Index Number:_____ SEC37/s3.21s

L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

SECONDARY EDUCATION CERTIFICATE LEVEL
2021 SUPPLEMENTARY SESSION

SUBJECT:	**Engineering Technology**
PAPER NUMBER:	Synoptic – Unit 3
DATE:	3rd November 2021
TIME:	4:00 p.m. to 6:05 p.m.

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

Answer **ALL** questions in the space provided. The use of non-programmable electronic calculators is allowed.

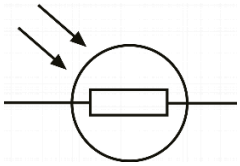
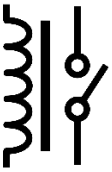
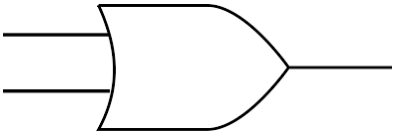
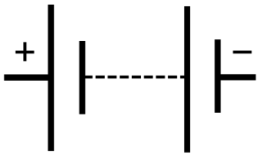
Scenario

- There is a job opportunity for a technician with a company manufacturing integrated circuits.
- As part of the selection process, the following test is being used to assess the knowledge in the area of electronics.

Question 1 **(8 marks)**

In Table 1, identify the component or logic gate corresponding to the schematic or real-life representation provided from (i) to (viii).

Table 1 – Schematic or real-life representations of electronic components.

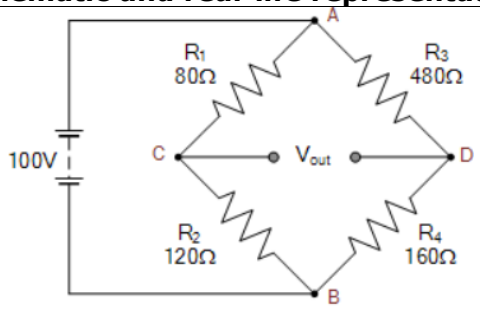
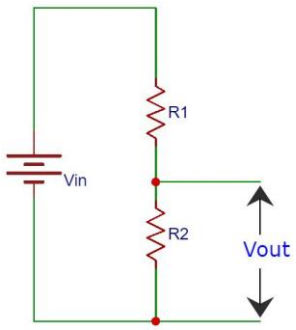
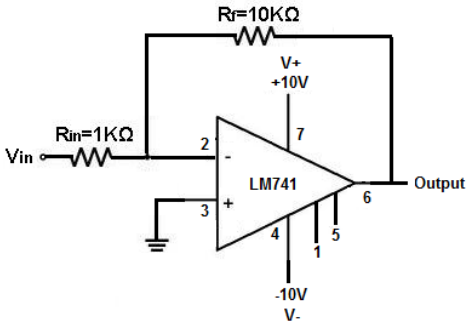
	Schematic and real-life representations	**Component name**
i.	 *Source: https://www.minikits.com.au/Carbon-Film-1W*	
ii.	 *Source: https://mt.rsdelivers.com/product/*	
iii.	 *Source: https://www.google.com/*	
iv.	 *Source: https://www.google.com/*	
v.	 *Source: https://www.google.com/*	
vi.	 *Source: https://www.google.com/*	

	Schematic and real-life representations	Component name
vii.	 *Source: https://en.wikipedia.org*	
viii.	 *Source: https://www.google.com/*	

Question 2 **(3 marks)**

In Table 2, identify the sub-circuit corresponding to the schematic or pictorial representation provided from (i) to (iii).

Table 2 – Schematic and real-life representations of sub-circuits.

	Schematic and real-life representations	Sub-circuit name
i.	 *Source: https://www.electronics-tutorials.ws/blog/*	
ii.	 *Source: https://www.pinterest.ru/pin/551268810630835106/*	
iii.	 *Source: http://www.learningaboutelectronics.com*	

Question 3 **(9 marks)**

As a technician, you may be required to troubleshoot a circuit by predicting the value of components, using basic laws of electricity.

a. A circuit is connected with a 12V battery, as shown in Figure 1. R1 is 10Ω, R2 is 30Ω and R3 is 20Ω.

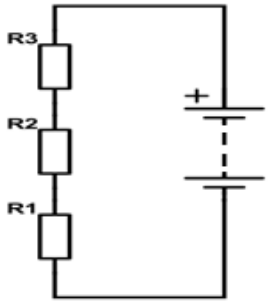


Figure 1 – Circuit 1

i. Calculate the total current in the circuit. Show all workings.

