

External Assessment 2025

ELECTRONICS AND ADVANCED TECHNOLOGIES

EAT315124

Section **A**

Pages: 12

Questions: 6

Information Sheet: 1

Preparation time for this exam: 15 minutes

Suggested working time: 36 minutes

Instructions:

- Answer **all** questions and **all** items within each section.
- Write your answers in the spaces provided in this exam paper.
- Spare diagrams have been provided at the end of this section. Indicate in the box provided if you have used the spare diagram.
- The exam is **three (3) hours** in length. The suggested working time for this section is **approximately 36 minutes**.
- The Electronics and Advanced Technologies Information Sheet can be used throughout the exam.
- TASC approved scientific calculators can be used throughout the exam.
- All answers must be written in **English**.
- You **must** make sure your answers address the listed criterion.

Marker use	
C3	/ 36

Guide to Exam Structure

	Questions available	Questions to answer	Suggested working time	Marks available
Section A	6	6	36 minutes	36 marks
Section B	6	6	36 minutes	36 marks
Section C	6	6	36 minutes	36 marks
Section D	6	6	36 minutes	36 marks
Section E	5	5	36 minutes	36 marks
Totals	29	29	180 minutes (3 hours)	180 marks

Criterion

You **must** make sure your answers address:

- Criterion 3 apply professional electronic engineering practices to safely construct, test and evaluate electronic systems.

Question 1

Marker use

Circle the correct response for each of the following questions.

- a) The primary purpose of a residual current detector (RCD) is to provide:
- short-circuit protection
 - circuit overload protection
 - protection from electrical fires
 - protection against electric shock.
- b) A torch requires four AAA alkaline batteries connected in series. The total voltage applied to the globe is:
- 1.2V
 - 1.5V
 - 4V
 - 6V.
- c) What identifies the power rating of a resistor?
- physical size
 - the colour of the last band
 - the number of colour bands
 - the colour of the resistor casing.

/1

/1

/1

Total
Q1
/3

Question 2

Marker use

Electrostatic Discharge (ESD) can be problematic in an electronics environment.

a) For the list of items below, indicate items that prevent ESD problems with a **tick** (✓) and items that create ESD problems with a **cross** (×).

/4

- Air dehumidifier
- Anti-static wrist strap
- Woollen carpet
- Laminated plastic data sheets
- Grounded soldering iron tips
- Polystyrene plastic packaging
- Synthetic nylon clothing
- Metalised (grey) plastic bags.

b) For the list of components below, indicate each component that is likely to be damaged by ESD with a **tick** (✓) and each component that is unlikely to be damaged by ESD with a **cross** (×).

/3

- Resistors
- Microcontrollers
- Electrolytic capacitors
- Field-effect transistors
- Operational amplifiers
- Fibre optic cables.

Total
Q2
/7

Question 3

Marker use

Designing and testing electronic circuits involves several steps to ensure they function as intended.

a) Circuit simulation is an important step before physically building a circuit. Name a website or software program that can be used for circuit simulation.

/1

.....

b) Breadboarding is often used after simulation. What is the purpose of breadboarding in circuit design?

/1

.....

.....

c) When transitioning from a breadboard prototype to a PCB (Printed Circuit Board), factors like track width and spacing must be considered. What are the reasons for using wide tracks and proper spacing in a circuit layout?

/2

.....

.....

.....

d) Testing is crucial in circuit development. Name a tool commonly used for testing analogue electronic circuits and describe how it helps in troubleshooting.

/2

.....

.....

.....

**Total
Q3
/6**

Question 4

Marker use

Maddy has found a circuit schematic for a common logic gate, shown in Figure 1. The logic gate has two inputs, labelled A and B.

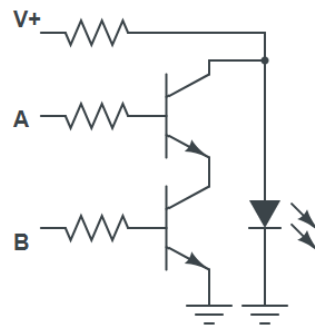


Figure 1

Spare diagram used (X)

- a) Use appropriate symbols to indicate where Maddy should connect an ammeter to measure the forward current of the LED and a voltmeter to measure its voltage drop.

/2

Maddy breadboards the circuit using a 9V battery so that the inputs are set to HIGH, as shown in Figure 2. Unfortunately, the circuit is not operational because Maddy has made a few mistakes.

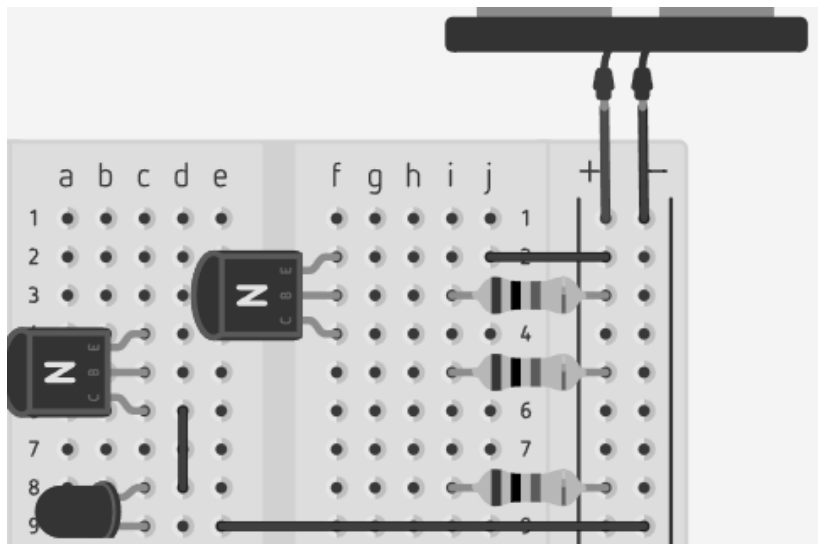


Figure 2

Spare diagram used (X)

- b) Correct and complete the breadboard layout in Figure 2.

/3

Question 4 continues

Question 4 continued

Marker use

The datasheet for the LED that Maddy used is shown in Figure 3. When the circuit is operational, with input A connected to HIGH and input B connected to LOW, the LED is HIGH and illuminates.

Absolute Maximum Ratings at Ta=25°C

Parameter	MAX.	Unit
Power Dissipation	100	mW
Peak Forward Current (≤ 1/10 Duty Cycle, 0.1ms Pulse Wide)	100	mA
Continuous Forward Current	20	mA
Derating Linear From 50°C	0.4	mA/°C
Reverse Voltage	5	V
Operating Temperature Range	-40°C to +80°C	
Storage Temperature Range	-40°C to +80°C	
Lead Soldering Temperature [4mm(.157") From Body]	260°C for 3 seconds	

Electrical Optical Characteristics at Ta=25°C

Part Number	Lens Colour	Source colour	Dominant Wavelength λd/ nm If = 20mA (Note8)			Luminous Intensity Iv/ mcd If = 20mA (Note 5)			Forward Voltage / V If = 20mA			Viewing Angle / Deg (Note 6)
			Min.	Typ.	Max.	Min.	Typ.	Max.	Min.	Typ.	Max.	
WW05A3SBQ4-N	Water Clear	Blue	465	---	475	4900	6300	---	---	3.2	4.0	15°
Reverse Voltage = 5V						Reverse Current = 50µA						

Figure 3

c) Determine the typical voltage drop of the LED when it is illuminated, and its colour.

/2

.....

d) Is the LED at risk of blowing when it is breadboarded with reverse polarity?

/1

.....

e) Outline a consideration for Maddy when soldering the LED in her final design.

/1

.....

.....

f) State the name of the logic gate of Maddy's circuit in Figure 1.

/1

.....

Total
Q4

/10

Question 5

Marker use

The incomplete circuit in Figure 4 will control the rotational direction of a DC motor. SW1 is the power switch and SW2 will be used as a direction control switch.

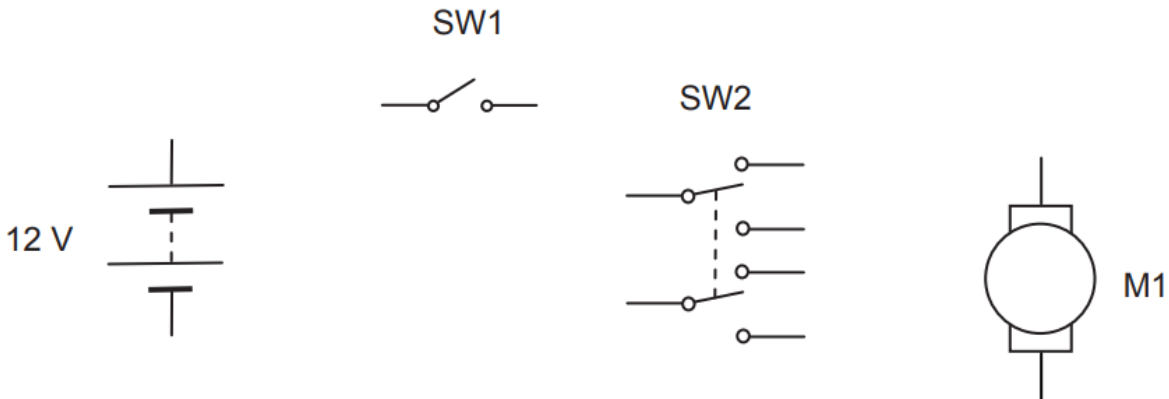


Figure 4

Spare diagram used (X)

a) Add wire connections to the schematic so the motor functions as described.

