MINISTRY OF EDUCATION, SINGAPORE
in collaboration with
CAMBRIDGE ASSESSMENT INTERNATIONAL EDUCATION
General Certificate of Education Ordinary Level

CANDIDATE NAME	

CENTRE NUMBER	S					INDEX NUMBER			

ELECTRONICS

6063/01

Paper 1

For examination from 2025

SPECIMEN PAPER

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, index number and name in the spaces at the top of this page.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE ON ANY BARCODES.

You may use a calculator.

Section A
Answer **all** questions.

Section B
Answer **all** questions.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 100.

This document consists of **22** printed pages.

Singapore Examinations and Assessment Board

Cambridge Assessment International Education

DATASHEET

Resistor Colour Codes

1st Colour Band 1st Digit	2nd Colour Band 2nd Digit	3rd Colour Band Multiplier	4th Colour Band Tolerance
Black 0	Black 0	Black 0	Gold ±5%
Brown 1	Brown 1	Brown 1	Red ±2%
Red 2	Red 2	Red 2	
Orange 3	Orange 3	Orange 3	
Yellow 4	Yellow 4	Yellow 4	
Green 5	Green 5	Green 5	
Blue 6	Blue 6	Blue 6	
Violet 7	Violet 7	Violet 7	
Grey 8	Grey 8	Silver 0.01	
White 9	White 9	Gold 0.1	

Preferred values for resistors (E24 SERIES)

1.0 1.1 1.2 1.3 1.5 1.6 1.8 2.0 2.2 2.4 2.7 3.0 3.3
3.6 3.9 4.3 4.7 5.1 5.6 6.2 6.8 7.5 8.2 9.1 and multiples of ten.

FORMULAE

Astable and monostable generators using 555 timers

Monostable mode Period $T = 1.1RC$

Astable mode Period $T = \dfrac{(R_1 + 2R_2)C}{1.44}$

Bipolar Junction Transistor (BJT)

Current gain $\beta = \dfrac{\text{Collector current}}{\text{Base current}}$

Operational Amplifiers (Op-Amp)

Closed-loop gain for a non-inverting operational amplifier

$$A_{CL} = 1 + \frac{R_f}{R_{in}}$$

Closed-loop gain for an inverting operational amplifier

$$A_{CL} = -\frac{R_f}{R_{in}}$$

Table on Boolean algebra

Single-variable theorems	Laws of Complementation	• $\overline{0} = 1$ • $\overline{1} = 0$ • $\overline{\overline{A}} = A$
	AND Laws	• $A \cdot 0 = 0$ • $A \cdot 1 = A$ • $A \cdot A = A$ • $A \cdot \overline{A} = 0$
	OR Laws	• $A + 0 = A$ • $A + 1 = 1$ • $A + A = A$ • $A + \overline{A} = 1$
Multivariable theorems	Commutative Laws	• $A + B = B + A$ • $A \cdot B = B \cdot A$
	Associative Laws	• $A + (B + C) = (A + B) + C = A + B + C$ • $A \cdot (B \cdot C) = (A \cdot B) \cdot C = A \cdot B \cdot C$
	Distributive Laws	• $A \cdot (B + C) = A \cdot B + A \cdot C$ • $(A + B) \cdot (C + D) = A \cdot C + B \cdot C + A \cdot D + B \cdot D$
	Absorptive Laws	• $A + A \cdot B = A$ • $A \cdot (A + B) = A$ • $A + \overline{A} \cdot B = A + B$ • $A \cdot (\overline{A} + B) = A \cdot B$
	DeMorgan's Theorems	• $\overline{(A + B)} = \overline{A} \cdot \overline{B}$ • $\overline{(A \cdot B)} = \overline{A} + \overline{B}$

[Turn over

Section A
Answer all questions in this section.

1 Fig. 1.1 shows a simple system made up of a circuit powered by a 9 V battery.

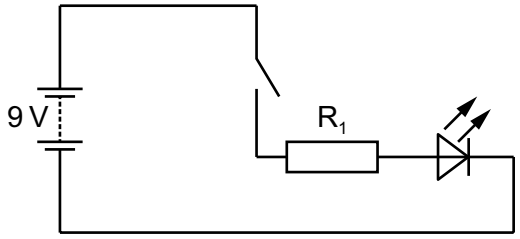


Fig. 1.1

(a) (i) Circle the type of switch used in the circuit.

SPST PTM PTB SPDT [1]

(ii) The LED has a forward voltage of 2.1 V.
Calculate the value of R_1 if the current is to be limited to 15 mA.

..... [2]

(iii) A list of possible resistors is given below.