_____

_____

_____

_____

_____

_____

_____ (3)

ii. Calculate the power dissipated by Resistor R2. Show all workings.

_____

_____

_____

_____

_____

_____ (2)

b. Calculate the current across resistor R1, for the circuit shown in Figure 2 if the battery voltage is 10V, R1 is 10Ω and R2 is 20Ω. Show all workings.

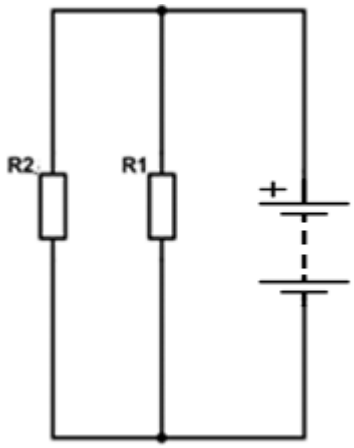


Figure 2 – Circuit 2

_____

_____

_____

_____

_____ (2)

c. Calculate the total capacitance of the circuit shown in Figure 3, if C1 is 22nF and C2 is 33nF. Show all workings.

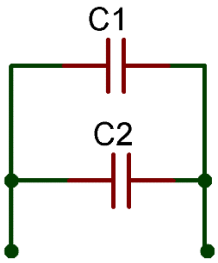


Figure 3 – Circuit 3

_____

_____

_____

_____

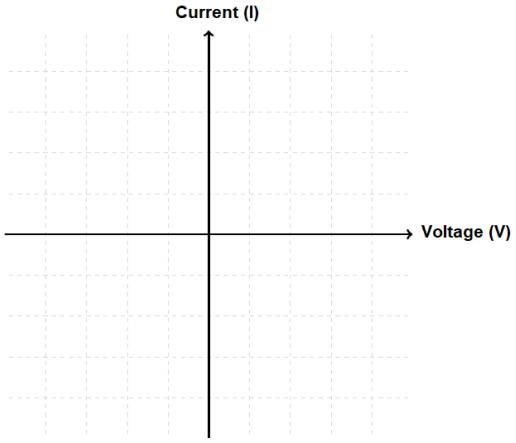
_____ (2)

Please turn the page.

Question 4 **(11 marks)**

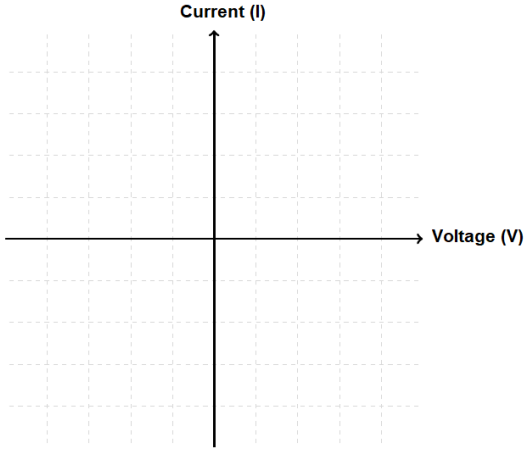
For each component describe the behaviour. Support your answer by sketching the characteristic curve or completing the truth table in the space provided.

a. Resistor



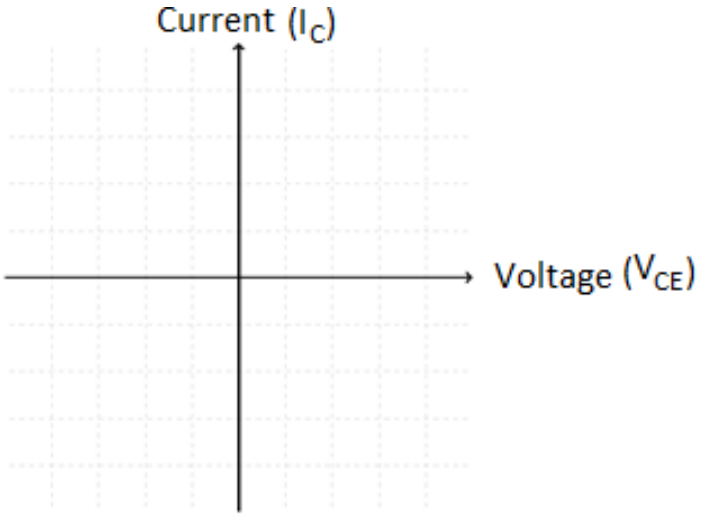
(3)

b. Diode



(3)

c. Transistor



(3)

d. AND Gate

Input A	Input B	Output Y
0	0	
0	1	
1	0	
1	1	

(2)

Please turn the page.