/2

b) SW1 is a SPST switch. Describe SW2.

/1

.....

c) What component could be added to adjust the speed of the DC motor?

/1

.....

Total
Q5
/4

Question 6

Marker use

- a) Use a block diagram to explain the process of energy conversion that takes place in an 8Ω speaker, such as the one shown in Figure 5.

/3



Figure 5

- b) Sketch the schematic of a circuit that is able to amplify an audio signal and drive the 8Ω speaker.

/3

Total
Q6
/6

Spare Diagrams

Question 4 a)

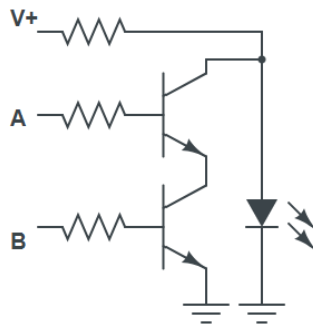


Figure 1

Question 4 b)

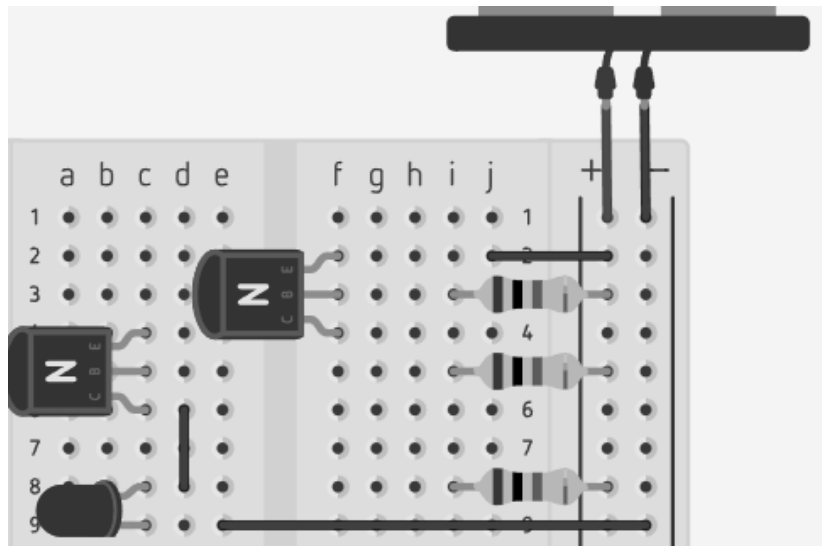


Figure 2

Question 5 a)

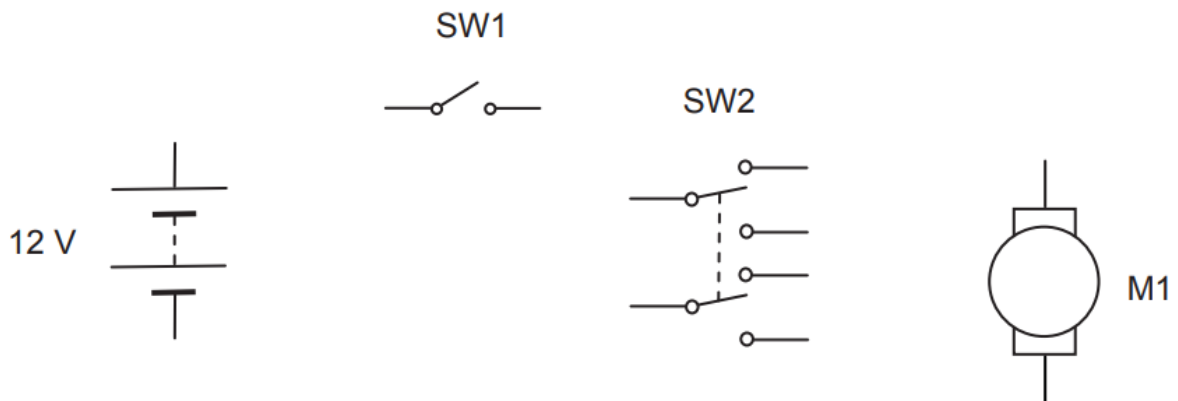


Figure 4

End of Section A

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External Assessment 2025

ELECTRONICS AND ADVANCED TECHNOLOGIES

EAT315124

Section **B**

Pages: 12

Questions: 6

Information Sheet: 1

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Marker use

C5

/ 36

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Criterion

You **must** make sure your answers address:

- Criterion 5 explain and apply mathematical concepts and scientific inquiry in relation to electronics.

Question 7

Marker use

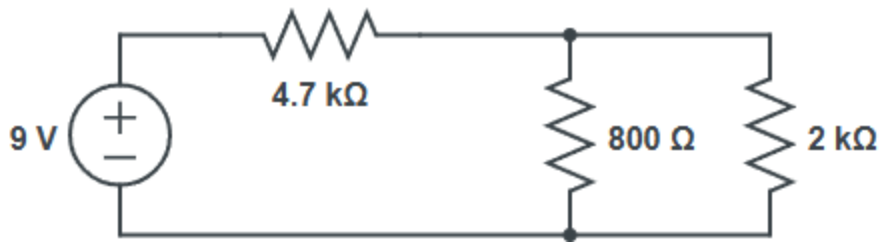


Figure 6

a) Calculate the equivalent resistance of the parallel resistors in Figure 6.

/2

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.....

.....

b) Calculate the voltage drop across the 4k7 resistor.

/2

.....

.....

.....

.....

c) State the value of the closest E12 resistor to the resistance calculated in part a), and give the colour code with a $\pm 2\%$ tolerance.

/2

.....

.....

Total
Q7
/6

Question 8

Marker use

A yellow LED is connected to a 9V supply as shown in Figure 7. The LED has a forward voltage drop of 2.2V and a maximum current rating of 20mA.

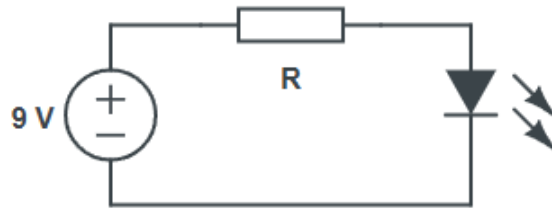


Figure 7

a) When the LED is illuminated, what is the voltage drop across resistor R?

.....

/1

b) Calculate the maximum possible power dissipated by resistor R.

.....
.....
.....

/2

c) Is a quarter watt resistor suitable for use as resistor R?

.....

/1

Total
Q8
/4

Question 9

Marker use

a) A 12V, 75W halogen lamp is controlled using two NPN transistors configured as a Darlington pair.

- The first transistor has a forward current gain of 40.
- The second has a forward current gain of 80.

Assuming ideal conditions with no voltage drops across the transistors, determine the base current needed to turn the lamp fully on.

/3

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b) An alternative to the Darlington pair is a configuration that uses an NPN and a PNP transistor instead. What is the name of this transistor arrangement?

/1

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**Total
Q9
/4**

Question 10

Marker use

You are tasked with determining the Thevenin equivalent circuit of Figure 8.

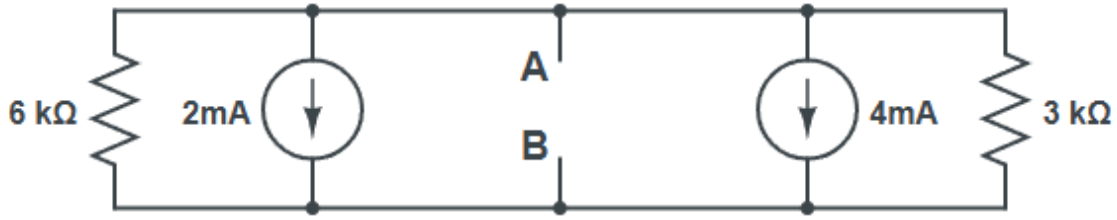


Figure 8

a) Determine the voltage that would be measured between A and B.

/2

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.....

b) By disconnecting all current sources (open-circuit), find the Thevenin resistance seen between A and B.

/2

.....

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.....

c) Hence, draw the Thevenin equivalent circuit.

