SEC37/c2.25m

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2025 MAIN SESSION

SUBJECT:	**Engineering Technology**
PAPER NUMBER:	Controlled – Unit 2
DATE:	10th May 2024
TIME:	10:00 a.m. to 11:35 a.m.

THIS PAPER SHOULD BE RETURNED TO THE INVIGILATOR AFTER THE EXAMINATION.

Name of candidate _____

I.D. number _____

School _____

Class _____

Answer **ALL** questions in the space provided.

Scenario

The school teacher at a Technical College will construct and test a number of circuits using different materials and electronic components provided to her by the school technician.

Question 1 **K-1 (4 marks)**

Based on their electrical characteristics, all materials can be classified into three groups: conductors, semiconductors, and insulators.

a) Categorise the given set of materials into either conductors or insulators, considering their electrical properties. Place them in the appropriate column of Table 1. An illustrative sample from each category is already provided in the table to assist you.

Oil	Porcelain	Copper	Gold

Table 1: Conductors and Insulators

Conductor	**Insulator**
Aluminium	Glass

(1)

b) Define the term semi-conductor.

_____

_____

_____

_____ (1)

c) The resistance of a copper or aluminium wire is influenced by three different parameters. State any **TWO** of these parameters.

_____

_____

_____

_____ (2)

Question 2 **K-3 (4 marks)**

- Electrical circuits can be either closed or open.
- Moreover, electrical circuits can be either series, parallel or a combination of the two.

a) Differentiate by highlighting the differences between open and closed circuits.

_____

_____

_____

_____ (1)

b) In the space provided below draw:

i) A series circuit consisting of a 3 V battery and two resistors of: 1 x 560 Ω and 1 x 680 Ω.

(0.5)

ii) A parallel circuit made up of a 3 V battery and a 150 Ω resistor in parallel with a 120Ω resistor.

(0.5)

This question continues on next page.

c) Figure 1 illustrates a series-parallel circuit.
From this circuit shown in Figure 1, identify **ONE** series and **ONE** parallel circuit combination by referring to the resistors R1, R2 and R3. Write your answers in the space provided below.

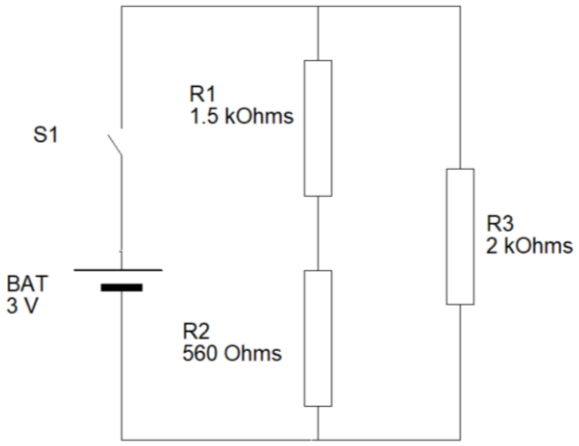


Figure 1: Series-parallel circuit

Series sub-circuit: _____ (1)

Parallel sub-circuit: _____ (1)

Question 3 **C-2 (6 marks)**

The equivalent resistance of a circuit is important to determine the power supplied by the battery.

a) Find the total resistance of the circuit shown in Figure 2. Show all your working.

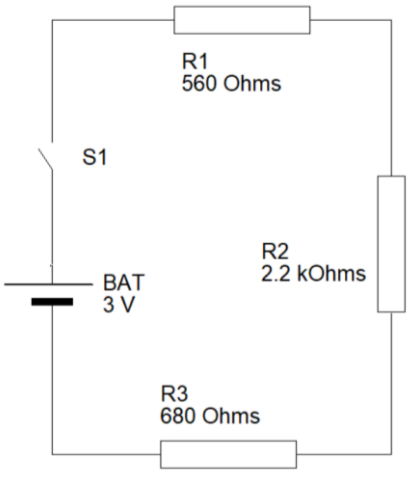


Figure 2: Circuit 1

_____

_____

_____

_____

_____

_____

_____

_____ (2)

b) Find the total resistance of the circuit shown in Figure 3 below. Show all your working.