330 Ω 430 Ω 470 Ω 560 kΩ 1 MΩ

Circle the resistor that should be used in the circuit of Fig. 1.1. [1]

(b) Draw an LED showing two physical features that allow identification of the cathode.

[2]

2 The list below shows a number of capacitance values.

(a) Complete the table to show the capacitance values in ascending order with the lowest on the left.
One has been done for you.

0.1 μF 1 F 4700 pF 10 nF 470 μF

lowest value				highest value
				1 F

[3]

(b) Identify the capacitance value of the following capacitor.

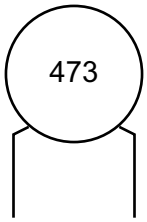


Fig. 2.1

..... [1]

(c) Describe what is meant by the 'working voltage' of a capacitor.

.....

..... [2]

3 Fig. 3.1 shows the graphs of two electronic signals.

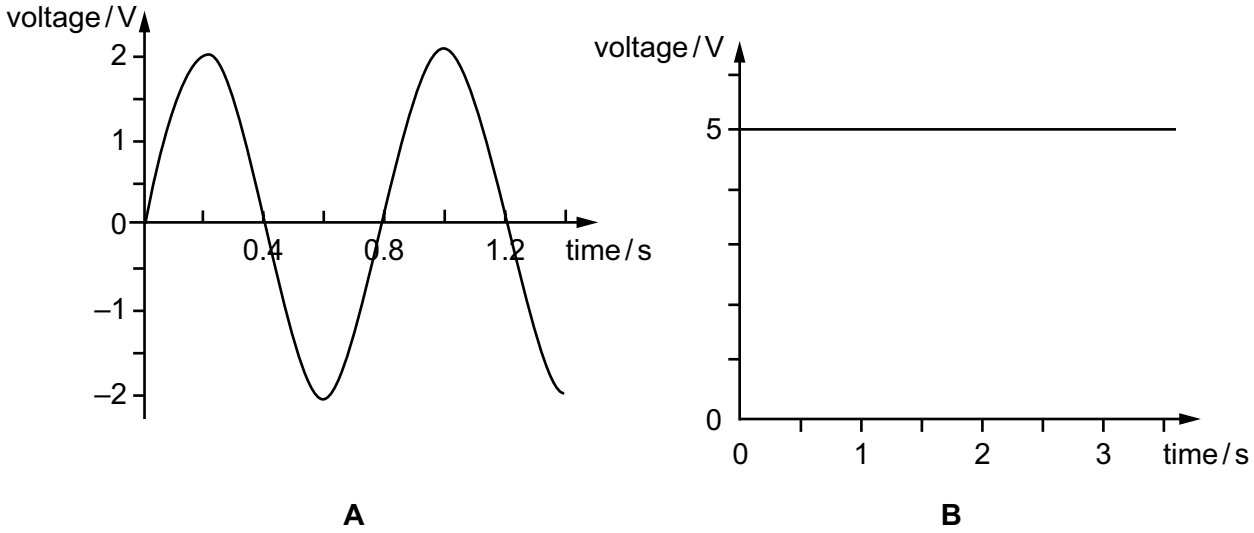


Fig. 3.1

(a) Identify the two types of signal.

Signal in graph A .....

Signal in graph B .....

[2]

(b) The signal in graph **A** is modified such that its:

- frequency is doubled
- peak-to-peak voltage is 2 V
- DC level is 1 V

Complete Fig. 3.2 with the new signal for a duration of 1 second.
Your answer must include suitable axis scales and labels.