/2

Total
Q10
/6

Question 11

Marker use

a) Calculate the gain and unknown voltage for each of the ideal op-amp circuits:

i.

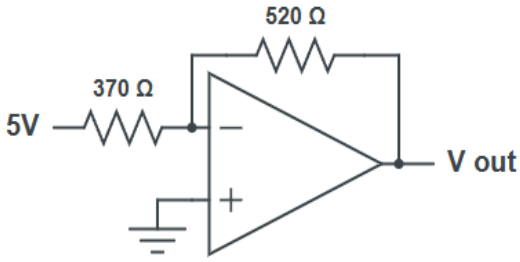


Figure 9

ii.

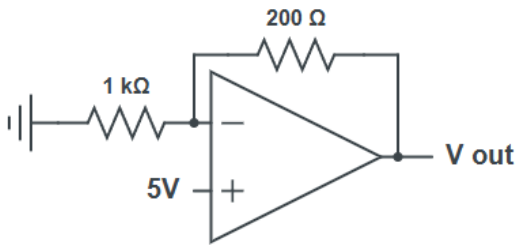


Figure 10

iii.

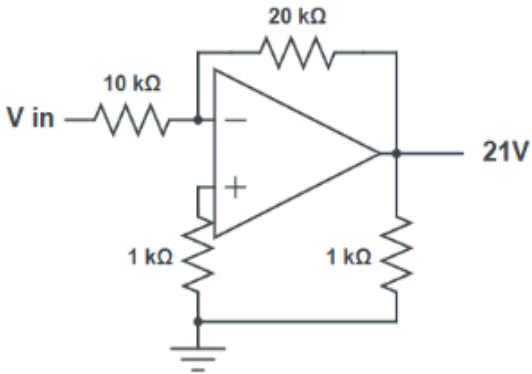


Figure 11

b) What power supply would be suitable for the circuit in Figure 9?

.....

/2

/2

/2

/2

Total
 Q11
 /8

Question 12

Marker use

Several different types of diodes have been concealed, preventing you from identifying whether they are standard, Zener, LED or Schottky diodes.

a) List the equipment you would use to identify each type of diode.

/2

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b) Explain the method you would use to test each diode.

/3

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c) Describe the expected results that would allow you to determine the type of each diode.

/3

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**Total
Q12
/8**

End of Section B

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ELECTRONICS AND ADVANCED TECHNOLOGIES

EAT315124

Section **C**

Pages: 12

Questions: 6

Information Sheet: 1

Suggested working time: 36 minutes

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Marker use	
C6	/ 36

Guide to Exam Structure

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Criterion

You **must** make sure your answers address:

- Criterion 6 analyse and apply concepts and principles relating to discrete components and analogue circuits.

Question 13

Marker use

A small power diode (IN 4004) is shown alongside a capacitor (203) in Figure 12.

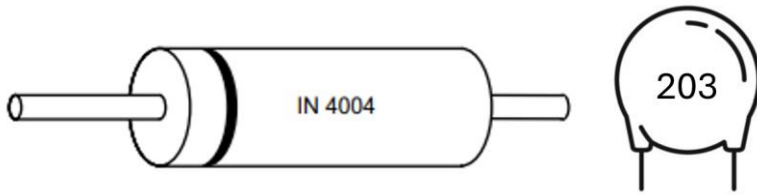


Figure 12

Spare diagram used (X)

a) Indicate the direction that conventional current could flow through the diode by drawing an arrow on Figure 12.

/1

b) Draw the matching circuit symbol of the diode with the same orientation.

/1

c) What is the value of the capacitor?

/1

d) Using an appropriate circuit symbol, draw **two (2)** of these capacitors in parallel and calculate the total capacitance of the arrangement.

/2

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.....

.....

.....

Total
Q13
/5

Question 14

Marker use

Figure 13 shows a circuit controlled by an LDR, along with its characteristic graph.

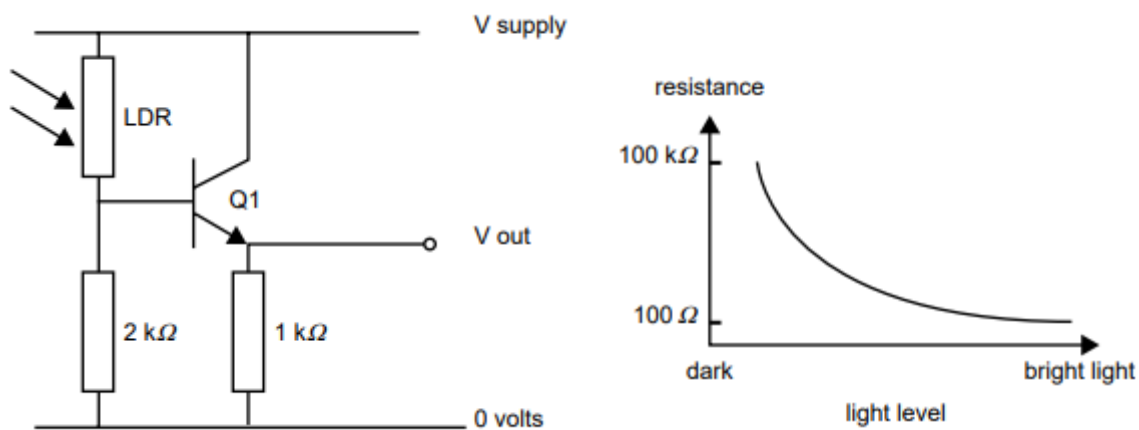


Figure 13

a) What do the letters LDR represent?

.....

/1

b) Identify the component labelled Q1.

.....

/1

c) When the LDR is in bright light, what will V out be?

.....

/1

Total
Q14
/3

Question 15

The stages of a typical DC power supply such as the one shown in Figure 14 can be represented as the block diagram in Figure 15.

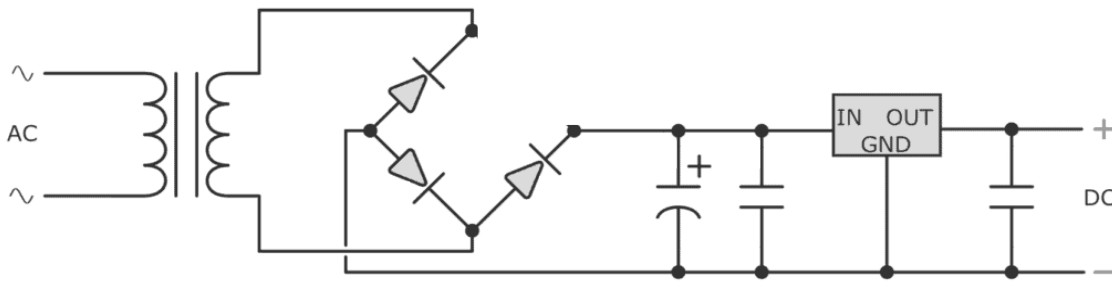


Figure 14

Spare diagram used (X)

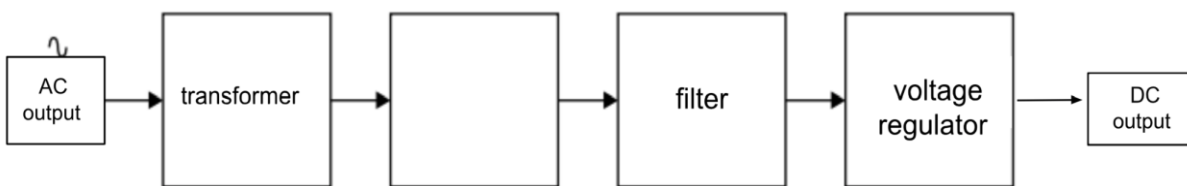


Figure 15

Spare diagram used (X)

- a) The circuit is able to redirect current through both positive and negative cycles.
 - i. Complete Figure 14 by adding the missing component that allows this.
 - ii. Complete Figure 15 by stating the common name of this part of the circuit.

/₁

/₁

- b) Circle the voltage regulator on Figure 14.

/₁

- c) Explain the function of the transformer.

/₂

.....

- d) Calculate V_{rms} if the transformer has a peak voltage output of 18V.

/₁

.....

- e) Explain the function of the polarised capacitor.

/₂

.....

Total
Q15
 /₈

Question 16

The reading of the voltmeter in Figure 16, V_{out} , is initially 0V. Then, the switch is moved upwards, and the capacitor begins to charge.