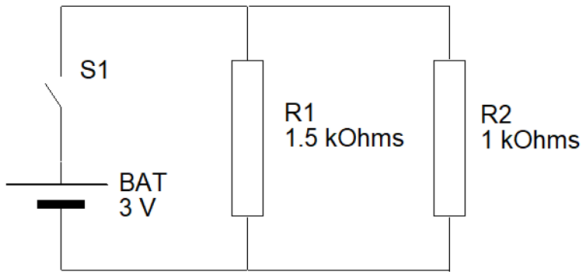


Figure 3: Circuit 2

_____

_____

_____

_____

_____

_____

_____ (2)

This question continues on next page.

c) Find the total resistance of the circuit shown in Figure 4 below. Show all your working.

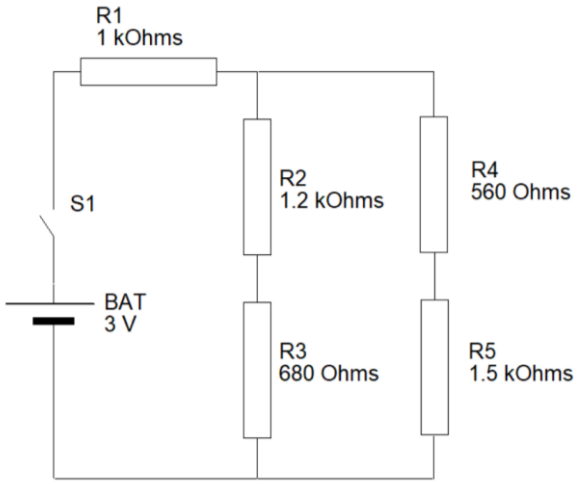


Figure 4: Circuit 3

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ (2)

Question 4 **C-3 (6 marks)**

The required equivalent capacitance can be obtained by connecting capacitors in series and/or in parallel in one circuit.

a) Find the total capacitance of the circuit shown in Figure 5 below. Show all your working.

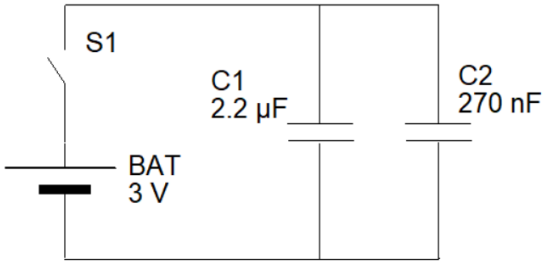


Figure 5: Circuit 4

_____

_____

_____

_____ (2)

b) Find the total capacitance of the circuit shown in Figure 6 below. Show all your working.

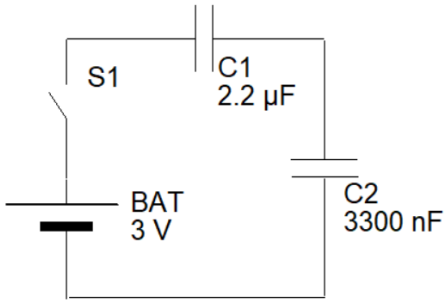


Figure 6: Circuit 5

_____

_____

_____

_____

_____

_____

_____ (2)

This question continues on next page.

c) Find the capacitance value of capacitor C1 required to obtain a time constant of 2.64 s for the RC circuit shown in Figure 7.