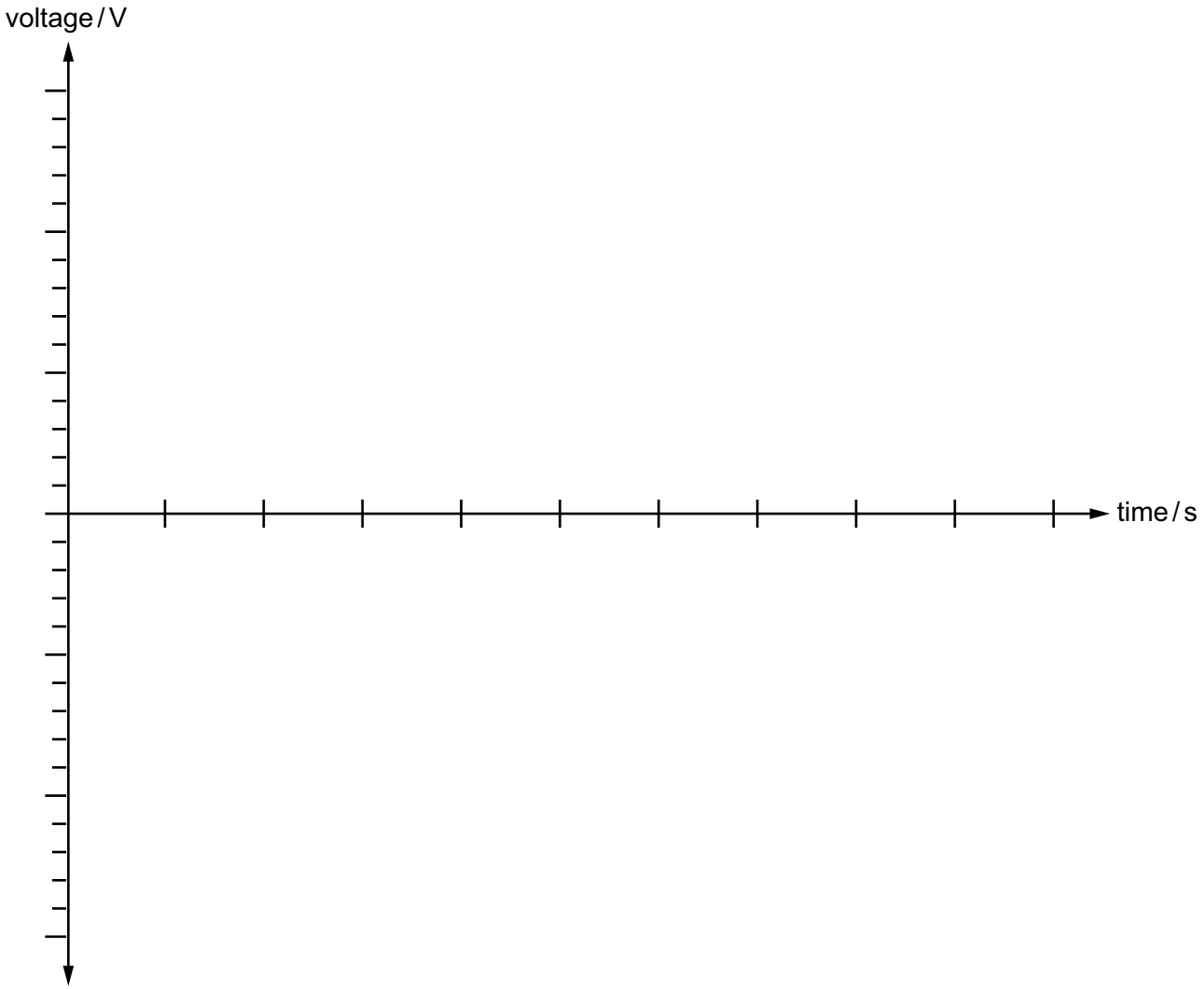


Fig. 3.2 [3]

4 **(a)** Table 4.1 shows numbers in a range of formats. Complete the table by adding the missing numbers. The first row has been done for you.

Table 4.1

decimal	binary	BCD
25	00011001	0010 0101
91		1001 0001
23	00010111	

[2]

(b) State one advantage and one disadvantage of using BCD rather than binary.

.....

.....

..... [2]

(c) Give one example of a number in 4-bit binary that cannot be converted to BCD comprising 4 digits only.

..... [1]

5 **(a)** A situation that can be described in logic terms is given below.

'A safe in a bank needs two keys to open it.
The manager and a director of the bank each have an identical key.
The security officer has a different key.
To open the safe the security officer and either the manager or director must be there to use their keys.'

Using only one OR gate and one AND gate, draw a logic circuit that can be used to represent the situation.

[3]

(b) **(i)** NOR gates are sometimes described as universal logic gates.

Name the other type of gate that can be described as a universal logic gate.

..... [1]

(ii) Convert your solution in part **(a)** to use the lowest number of NOR gates possible.

[3]

6 **(a)** Fig. 6.1 shows a non-inverting amplifier.