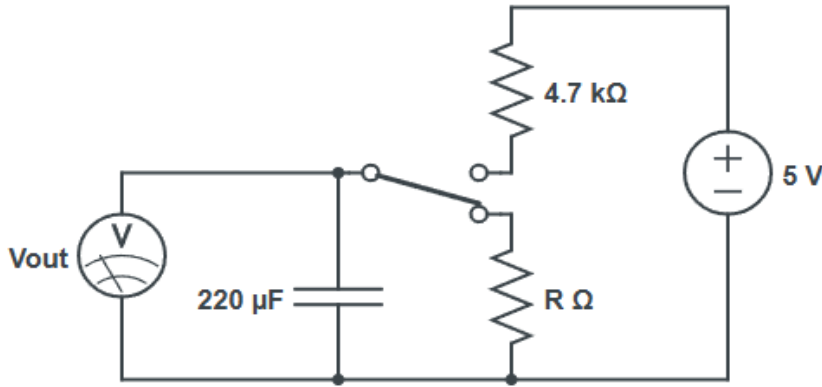


Figure 16

Spare diagram used (X)

a) Calculate the time constant for the charging phase.

.....

/1

b) Sketch the voltage at V_{out} if the switch remains in the charging phase for 10 seconds.

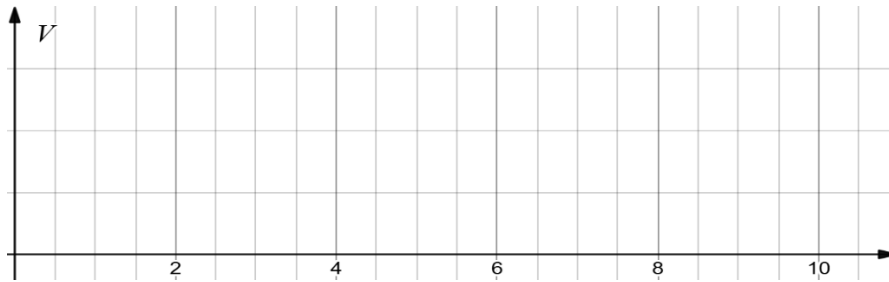


Figure 17

Spare diagram used (X)

c) Determine the current through the 4k7 resistor at 8 seconds.

.....

/1

d) If the discharging resistor R has a greater resistance than the charging resistor, will the capacitor discharge more quickly or more slowly than it charges?

.....

/1

.....

/1

e) Use Figure 16 to show the direction of conventional current flow when the switch changes to the discharging position.

Total Q16

/6

Question 17

Marker use

Figure 18 is a diagram of a 6-Volt DC electric doorbell.

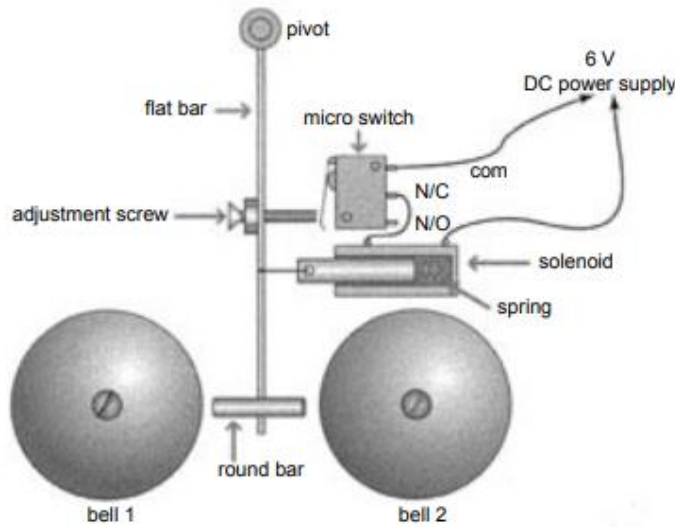


Figure 18

- a) Give a detailed description of how the bells are made to ring when power is supplied to the circuit. You may respond in point form.

/4

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.....

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.....

.....

.....

.....

- b) When the bells are ringing, what type of voltage waveform would be measured at the input of the solenoid?

/1

.....

- c) What type of switch would be appropriate to use at the front door for this doorbell?

/1

.....

Total
Q17
/6

Question 18

Marker use

Figure 19 is a dual flashing LED circuit.

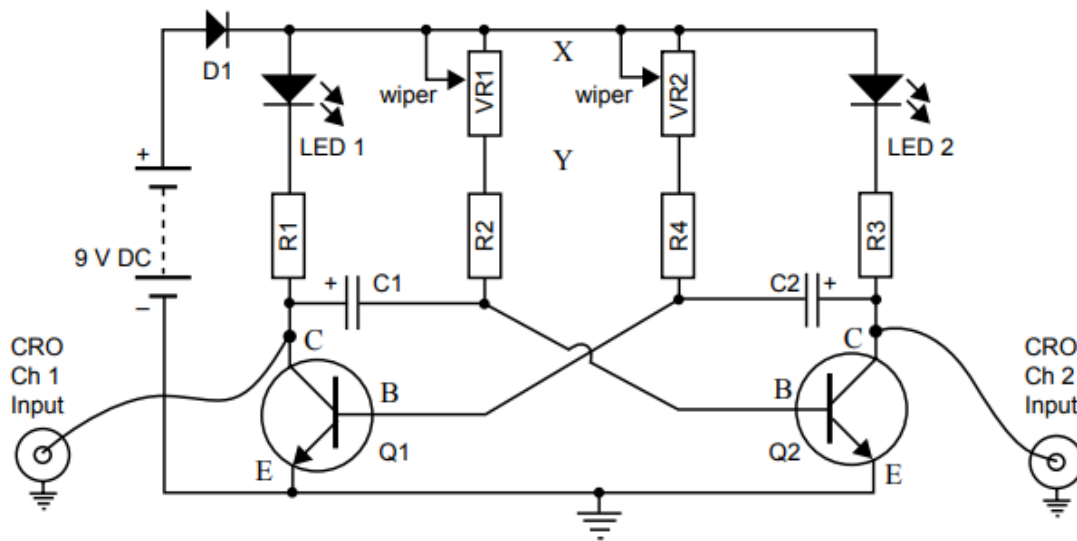


Figure 19

a) What type of multivibrator is this circuit?

.....

/1

b) What is the function of D1?

.....

/1

c) If the circuit was operating normally and D1 suddenly became shorted, how would this impact the circuit's functionality?

.....

/1

d) Explain the effect of moving the wipers of VR1 and VR2 towards X.

.....

.....

/1

Question 18 continues

Question 18 continued

Marker use

The wipers are set so that the LEDs are flashing at the same frequency. An oscilloscope set to 50 ms / division and 5 Volts / division shows the following output when the Ch 1 probe is connected to the collector of Q1 and ground.

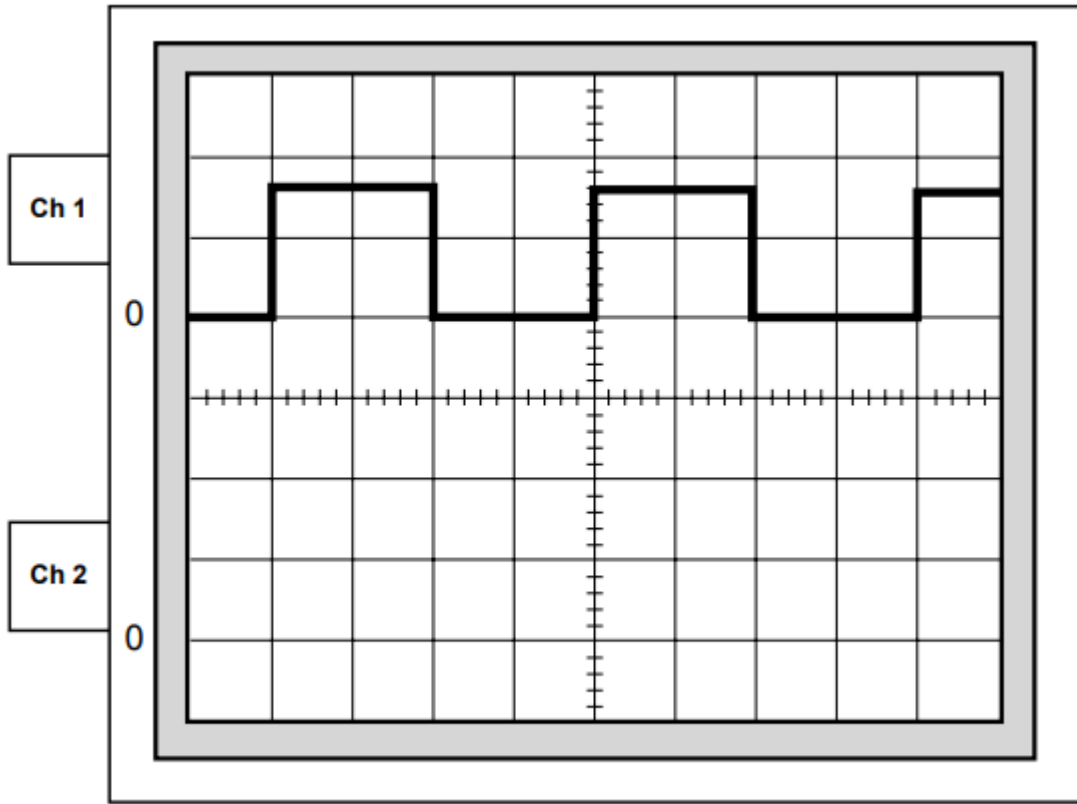


Figure 20

Spare diagram used (X)

e) Determine the peak voltage and the frequency as shown by Ch 1.