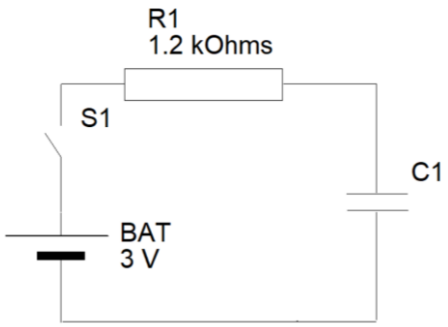


Figure 7: Circuit 6

_____

_____

_____

_____

_____

_____

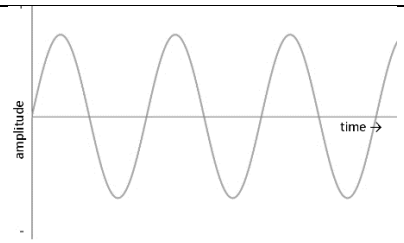
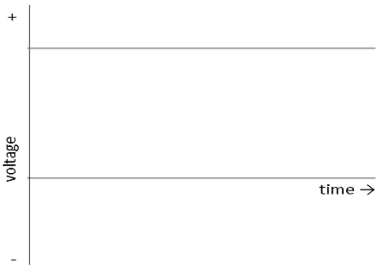
_____ (2)

Question 5 **K-6 (4 marks)**

Different signal waveforms describe the variation of a parameter as a function of time.

a) Identify the **TWO** different signals tabulated in Table 2.

Table 2: Different types of Signals

	Signal	Name
i)		_____ (0.5)
ii)		_____ (0.5)

(Source: https://www.seeedstudio.com)

b) Define **TWO** parameters of a square wave signal, and their SI units.

Parameter 1: _____ (0.25)

SI Unit of Parameter 1: _____ (0.25)

Parameter 2: _____ (0.25)

SI Unit of Parameter 2: _____ (0.25)

This question continues on next page.

c) Label the important features of the oscilloscope shown in Figure 8.

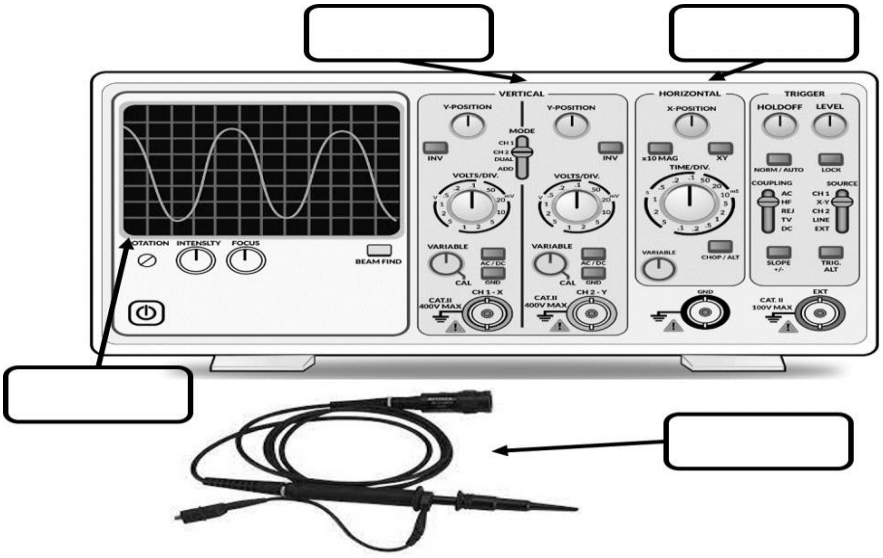


Figure 8: Oscilloscope
(Source: https://www.electronicshub.org/)

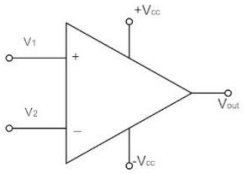
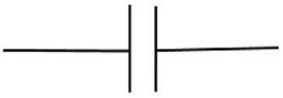
(2)

Question 6 **K-9 (4 marks)**

Different standardised electronic symbols are used to represent different electronic components.

a) Identify all the electronic symbols illustrated in Table 3.

Table 3: Electronic Symbols.