Question 5 **(15 marks)**

Translate the schematic diagram of the timer circuit in Figure 4 to its equivalent prototype, by drawing the circuit on the breadboard given in Figure 5.

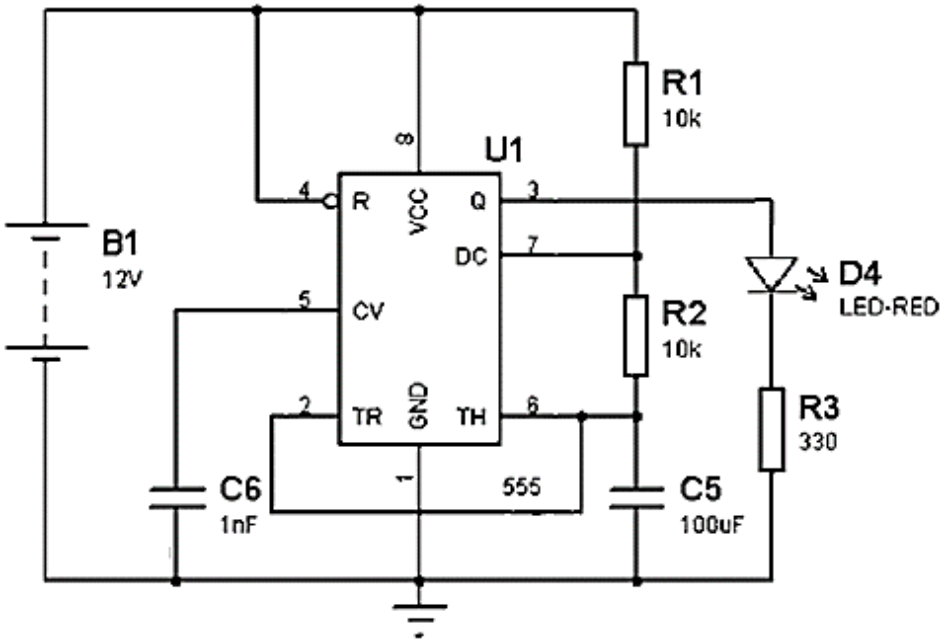


Figure 4 – Timer Schematic circuit

Source: https://circuit-diagramz.com/schematic-circuit-diagram-astable-multivibrator-using-555-timer-proteus-simulation/

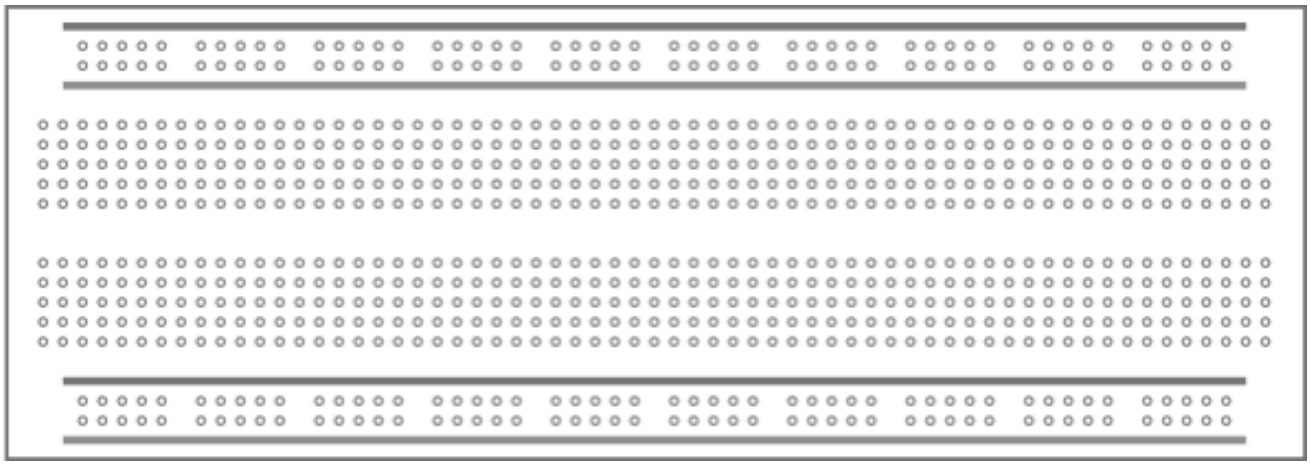


Figure 5 – Breadboard

Source: https://www.radiolocman.com/shem/schematics.html?di=33992

Question 6 **(4 marks)**

Identify the tools shown in Table 3 below which are used to construct electronic circuits.