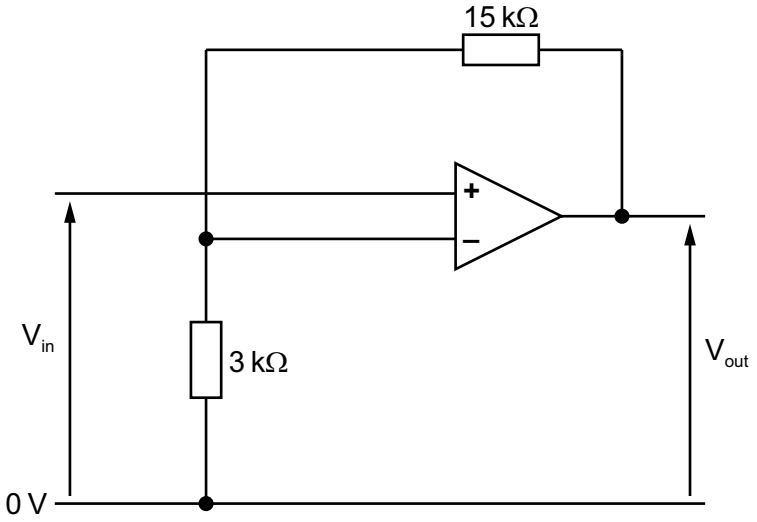


Fig. 6.1

Calculate the gain of the amplifier.

..... [3]

(b) Complete the inverting amplifier shown in Fig. 6.2 with a gain of –10.

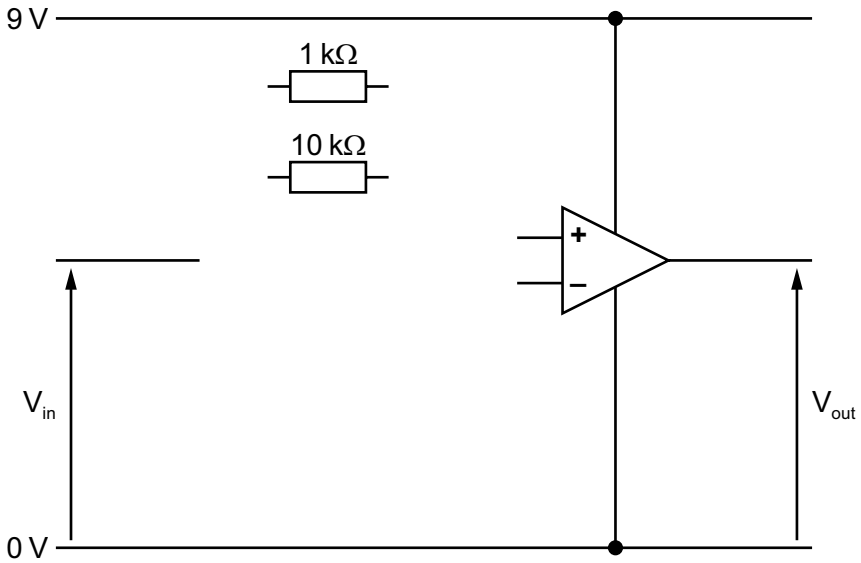


Fig. 6.2 [2]

(c) State the input impedance value of an ideal operational amplifier.

..... [1]

7 **(a)** Fig. 7.1 shows part of a temperature-sensing circuit using a bipolar junction transistor.

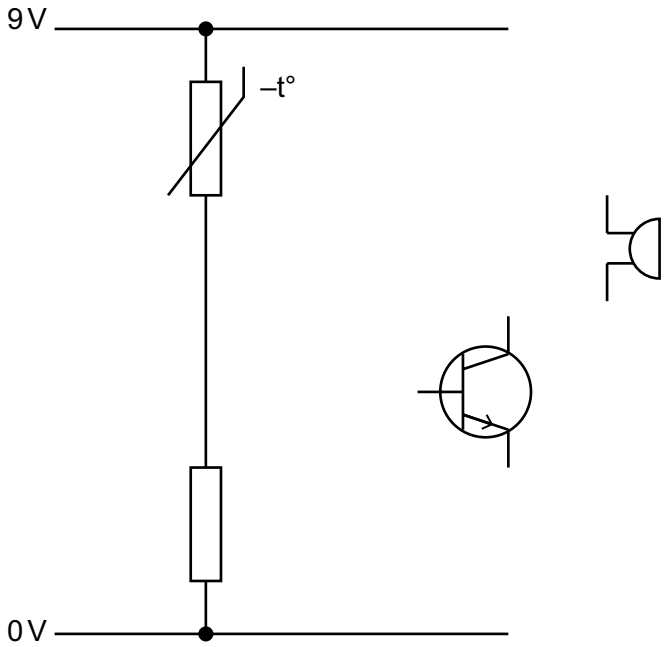


Fig. 7.1

Complete the circuit so that the buzzer sounds when the temperature rises.
Include any additional components required. [3]

(b) Give two advantages of a transistor switch over a mechanical switch.

Advantage 1 .....

Advantage 2 .....
[2]

Section B
Answer all questions in this section.

8 **(a)** A digital counting circuit using a mechanical switch often suffers from contact bounce.

(i) State what is meant by the term ‘contact bounce’.

.....[1]

(ii) State what effect contact bounce can have on a counting circuit.

