# *D.C. Circuits TEST 2A*

# *PHILIPS Chapters 5-7*

**Time allowed – 2 hours**
**17 Pages in this Question Booklet**

**Aids to be supplied by College:**

None

**Aids to be supplied by Students:**

Pen, pencil, eraser, rule, calculator

**Total Marks Available**

| SECTION | Possible Marks | Actual Marks |
|---|---|---|
| **A** | 25 | |
| **B** | 20 | |
| **C** | 18 | |
| **D** | 26 | |
| **TOTAL** | 89 | |

**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 – (25 Marks)**

**INSTRUCTIONS:**
Select the best answer for the following statements and place the identifying letter in the bracket. Each correct answer is worth 1 mark.

1. A piezo-electric material will produce an e.m.f when:

   A. exposed to sunlight
   B. subjected to mechanical pressure
   C. heated
   D. passed through a magnetic field.

   (1 Mark)

2. The ability of a conductor to permit the flow of electricity is called its:

   A. conductance
   B. resistance
   C. reluctance
   D. Capacitance.

   (1 Mark)

3. A VDR is a device that changes its properties when:

   A. current varies
   B. temperature varies
   C. voltage varies
   D. light varies.

   (1 Mark)

4. The proportion of what we get out of a machine or system for what we put into it is termed the:

   A. output of the system
   B. efficiency
   C. operating losses of the system
   D. proficiency of the system.

   (1 Mark)

5. The metal often used in heating elements is

   A. nichrome
   B. copper
   C. aluminium
   D. Silver.

   (1 Mark)

6. If the cross sectional area is increased, the resistance will be:

A. doubled
B. halved
C. increased
D. Decreased.

(1 Mark)

7. Total resistance in a series circuit is equal to the:

A. largest value resistor
B. lowest value resistor
C. sum of the resistor values connected in series
D. average of the resistors connected.

(1 Mark)

8. An open circuit in a series circuit will cause:

A. current to remain the same
B. current to stop flowing
C. current to rise
D. a doubling of the current

(1 Mark)

9. The relationship between current and voltage in a series circuit is considered:

A. logarithmic
B. inversely proportional
C. non proportional
D. proportional

(1 Mark)

10. When there's an open circuit in a branch of a parallel circuit the total power will:

A. decrease
B. increase
C. remain the same
D. stop flowing

(1 Mark)

11. The total power consumed in a parallel circuit is the:

A. sum of the power consumed by all branches of the circuit
B. voltage divided by the total resistance
C. current multiplied by the total resistance
D. Equivalent to one branch of the circuit

(1 Mark)

12. As the temperature of a copper conductor increases, its resistance:

A. increases
B. remains unchanged
C. decreases
D. reaches a minimum value

(1 Mark)

13. If five lamps are connected in series and the second lamp develops an open circuit, there is:

A. no current flow in lamps three, four and five only
B. current flow in lamp one only
C. no current flow in lamp two only
D. no current flow in all lamps

(1 Mark)

14. If the length of a conductor is doubled and its cross sectional area is halved, its resistance would:

A. remain unchanged
B. double
C. decrease
D. quadruple

(1 Mark)

15. When selecting a resistor for a circuit, the two factors which must be considered are:

A. the resistance and the current rating
B. the resistance and the voltage rating
C. the current and the voltage rating
D. the resistance and the power rating

(1 Mark)

16. When three 30Ω Resistors are connected in parallel to each other the equivalent circuit resistance is

A. 3Ω
B. 90Ω
C. 30Ω
D. 10Ω

(1 Mark)

17. What would be the value of a resistor if it had 4K7 written on it?

A. 47 ohms
B. 0.0047 ohms
C. 4700 ohms
D. 4.7 ohms

(1 Mark)

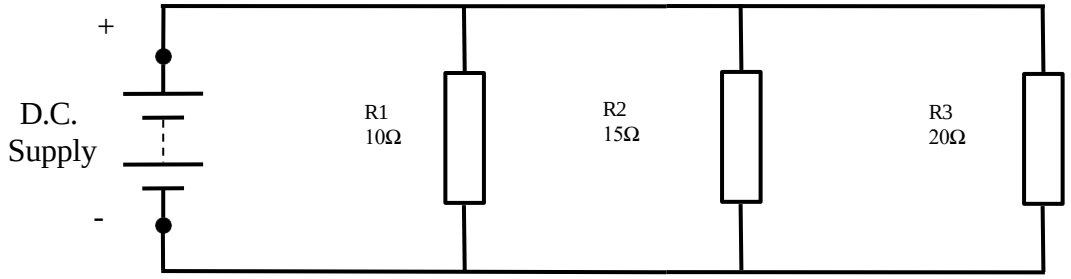



*Figure 1*

18. For the circuit shown in Fig.1, which resistance would have the most current flowing through it?

    A. R1
    B. R2
    C. R3
    D. the same current will flow through each resistor

(1 Mark)