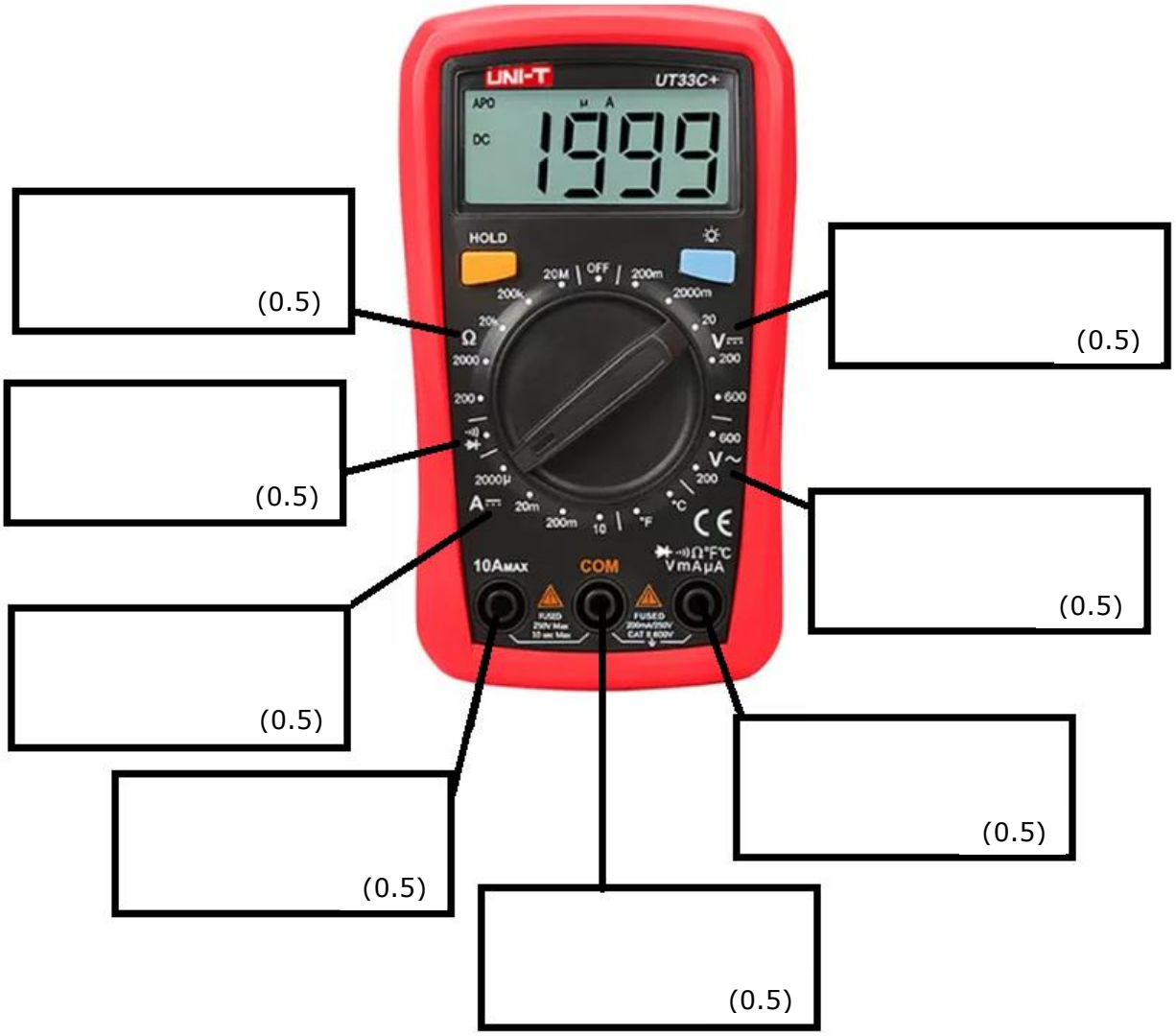
Table 2 – Tools used to manufacture electronic circuits.