..... [1]

(iii) A debounced switch can be constructed from an S-R latch.
Complete Fig. 8.1 to show the circuit diagram for the debounced switch

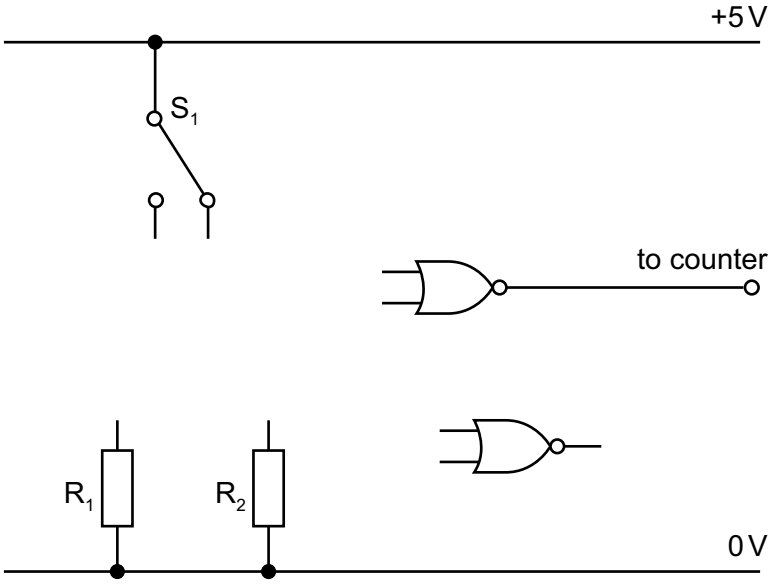


Fig. 8.1 [4]

(b) **(i)** A counter is to be constructed using a 74390 dual decade counter IC, which comes in a 16-pin DIL package.
Draw, in the space below, a 16-pin DIL package IC, showing how pin 1 is identified.

[2]

(ii) Fig. 8.2 shows an incomplete timing diagram of the 74390 counter IC.
The clock signal increases the count value by one for each falling edge.

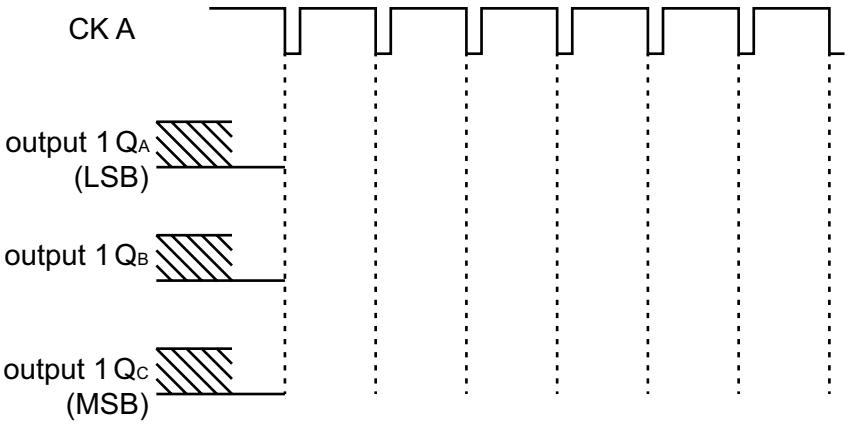
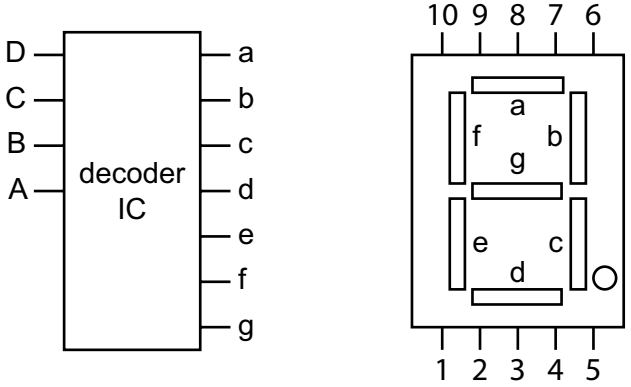


Fig. 8.2

Complete the timing diagram in Fig. 8.2. [3]

(c) The outputs from a decade counter are to be displayed on a 7-segment display.
Fig. 8.3 shows a decoder IC, a 7-segment display and the display pin diagram.



pin	connection
1	e
2	d
3	anode/cathode
4	c
5	DP
6	b
7	a
8	anode/cathode
9	f
10	g

Fig. 8.3

(i) Draw on Fig. 8.3 all the connections between the decoder IC and 7-segment display. [2]

(ii) Shade in the 7-segment display to show the number that would appear when the decoder input is 0011. [1]

(iii) The 7-segment display is a common-cathode display.
State the required voltage at the com pins.