.....

.....

.....

.....

/3

f) The Ch 2 probe is connected to the collector of Q2 and ground. Draw the expected waveform on the lower half of the oscilloscope screen in Figure 20 assuming the settings are the same as Ch 1.

/1

**Total
Q13
/8**

Spare Diagrams

Question 13 a)

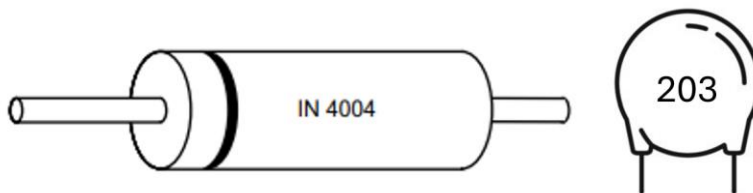


Figure 12

Question 15 a) i. and 15 b)

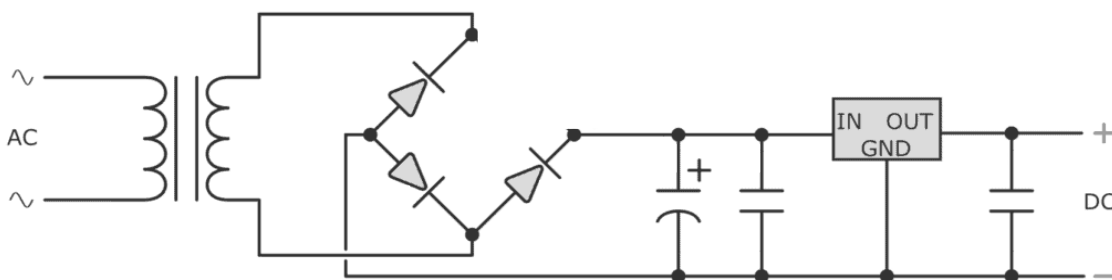


Figure 14

Question 15 a) ii.

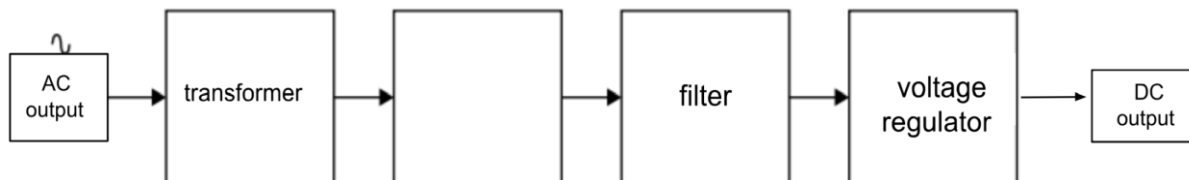


Figure 15

Question 16 e)

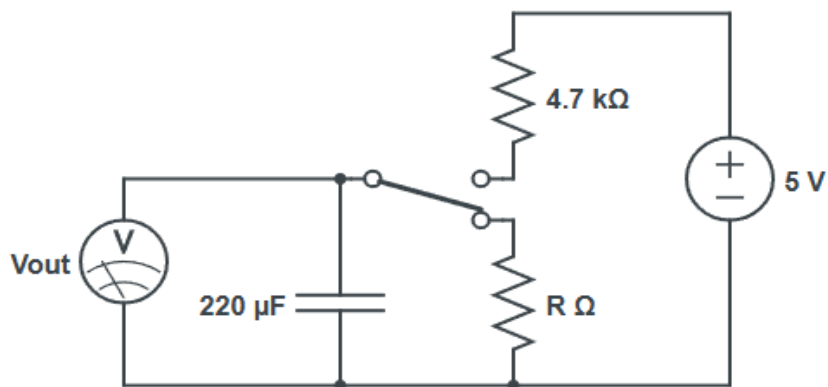


Figure 16

Spare Diagrams

Question 16 b)

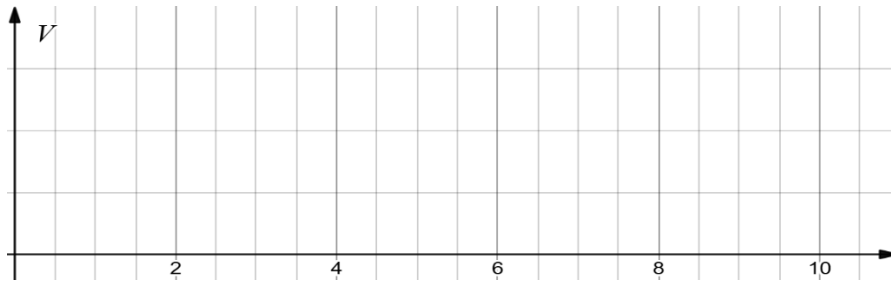


Figure 17

Question 18 f)

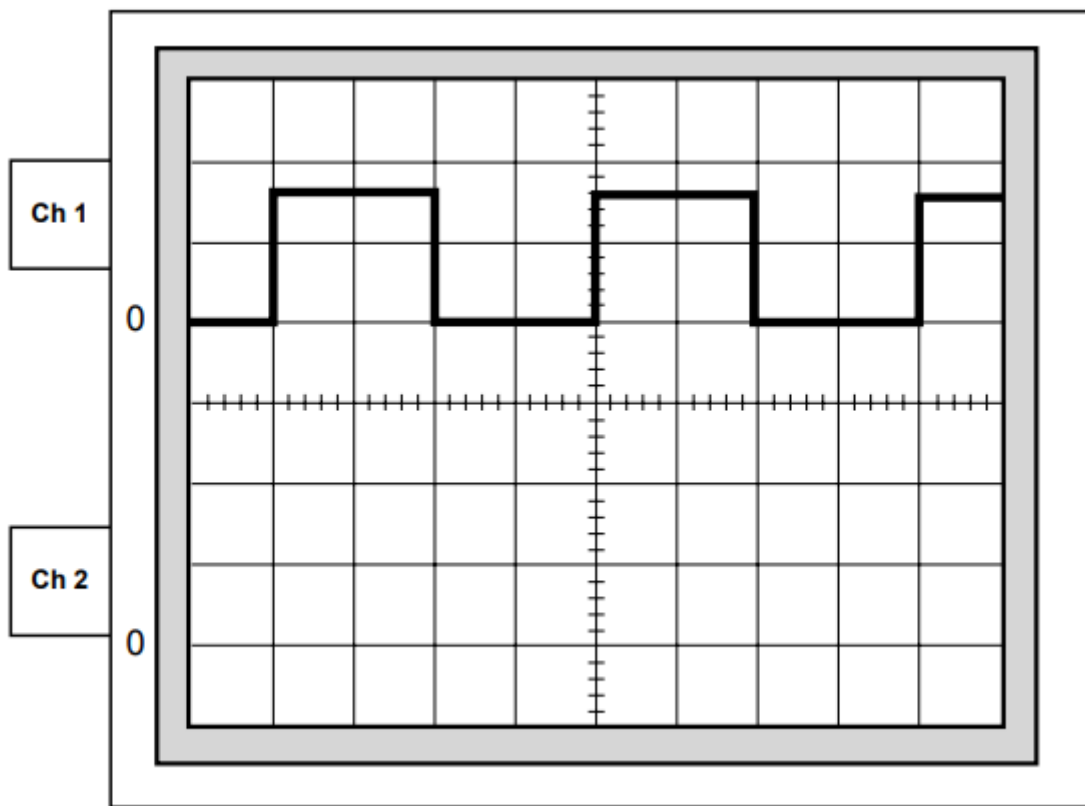


Figure 20

End of Section C



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ELECTRONICS AND ADVANCED TECHNOLOGIES

EAT315124

Section **D**

Pages: 12

Questions: 6

Information Sheet: 1

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Marker use	
C7	/ 36

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Criterion

You **must** make sure your answers address:

- Criterion 7 analyse and apply concepts and principles relating to integrated circuits.

Question 19

Marker use

a) Complete the following number conversion tables, showing your working.

Decimal	Binary	BCD
196		

Table 1

Hexadecimal	Binary	Decimal
E1A		

Table 2

b) Subtract 0011_2 from 1001_2 using the 2's complement method.

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.....