19. The equivalent resistance of the circuit in Fig. 1 would be:

    A. greater than R3
    B. less than R1
    C. greater than R1
    D. the sum of R1, R2 and R3

(1 Mark)

20. If a conductor has a negative temperature coefficient, it's resistance will:

    A. increase with an increase in temperature
    B. decrease with an increase in temperature
    C. be unaffected by a change in temperature
    D. remain constant throughout the negative temperature range

(1 Mark)

21. Resistivity's unit of measurement is:

    A. Degrees centigrade ( ℃)
    B. Ohms (Ω)
    C. Ohms per metre (Ω/m)
    D. Metres (m)

(1 Mark)

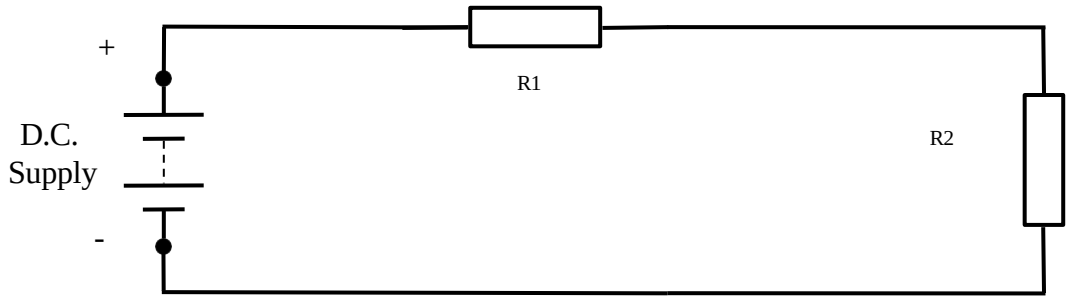



*Figure 2*

22. The equivalent resistance of the resistors R1 and R2 shown in Fig. 2:

A. is always smaller than the lowest value of resistance
B. is calculated by adding the two resistances
C. can only be found be using Ohm's Law
D. can only be found by using an ohmmeter

(1 Mark)

23. If resistor R2 in Fig. 2 was to develop a short circuit the equivalent resistance would:

A. increase
B. decrease
C. remain unchanged
D. quadruple

(1 Mark)

24. If the voltage applied to the circuit Fig. 2 was to be doubled, the total power consumed by the circuit would:

A. quadruple
B. halve
C. double
D. triple

(1 Mark)

25. If resistor R2 in Fig. 2 was to become an open circuit, the total resistance of the circuit would:

A. be infinity
B. decrease
C. remain unchanged
D. equal R1

(1 Mark)

**SECTION B – (20 Marks)**

Place the answer to each of the following questions in the appropriate place on the answer sheet.

Questions 1 to 3 refer to table 1 below.

| COLOUR | VALUE | MULTIPLIER | TOLERANCE |
|---|---|---|---|
| Black | 0 | 1 | - |
| Brown | 1 | 10 | 1% |
| Red | 2 | 100 | 2% |
| Orange | 3 | 1,000 | - |
| Yellow | 4 | 10,000 | - |
| Green | 5 | 100,000 | 0.5% |
| Blue | 6 | 1,000,000 | 0.25% |
| Violet | 7 | - | 0.1% |
| Grey | 8 | - | - |
| White | 9 | - | - |
| Gold | - | 0.1 | 5% |
| Silver | - | 0.01 | 10% |

**1.**

(a) Using Table 1, determine the value of a resistor with the following colour bands: - Brown, Black, Red, Red

_____ (2)

(b) Determine the tolerance range for the resistor in question 1a

_____ to _____ (2)

**2.**

(a) Determine the value of a resistor with the following colour bands:- White, Grey, Blue, Red, Gold

_____ (2)

(b) Determine the tolerance range for the resistor in question 2a

_____ to _____ (2)

**3.** Identify the colours of the four bands that would be found on a 120 Ω resistor with a range of 108 Ω to 132 Ω.

_____

_____ (2)

**4.** How many current paths does a series circuit have?

_____ (1)

**5.** If four identical resistors are connected in parallel and have a total resistance of 25Ω. What are the four individual resistance values?