..... [1]

9 **(a)** Fig. 9.1 shows a 555 monostable circuit used to sound a school bell for a set length of time.

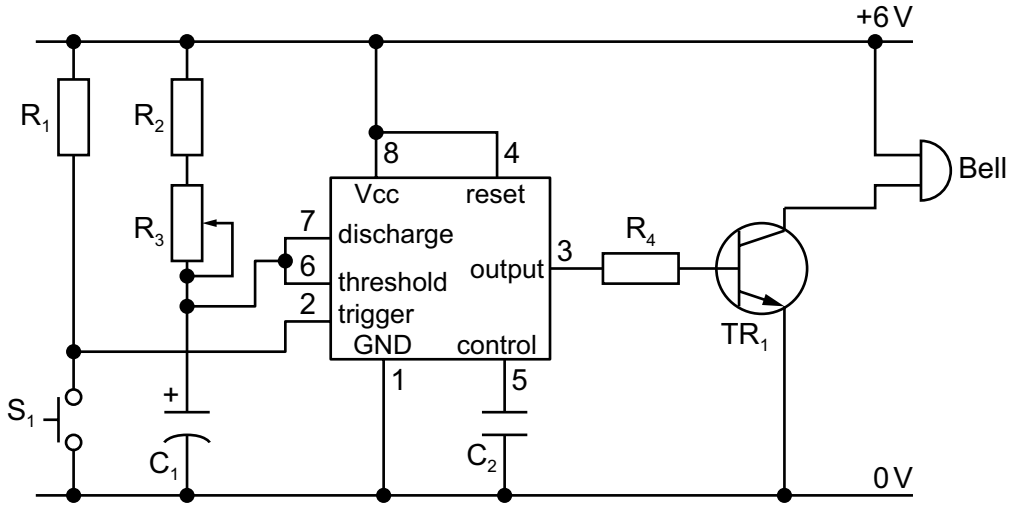


Fig. 9.1

(i) State how the circuit is triggered.

..... [1]

(ii) Describe how the duration the bell operates can be calculated and changed.

.....

.....

..... [2]

(iii) R_2 is a 1 kΩ, fixed resistor. Give **one** benefit of using this resistor connected to R_3.

.....

..... [1]

(b) It has been decided that the bell should turn on and off in order to attract attention.
Fig. 9.2 shows an incomplete circuit diagram of an astable.