/4

/2

Total
Q19
/6

Question 20

Marker use

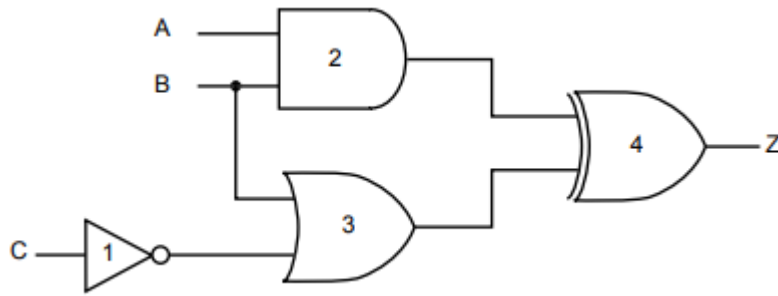


Figure 21

Spare diagram used (X)

a) Identify the gates in Figure 21.

Gate 1:

Gate 2:

Gate 3:

Gate 4:

/2

b) Determine the output at Z if the inputs A and B are HIGH whilst input C is LOW. Show your working by using Figure 21 or in the space below.

/2

.....

Total
Q20
/4

Question 21

Marker use

Figure 22 shows a waveform that is being digitalised by an ADC.

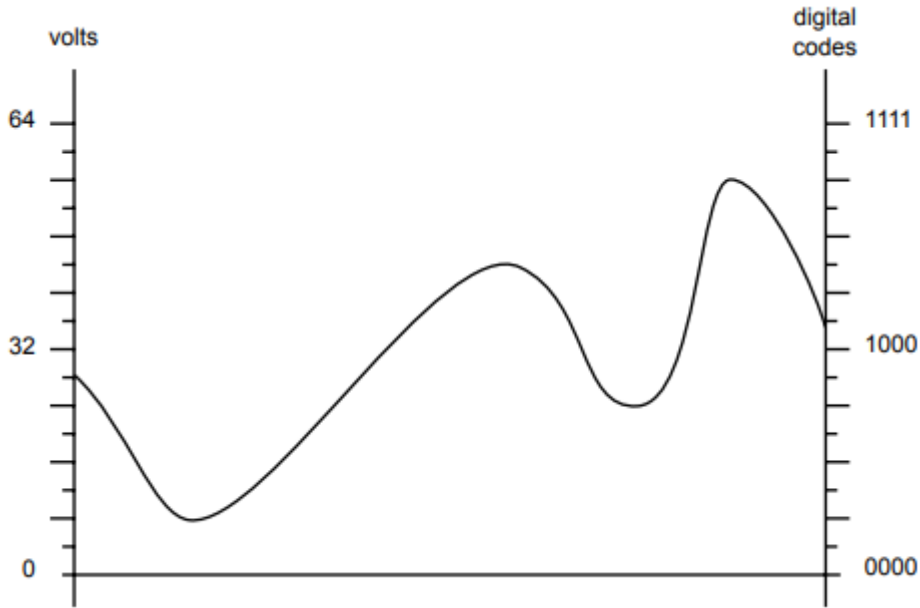


Figure 22

a) What does ADC stand for?

.....

/1

b) Determine the digital code produced for an input voltage of 16V.

.....

/1

c) How many times is the digital code 1010 produced for the waveform in Figure 22?

.....

/1

d) Determine the maximum amount the input voltage can change before the digital code produced changes.

.....

.....

/1

**Total
Q21**

/4

Question 22

A common flip flop is shown in Figure 23.

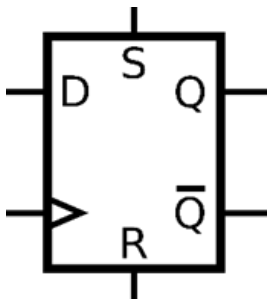


Figure 23

a) Input D is edge triggered. Explain what this means and use Figure 23 to determine which edge it is triggered by.

.....

.....

.....

.....

/2

b) Which input(s) are likely to be asynchronous?

.....

/1

c) Complete Q and Q' for the input D shown in the timing diagram in Figure 24. Assume S and R are held LOW.

/4

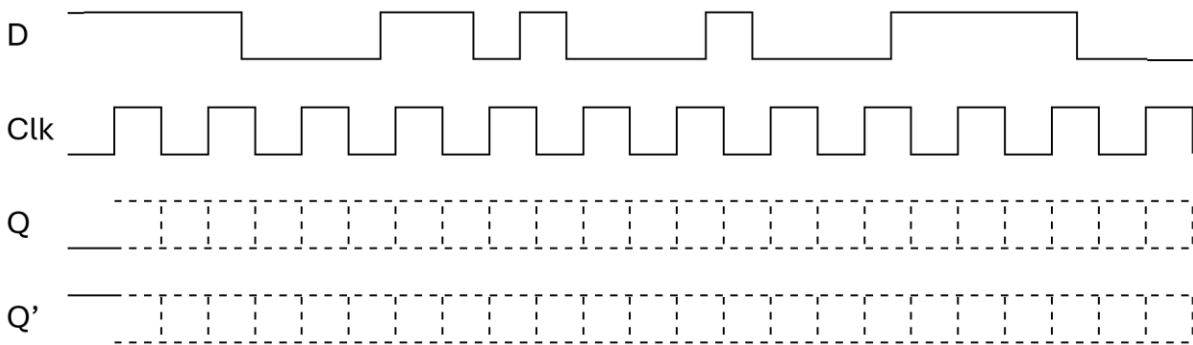


Figure 24

Spare diagram used (X)

Question 22 continued

Marker use

d) Complete Q for the inputs D, S and R as shown in the timing diagram in Figure 25.

/3

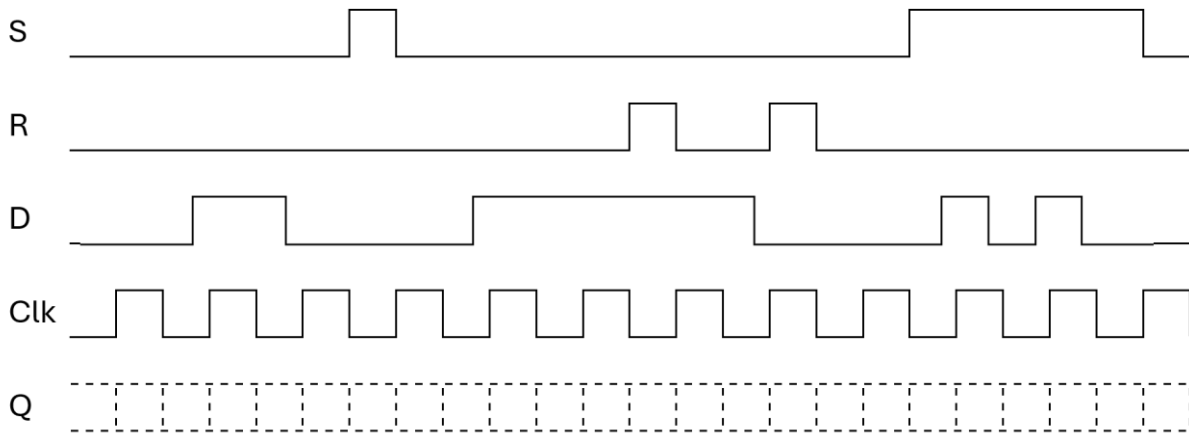


Figure 25

Spare diagram used (X)

Total
Q22
/10

Question 23

Marker use

You are tasked with designing an electronic system to sound a warning signal when both the temperature and the light intensity fall below set levels. Draw a block diagram that meets this design brief. You may use the options in Table 3 or others of your choosing.

/4

Buzzer	Light Dependent Resistor	Logic Gate
Driver (Relay)	Thermistor	Comparator

*Table 3*Total
Q23
/4

Question 24

Marker use

Figure 26 shows the circuit for a six-sided dice that makes use of a 4017 decade counter.

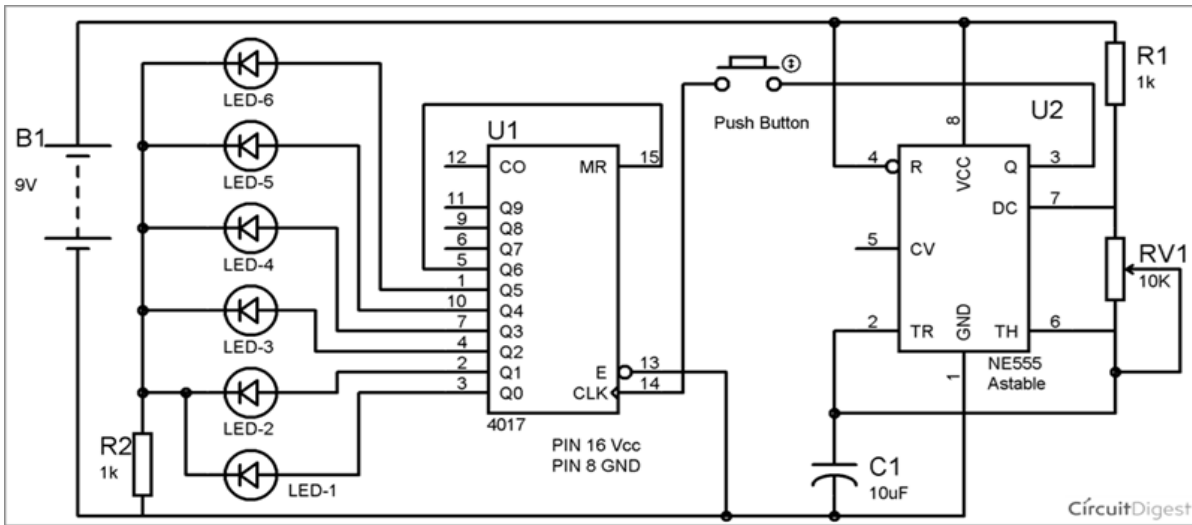


Figure 26

- a) State the number of integrated circuits used.
.....
- b) State the purpose of R2.
.....
- c) State what E stands for, and hence explain the wiring on pin 13 on U1.
.....
.....
- d) State what MR stands for, and hence explain the wiring of pin 15 on U1.
.....
.....
.....
- e) Describe the operation of the circuit when the push button is held for a time and then released.
.....
.....
.....
.....