	Tool picture	Tool name
i.	 *Source: https://www.toolstation.com*	
ii.	 *Source: https://www.conrad.com/p/*	
iii.	 *Source: https://mt.rsdelivers.com/product*	
iv.	 *Source: https://en.wikipedia.org/wiki/*	

Question 7 **(8 marks)**

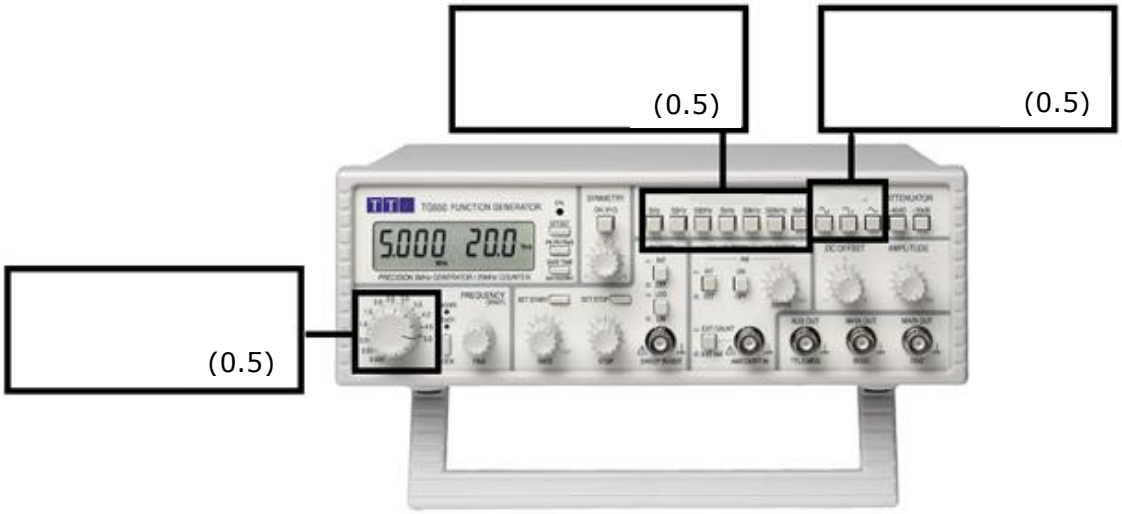
Label the following test bench equipment and settings in Figures 5, 6 and 7.

Test bench equipment 1: _____ (0.5)



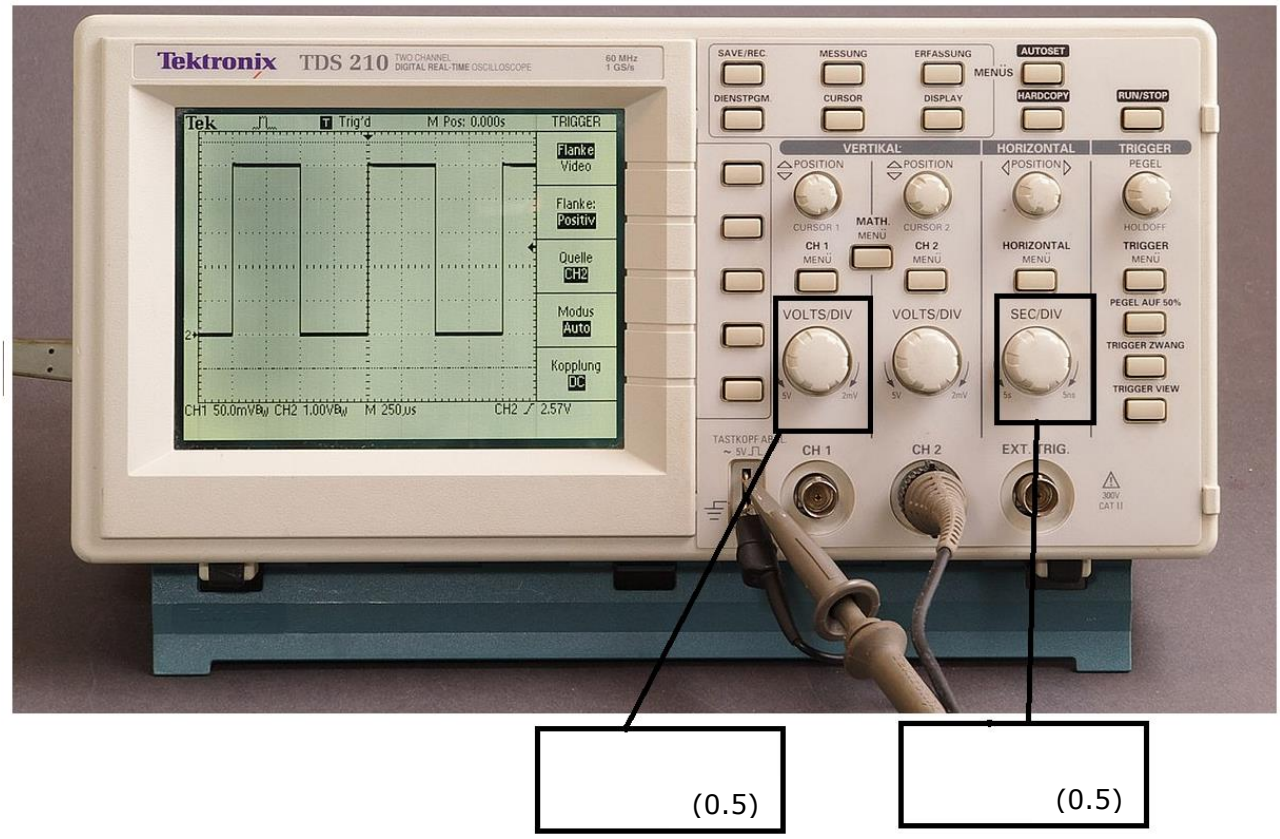
Source: shorturl.at/gstxQ
Figure 5 – Test bench equipment 1

