$$F_m = IN \qquad H = \frac{F_m}{l} \qquad B = \frac{\Phi}{A}$$

$$\Phi = \frac{F_m}{S} \qquad S = \frac{l}{\mu_o \mu_r A} \qquad V = N \frac{\Delta \Phi}{\Delta t}$$

$$e = Blv \qquad L = \frac{\mu_o \mu_r A N^2}{l} \qquad L = N \frac{\Delta \Phi}{\Delta I}$$

$$V = L \frac{\Delta I}{\Delta t} \qquad \tau = \frac{L}{R} \qquad F = BIl$$

$$T = Fr \qquad E_g = \frac{\Phi Z n P}{60a} \qquad P = \frac{2\pi n T}{60}$$

$$t = \frac{1}{f} \qquad f = \frac{np}{120} \qquad V = 0.707 V_{\max}$$

$$I = 0.707 I_{\max} \qquad V_{ave} = 0.637 V_{\max} \qquad I_{ave} = 0.637 I_{\max}$$

$$v = V_{\max} \sin \phi \qquad i = I_{\max} \sin \phi \qquad I = \frac{V}{Z}$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2} \qquad X_L = 2\pi f L \qquad X_C = \frac{1}{2\pi f C}$$

$$\cos\phi = \frac{P}{S}$$

$$\cos\phi = \frac{R}{Z}$$

$$S = \sqrt{P^2 + Q^2}$$

$$S = VI$$

$$P = VI\cos\phi$$

$$Q = VI\sin\phi$$

$$f_o = \frac{1}{2\pi\sqrt{LC}}$$

$$V_L = \sqrt{3}V_P$$

$$I_L = \sqrt{3}I_P$$

$$S = \sqrt{3}V_L I_L$$

$$P = \sqrt{3}V_L I_L \cos\phi$$

$$Q = \sqrt{3}V_L I_L \sin\phi$$

$$\tan\phi = \sqrt{3}\left(\frac{W_2 - W_1}{W_2 + W_1}\right)$$

$$Q = mC\Delta t$$

$$V' = 4.44\Phi fN$$

$$\frac{V_1}{V_2} = \frac{N_1}{N_2}$$

$$\frac{I_2}{I_1} = \frac{N_1}{N_2}$$

$$N_{syn} = \frac{120f}{p}$$

$$s\% = \frac{(n_{syn} - n)}{n_{syn}} \times \frac{100}{1}$$

$$f_r = \frac{s\% \times f}{100}$$

$$V_{reg}\% = \frac{(V_{NL} - V_{FL})}{V_{FL}} \times \frac{100}{1}$$

$$V_{reg}\% = \frac{(V_{NL} - V_{FL})}{V_{NL}} \times \frac{100}{1}$$

$$T = \frac{\Phi ZIP}{2\pi a}$$

$$I_{ST} = \frac{1}{3} \times I_{DOL}$$

$$T_{ST} = \frac{1}{3} \times T_{DOL}$$

$$I_{ST} = \frac{V_{ST}}{V} \times I_{DOL}$$

$$T_{ST} = \left(\frac{V_{ST}}{V}\right)^2 \times T_{DOL}$$

$$I_{motor\,st} = \frac{\%TAP}{100} \times I_{DOL}$$

$$I_{line\,st} = \left(\frac{\%TAP}{100}\right)^2 \times I_{DOL}$$

$$E = \frac{\Phi_v}{A}$$

$$E = \frac{I}{d^2}$$

$$\eta_v = \frac{\Phi_v}{P}$$

$$V_L = 0.45V_{ac}$$

$$V_L = 0.9V_{ac}$$

$$V_L = 1.17V_{phase}$$

$$V_L = 1.35V_{line}$$

$$PRV = \sqrt{2}V_{ac}$$

$$PRV = 2\sqrt{2}V_{ac}$$

$$PRV = 2.45V_{ac}$$

$$V_{ripple} = \sqrt{2}V_{ac}$$

$$V_{ripple} = 0.707V_{phase}$$

$$V_{ripple} = 0.1895V_{line}$$

Student Name : _____

Class : _____

ANSWER SHEET

Section A (Multi-choice Questions)

Instructions:

Enter your personal details in the top right hand corner of this sheet.

Place an **X** in box of your choice. If you make a mistake, circle your answer ⊗ and choose again.

Question	A.	B.	C.	D
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
Totals				

Question	A.	B.	C.	D
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
Totals				

Total Marks Section A:_____