/1

/1

/2

/2

/2

Total
Q24
/8

End of Section D

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External Assessment 2025

ELECTRONICS AND ADVANCED TECHNOLOGIES

EAT315124

Section **E**

Pages: 12

Questions: 5

Information Sheet: 1

Suggested working time: 36 minutes

Instructions:

- Answer **all** questions and **all** items within each section.
- Write your answers in the spaces provided in this exam paper.
- A spare diagram has been provided at the end of this section. Indicate in the box provided if you have used the spare diagram.
- The exam is **three (3) hours** in length. The suggested working time for this section is **approximately 36 minutes**.
- The Electronics and Advanced Technologies Information Sheet can be used throughout the exam.
- TASC approved scientific calculators can be used throughout the exam.
- All answers must be written in **English**.
- You **must** make sure your answers address the listed criterion.

Marker use

C8

/ 36

Guide to Exam Structure

	Questions available	Questions to answer	Suggested working time	Marks available
Section A	6	6	36 minutes	36 marks
Section B	6	6	36 minutes	36 marks
Section C	6	6	36 minutes	36 marks
Section D	6	6	36 minutes	36 marks
Section E	5	5	36 minutes	36 marks
Totals	29	29	180 minutes (3 hours)	180 marks

Criterion

You **must** make sure your answers address:

- Criterion 8 analyse and apply concepts and principles relating to programmable circuits.

Question 25

Marker use

Circle the best response for each of the following questions.

- a) What is a key economic and social impact of widespread microcontroller use?
- i. No need for maintenance in automated systems
 - ii. Complete elimination of energy costs in industrial applications
 - iii. Greater efficiency through automation but potential job losses in some sectors
 - iv. Higher production costs.
- b) Why are microcontrollers invaluable in modern vehicles?
- i. They eliminate the need for external sensors and power sources
 - ii. They provide unlimited processing power for self-driving cars
 - iii. They replace all mechanical components in a vehicle
 - iv. They control engine functions, safety features, and infotainment systems.
- c) What is the main role of a microcontroller in a robotic system?
- i. Providing real-time control of sensors and actuators
 - ii. Storing large amounts of video data
 - iii. Supplying power directly to motors and servos
 - iv. Making the robot physically stronger.

/1

/1

/1

**Total
Q25
/3**

Question 26

Marker use

Figure 27 shows a microcontroller circuit controlling the operation of a fan depending on the temperature read by a thermistor.

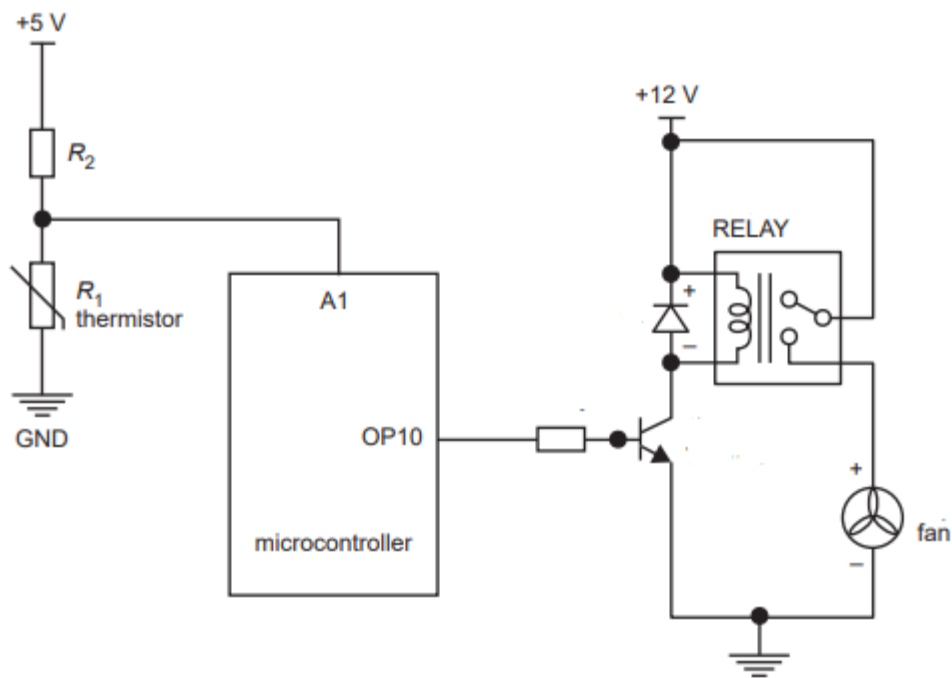


Figure 27

The characteristic curve of the thermistor is shown in Figure 28.

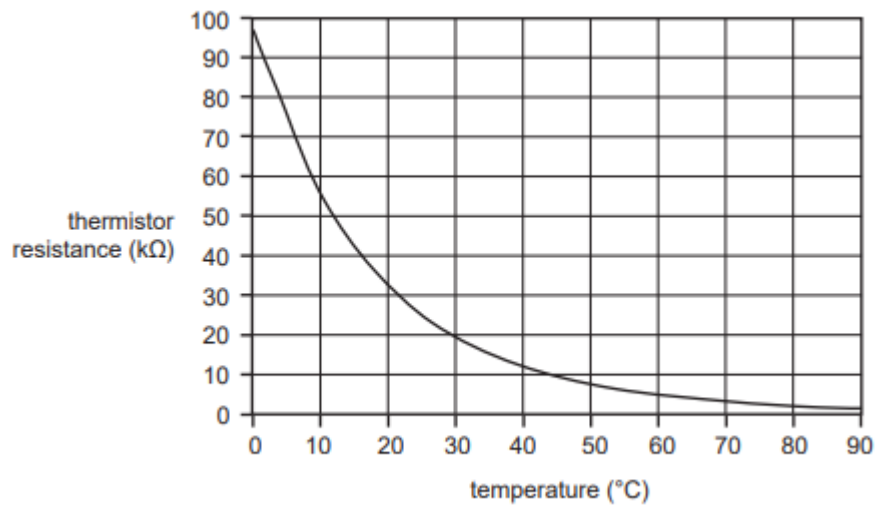


Figure 28

Question 26 continues

Question 26 continued

Marker use

a) If R2 is 20kΩ and the voltage at the analogue input (A1) is 2.5V, determine:

i. The resistance of the thermistor.

.....

ii. The corresponding temperature.

.....

b) If the voltage input to pin A1 is instead 2V, what digital value will 'analogueRead(A1)' return, given the function produces a digital value between 0 and 255, with 0 representing 0V and 255 representing 5V?

.....

.....

Figure 29 is of the program uploaded to the microcontroller.

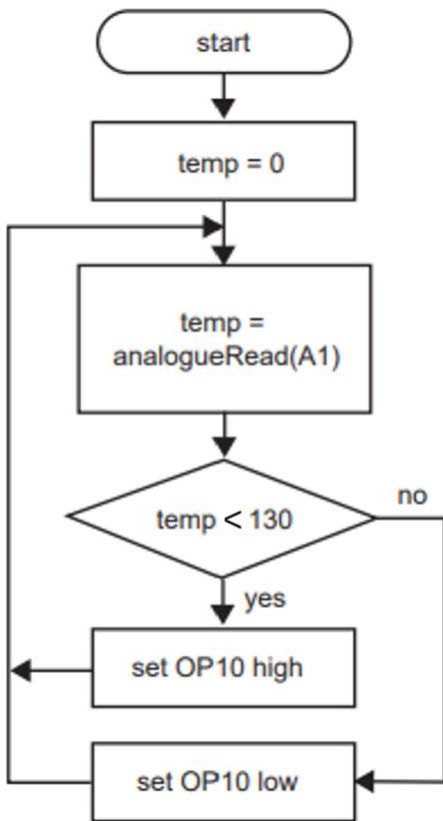


Figure 29

c) Describe what the program is doing.