_____ (1)

**6.** What is a common semiconductor material?

_____ (1)

**7.** What is the tolerance range of an E12 resistor?

_____ (1)

**8.** What is the typical emf per cell of a standard lead-acid battery?

_____ (1)

**9.** List the four (4) factors that affect the resistance of a conductor.

_____

_____ (2)

**10.** Give an example of where a thermistor is used and why?

Application_____ (1)

Purpose _____ (1)

**11.** What type of temperature coefficient does “Constantan” have?

_____ (1)

**SECTION C – (18 Marks)**

**INSTRUCTIONS:**
The question in this section requires some simple drawing and calculations. Ensure that the drawing is neat and legible. The use of pencil on the drawing is acceptable in this section only.

**Q.1**

The diagram drawn below shows the components of a circuit. Using all components draw the connections that are required to meet the following description:

(a) R1, R2, R3 and R4 are connected in parallel

(b) The ammeter measures total circuit current

(c) The voltmeter measures the voltage across R4

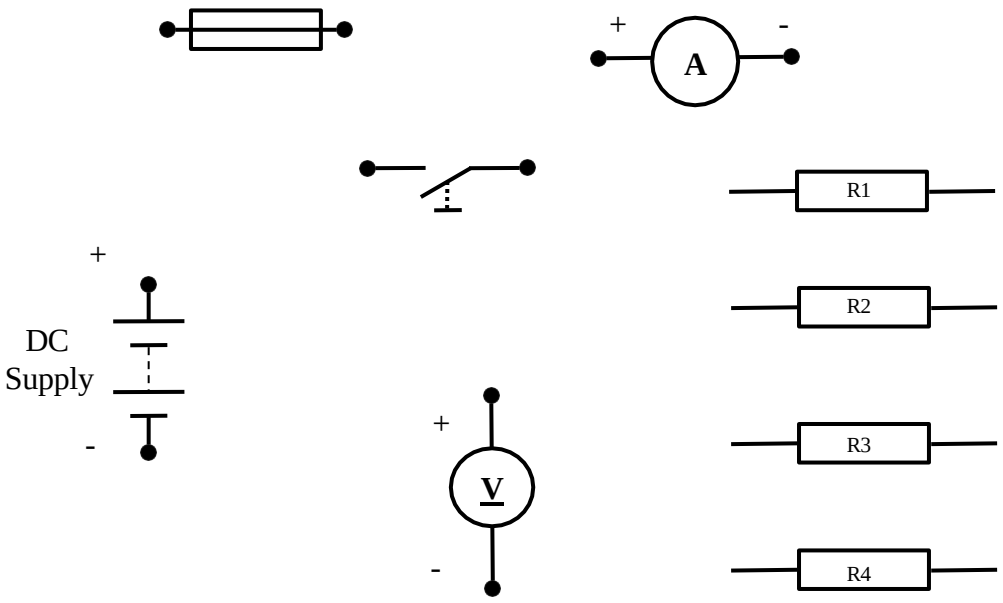


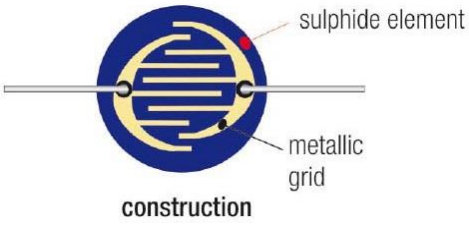

*Figure 5 Electric Circuit Connections*

( 6)

**QUESTION 2**

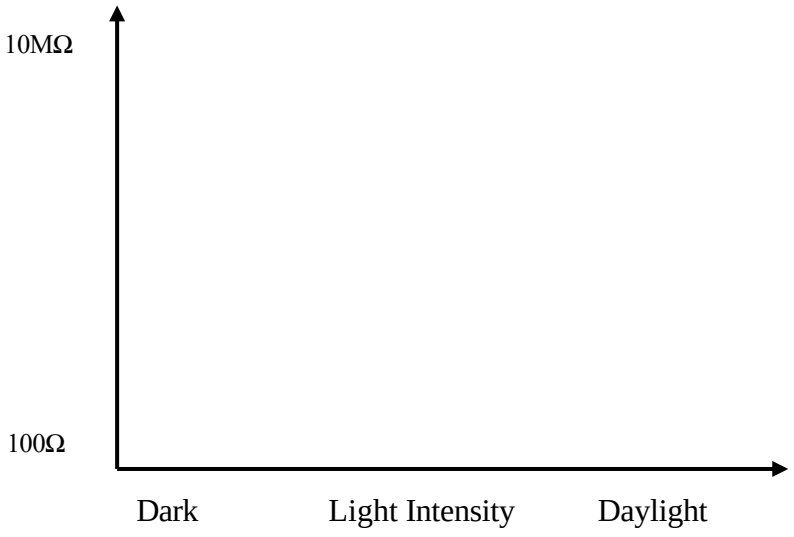
Identify the following component and sketch the resistance/light response curve and symbol.