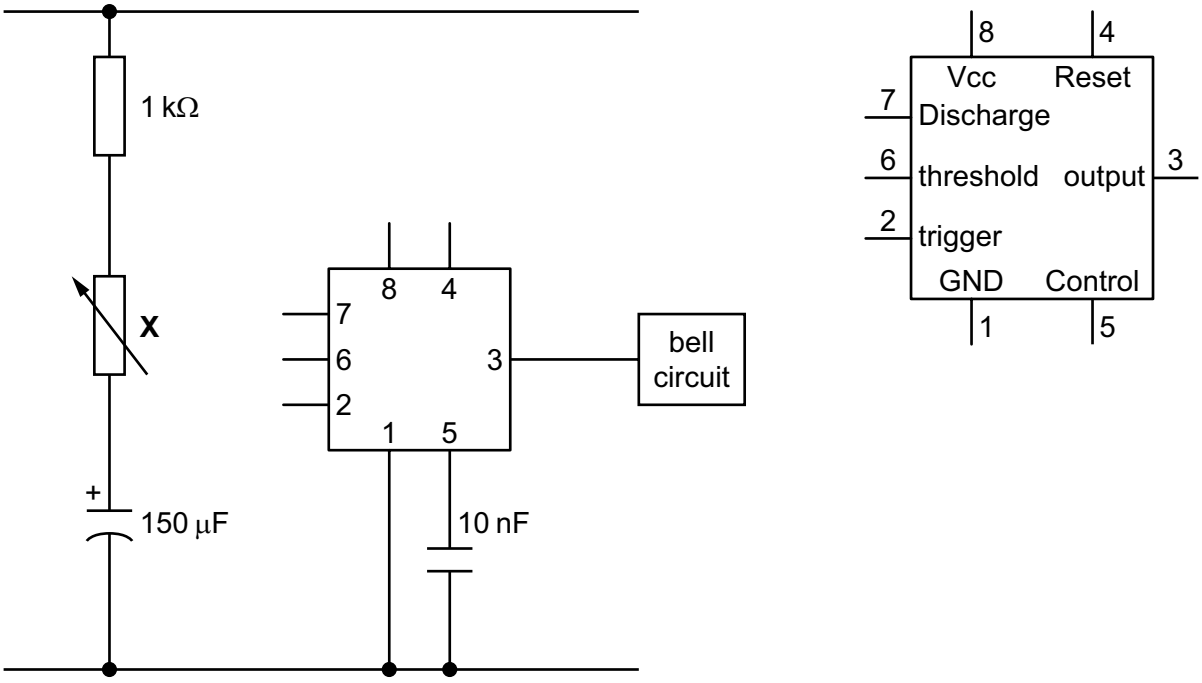


Fig. 9.2

(i) Add the missing connections to Fig. 9.2 to complete the astable circuit. [3]

(ii) The bell needs to turn on and off with a frequency 2 Hz.
Calculate the value of component **X** in Fig. 9.2 to achieve this frequency.
Your answer must include units.

..... [4]

(c) An output transducer requiring higher current could be operated by a relay.

(i) State one fact that would need to be considered when choosing a suitable relay.

.....

..... [1]

[Turn over

(ii) The incomplete relay operating circuit is shown in Fig. 9.3.
Add connections to complete the circuit using a Darlington driver arrangement to operate the relay.

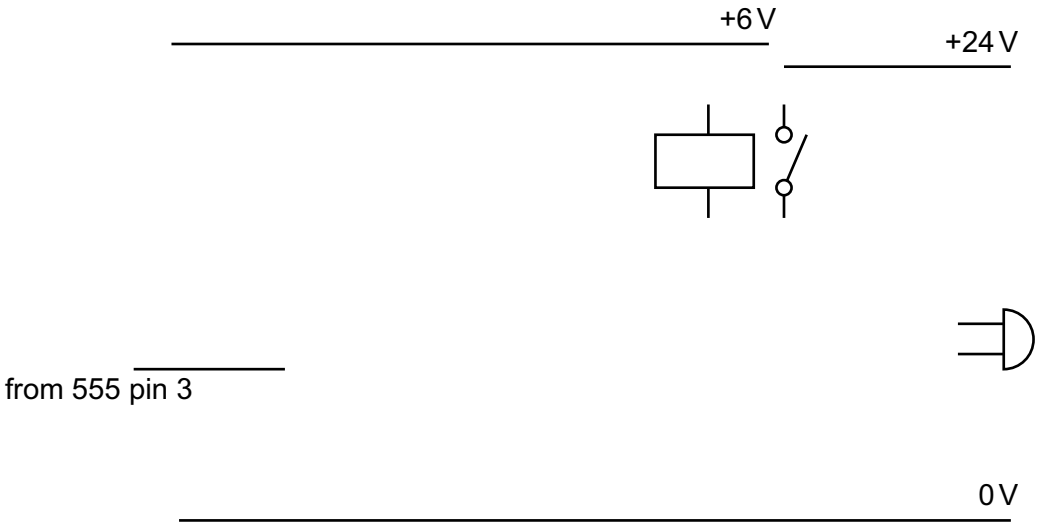


Fig. 9.3 [3]

10 (a) A circuit is being developed to supply a DC voltage from an AC supply.