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.....

.....

.....

.....

.....

.....

.....

.....

.....

/1

/1

/2

/3

Total
Q26

/7

Question 27

Marker use

- a) Fill in Table 4 by indicating with a **tick (✓)** which communication protocol (SPI or I2C) each feature belongs to.

/ 3

Feature	SPI	I2C
Uses two-wire communication		
Supports multiple devices with a single bus		
Has faster data transfer speed		
Has fewer wires		
Uses a clock signal		
Has an enable for each connected device		

Table 4

- b) Name **one (1)** other communication protocol and describe **two (2)** of its features.

/ 3

.....

.....

.....

.....

**Total
Q27
/ 6**

Question 28

The Picaxe 14M2 is a popular microcontroller for hobbyists. Its pinout is shown in Figure 30.

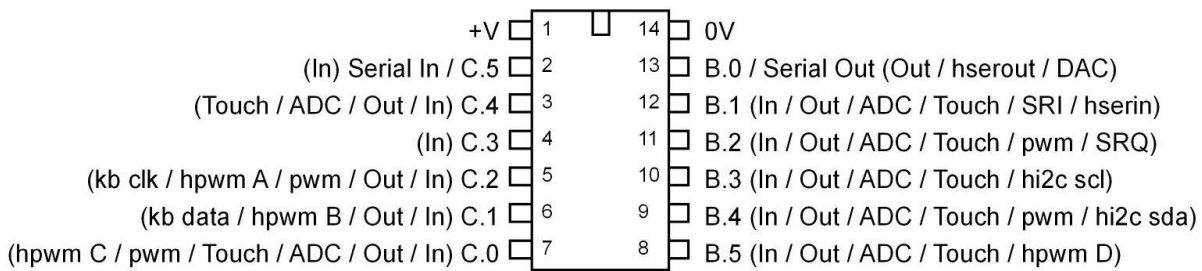


Figure 30

Figure 31 shows a partially connected circuit using the Picaxe 14M2. Complete Figure 31 by drawing the necessary connections to the components listed below, selecting appropriate pins from Figure 30 to ensure proper functionality of the microcontroller.

The components to connect are:

- pins 1 and 2 of J1 to all +V and 0V locations
- analogue pressure sensor
- PWM motor driver
- D1 and R1, so that logic LOW from the microcontroller turns the LED on.

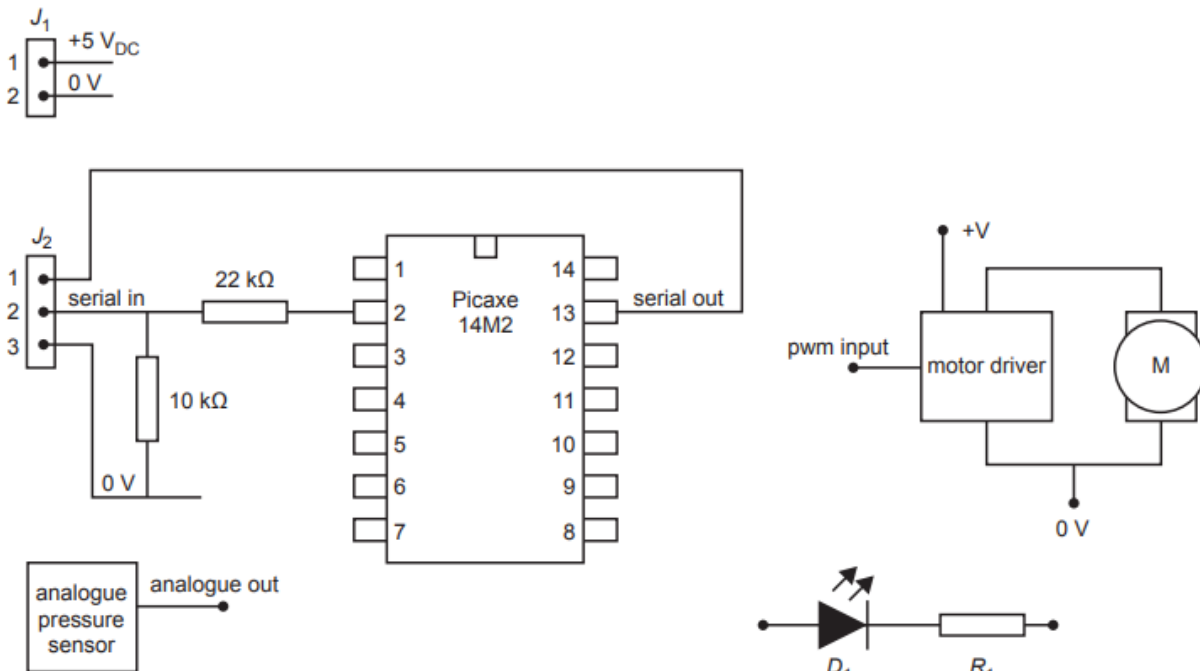


Figure 31

Spare diagram used (X)

/6

Total Q28 /6

Question 29

Marker use

You are tasked with designing a roadside system using a microcontroller which reads the speed of an approaching car, and controls a traffic light and siren based on the speed. The system should:

- read the speed of a car every 2 seconds
- light a traffic indicator for 1 second; the indicator is green if the speed is at or below a specified benchmark (e.g. 60 km/h), and red if the speed is above the benchmark
- activate a siren for 1 second if the red indicator is shown twice consecutively.

a) List the peripheral devices required for implementing this system with a microcontroller. For each device, indicate whether it is digital or analogue, and whether it serves as an input or output.

/4

.....

.....

.....

.....

b) Write a program, or provide a block diagram, that would be uploaded to the microcontroller to accomplish the tasks described.

/6

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Question 29 continues

Question 29 continued

Marker use

- c) Describe how you would test and observe the simulated and real-time operation of the system to ensure the peripheral devices are functioning correctly. What tools or techniques would you use?

/4

.....

.....

.....

.....

.....

.....

.....

**Total
Q29
/14**

Spare Diagrams

Question 28

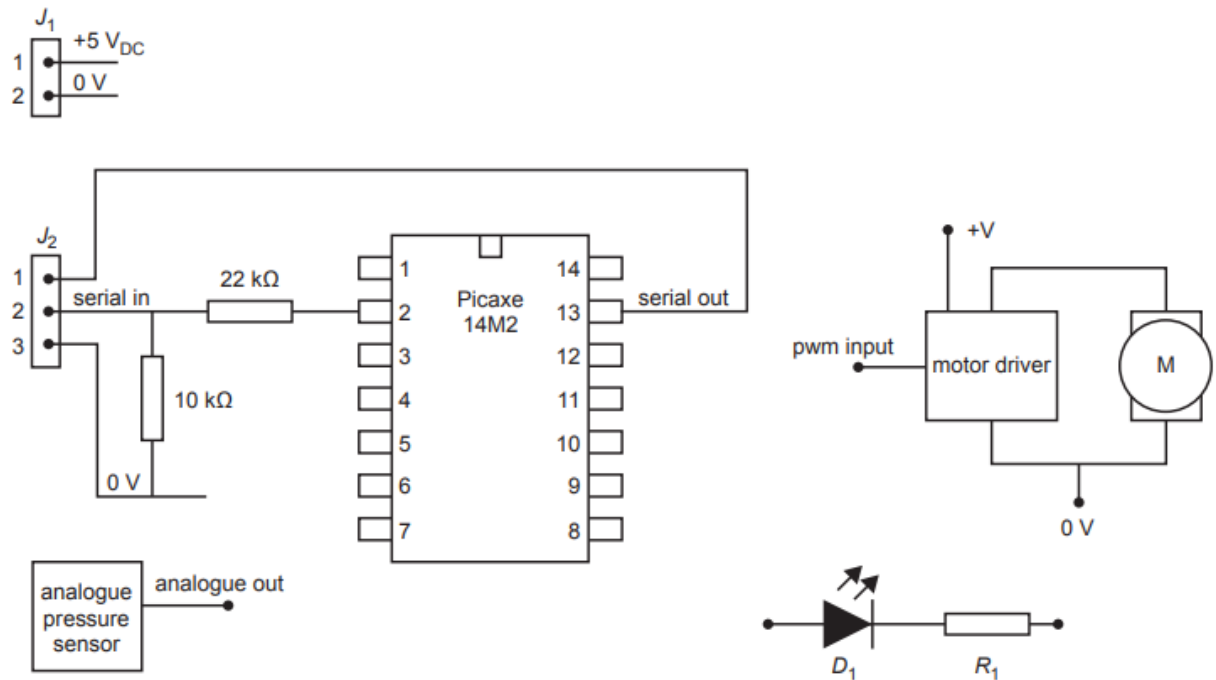


Figure 31

End of Section E

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