Actual Size




Component name_____

_____



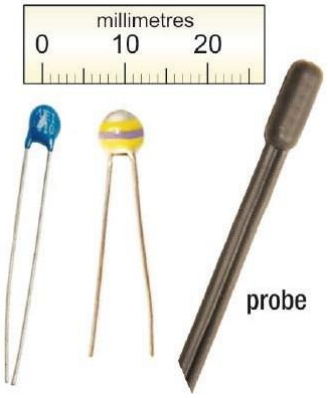

Draw its response curve

Draws its SI symbol

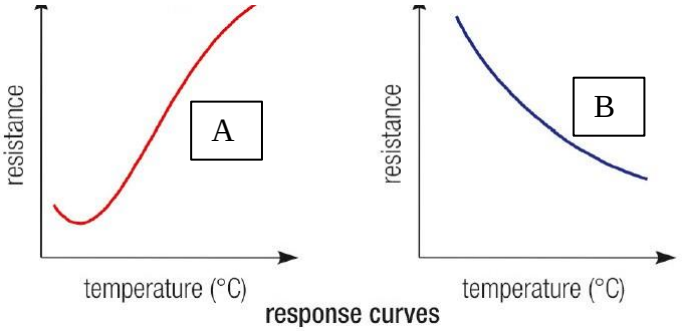
(6)

**QUESTION 3**

Identify the following component, temperature/resistance, response curve and draw its symbol.




Component name_____




Which curve has a PTC, A or B

_____

| Draws the symbol for response curve B |
|---|
| |

(6)

**SECTION D Calculations – (26 Marks)**

Show **ALL** working for your calculations.

**1.** A 12VdD.C supply is connected to a series circuit containing a 10Ω and a 27Ω resistor. Determine the value of current drawn.

(3)

**2.** Determine the resistance of a 180 metre length of 1.5mm$^2$ conductor. The resistivity of this aluminium is $2.83^{x10-8}$

(2)

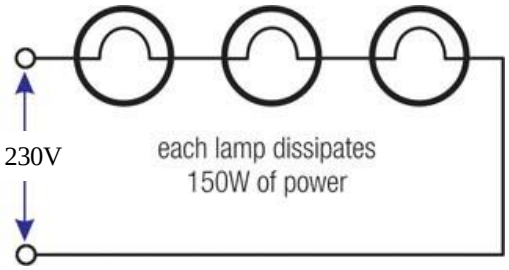
**3.** If the branches of a parallel circuit dissipate 10W, 20W and 30W respectively, what amount of power is dissipated by the entire circuit?

(2)

**4.** A 160 metre long ***copper*** cable is allowed a maximum resistance of 1Ω. Determine the minimum cross sectional area of a suitable cable. The resistivity of copper is $1.72^{x10-8}$

(3)

5. The circuit below has three identical lamps. Find the current flowing in the circuit




(3)

6. Calculate the cost of running of 1200 watt electric heater for eight hours. The cost of electricity is $0.12 per kWh.

(3)

7. Determine the total power dissipated in a 230V parallel circuit with three resistor of value, $R_1$ =120 Ω, R2 = 60 Ω and $R_3$ = 47 Ω.

(3)

**8.** Find the resistance of a copper conductor at 120°C, if it has a resistance of 25Ω at 200C. The coefficient for copper is 0.004Ω/°C .

(3)

**9.** Calculate the following values in figure 1

a) Total resistance $R_T$

b) Supply Voltage $V_T$

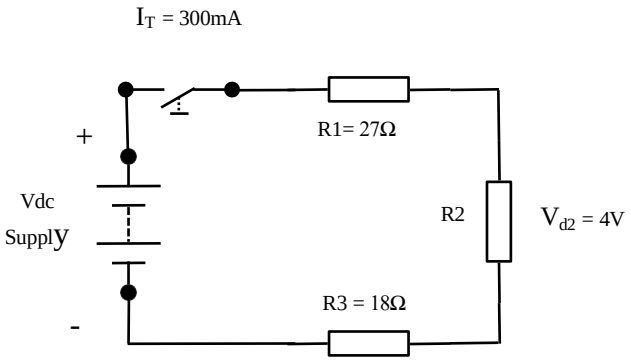



*Figure 1*

(4)

END

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 | | | | |
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| 13 | | | | |
| **Totals** | | | | |

| Question | A. | B. | C. | D. |
|---|---|---|---|---|
| 14 | | | | |
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**Total Marks Section A: _____**