	Electronic Symbol	Name
i)	 *(Source: https://www.keystagewiki.com/)*	_____ (0.25)
ii)	 *(Source: https://www.electrostudy.com)*	_____ (0.25)
iii)	 *(Source: https://www.electronicshub.org/)*	_____ (0.25)
iv)	 *(Source: https://www.tutorialspoint.com/)*	_____ (0.25)

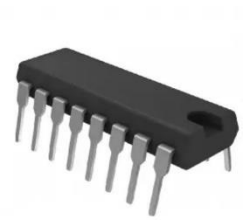
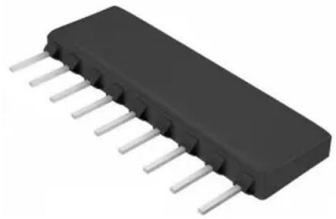
b) Match the SI units on the left to their respective parameters on the right by connecting a line between them.

Ohms	Current
Farads	Power
Amps	Capacitance
Watts	Resistance

(1)

c) Table 4 below shows different packaging for an operational amplifier and a diode. Identify each of the given package, by underlining the correct answer.

Table 4: Component Packaging.

	Component	**Packaging 1**	**Packaging 2**
i)	Operational Amplifier	 Single in line / Dual in Line	 Single in line / Dual in Line
ii)	Diode	 Through hole / Surface mount	 Through hole / Surface mount

(Sources: https://www.electroschematics.com, https://www.electroschematics.com, https://eu.mouser.com/, https://www.directindustry.com)

(2)

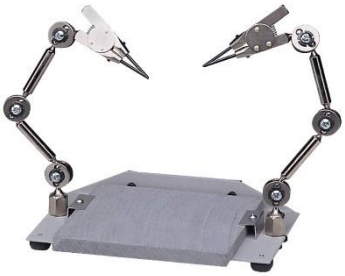
Please turn the page.

Question 7 **K-10 (4 marks)**

To construct electronic circuits specialised tools are required.

a) Label the different tools used in the construction of electronic circuits shown in Table 5.

Table 5: Tools

	Tool	Name
i)	 *(Source: https://fixit.com.mt/)*	_____ (0.25)
ii)	 *(Source: https://www.techsoft.co.uk/)*	_____ (0.25)
iii)	 *(Source: https://grs.com/)*	_____ (0.25)
iv)	 *(Source: https://dk.farnell.com/)*	_____ (0.25)

b) Identify the remaining **FOUR** correct steps in their respective order to use a soldering iron effectively. The first step has been provided.

Step 1: Clean the soldering tip

Step 2: _____

_____ (0.25)

Step 3: _____

_____ (0.25)

Step 4: _____

_____ (0.25)

Step 5: _____

_____ (0.25)

c) Different tools with different functions are required in the construction of circuits on a PCB board. Outline the functions of the following **TWO** tools used in a circuit construction.

Soldering Iron	Side Cutter

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ (2)

Please turn the page.

Question 8 **C-5 (6 marks)**

Different safety precautions need to be taken to mitigate with a number of hazards present during the PCB manufacturing process.

a) Identify the appropriate warning sign for each of the hazardous scenario given in Table 6. Draw a circle around the correct sign.

Table 6: Warning signs for hazardous scenarios.

	Scenario	**Warning Sign**
i)	A liquid used during the etching process that is highly corrosive	 (1)
ii)	A liquid used during the etching process that is flammable	 (1)

(Source: https://www.vectorstock.com/)

b) Identify **FOUR** hazards that might be present when manufacturing a PCB.

Slipping on the floor	Burns	Chemical spill
Dangerous fumes from solder	Airborne fragments	Falling from heights

Hazard 1: _____ (0.5)

Hazard 2: _____ (0.5)

Hazard 3: _____ (0.5)

Hazard 4: _____ (0.5)

c) Identify **FOUR** ways to eliminate or minimize the risks involved when manufacturing a PCB.

Work in a humid area Keep the work area safe and clean Wear appropriate PPE Work in a well-ventilated area Use chemicals according to its Data Safety Sheet Store chemical on shelves

Minimize risk 1: _____ (0.5)

Minimize risk 2: _____ (0.5)

Minimize risk 3: _____ (0.5)

Minimize risk 4: _____ (0.5)

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