Test bench equipment 2: _____ (0.5)



Source: https://mcs-testequipment.com/
Figure 6 – Test bench equipment 2

Test bench equipment 3: _____ (0.5)



Source: https://www.elfadistrelec.pl/
Figure 7 – Test bench equipment 3

Please turn the page.

Question 8 **(9 marks)**

The circuit shown in Figure 8 below is used to monitor heat in a mains distribution box. Discuss the function of the sub-circuits a, b and c, in relation to the characteristics of its individual components.

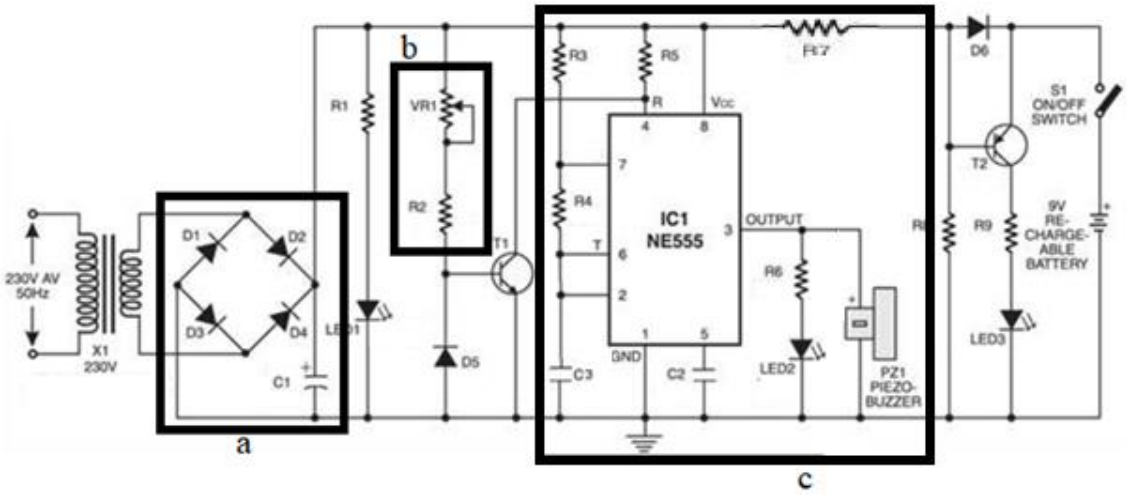


Figure 8 – Schematic circuit diagram
Source: https://www.researchgate.net/publication

a. Sub-circuit a: bridge rectifier (network)

_____

_____

_____

_____ (3)

b. Sub-circuit b: potential divider

_____

_____

_____

_____ (3)

c. Sub-circuit c: timing circuit

_____

_____

_____

_____ (3)

Question 9 **(8 marks)**

Identify the following **TWO** electronic boards and their parts.

Name of circuit board 1: _____ (1)

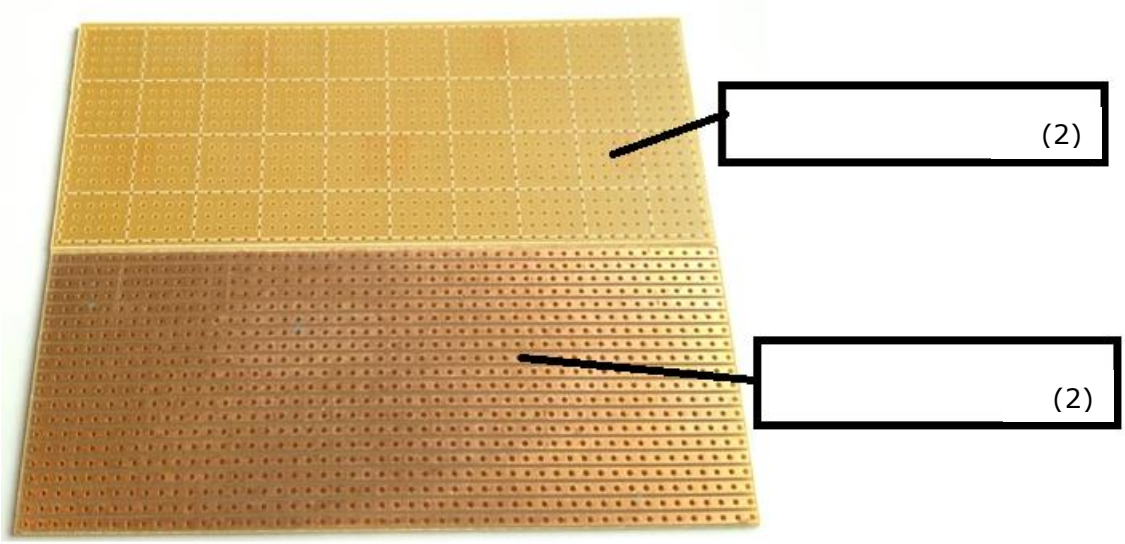


Figure 9 – Circuit board 2
Source: shorturl.at/luAV2

Name of circuit board 2: _____ (1)

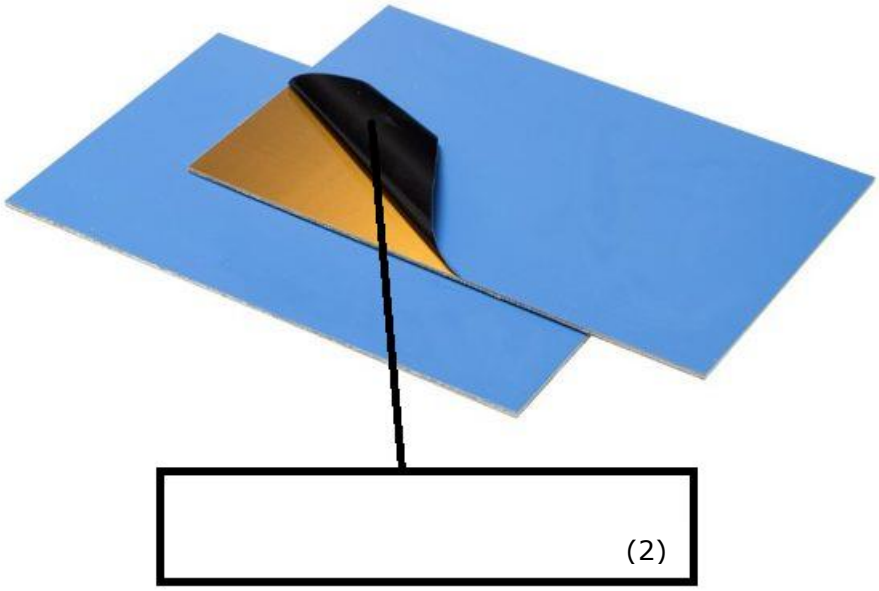


Figure 10 – Circuit board 3
Source: https://www.amazon.co.uk/

Please turn the page.

Question 10 **(10 marks)**

Electronic circuit boards are used to electrically connect components together. There are various electronic boards which can be used.

a. Identify **TWO** advantages and **TWO** disadvantages of a breadboard.

Advantage 1: _____

_____ (1.25)

Advantage 2: _____

_____ (1.25)

Disadvantage 1: _____

_____ (1.25)

Disadvantage 2: _____

_____ (1.25)

b. Identify **TWO** advantages and **TWO** disadvantages of a strip-board in the space provided.

Advantage 1: _____

_____ (1.25)

Advantage 2: _____

_____ (1.25)

Disadvantage 1: _____

_____ (1.25)

Disadvantage 2: _____

_____ (1.25)

Question 11 **(15 marks)**

You were given the schematic circuit shown in Figure 11 to manufacture it on a Printed Circuit Board (PCBs) using the chemical process.

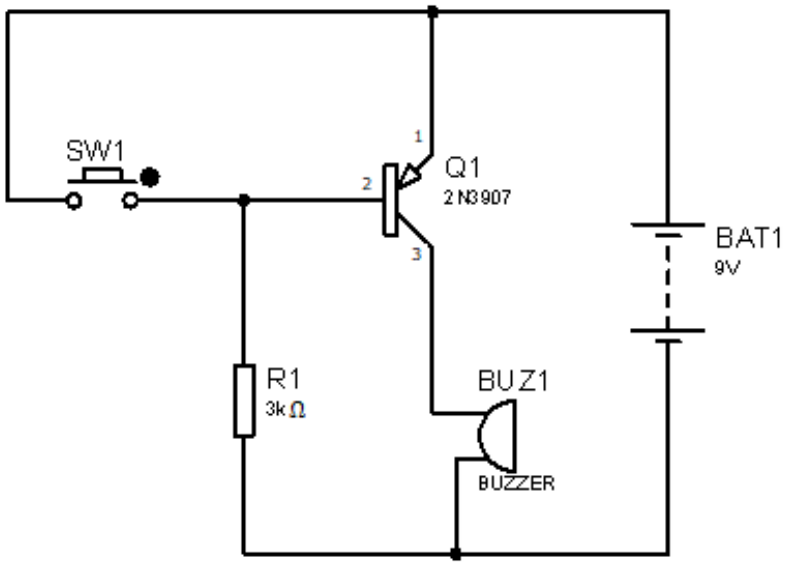
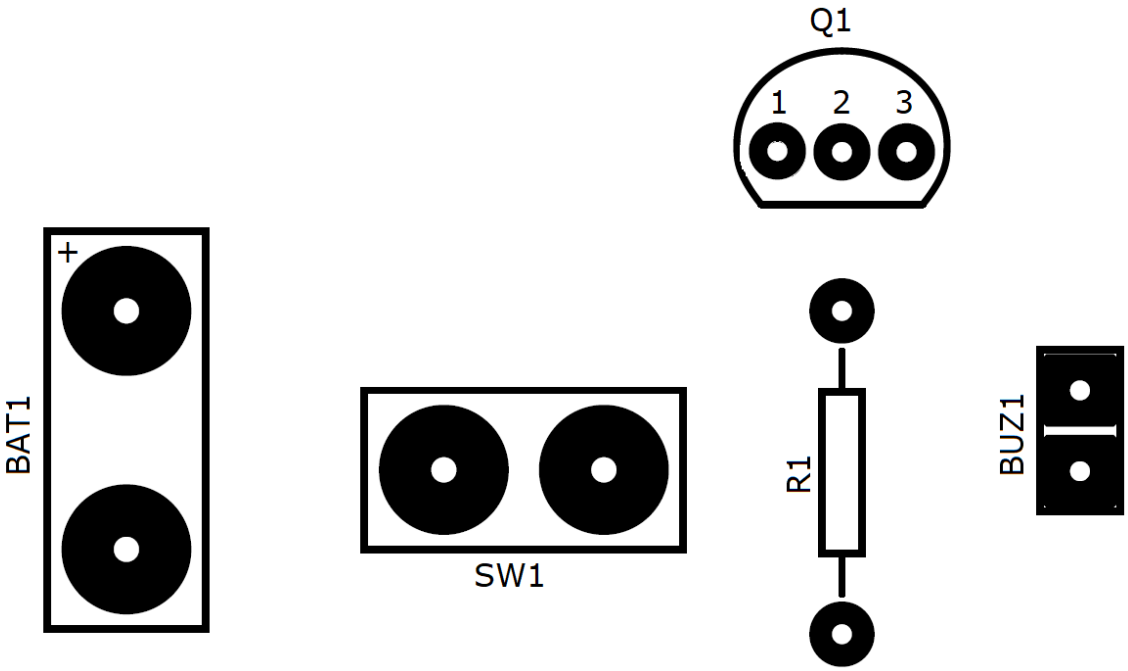


Figure 11 – Transistor as a Switch
Source: shorturl.at/itzIK

a. Design the layout of the circuit on the PCB by completing the connections.



(5)

This question continues on next page.

b. List **TEN** steps needed to construct a PCB using the chemical process from the design process to the finished product.

Step 1:_____

_____ (1)

Step 2:_____

_____ (1)

Step 3:_____

_____ (1)

Step 4:_____

_____ (1)

Step 5:_____

_____ (1)

Step 6:_____

_____ (1)

Step 7:_____

_____ (1)

Step 8:_____

_____ (1)

Step 9:_____

_____ (1)

Step 10:_____

_____ (1)