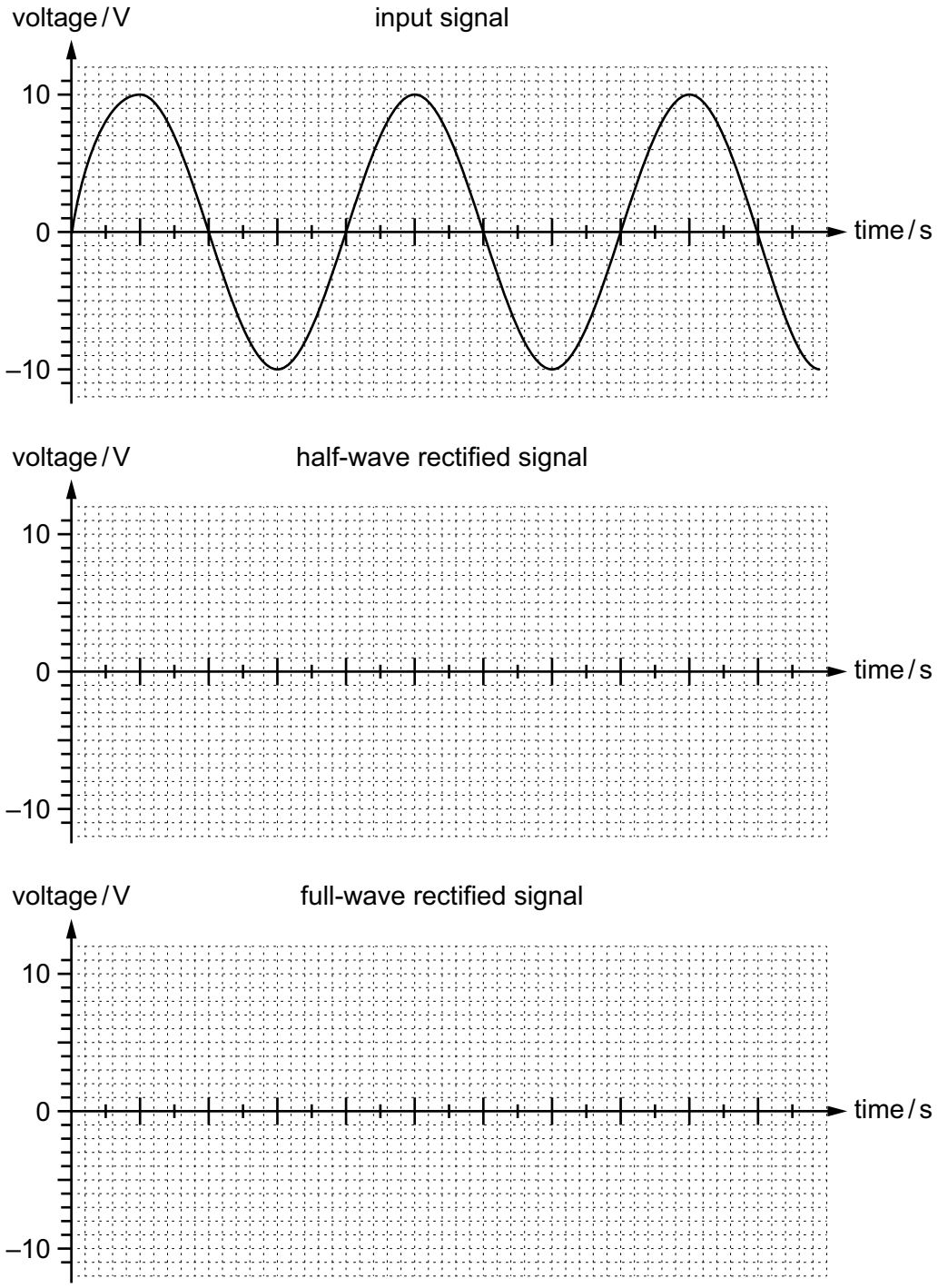


Fig. 10.1

Diodes can be used to rectify an AC voltage into a DC voltage.
The input signal in Fig. 10.1 is fed into two different rectifiers which use the simplified diode model. The forward voltage of the diode is 0.7 V.

(i) Draw on Fig. 10.1 to show the output of a half-wave rectifier.
Mark the peak value of the output. [2]

(ii) Draw on Fig. 10.1 to show the output of a full-wave rectifier.
Mark the peak value of the output. [2]

(b) Fig. 10.2 shows a full-wave rectifier consisting of four diodes arranged in a bridge rectifier configuration.

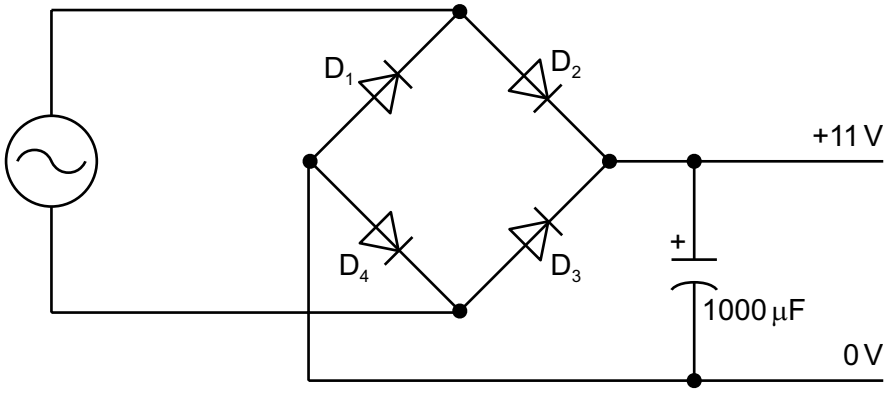


Fig. 10.2

Describe how this circuit operates.

.....

.....

.....

.....

.....

..... [3]

(c) The DC supply from the rectifier circuit can be regulated using a zener diode as shown in Fig. 10.3.
The zener diode has a breakdown voltage of 5.1 V and a power rating of 1.3 W.

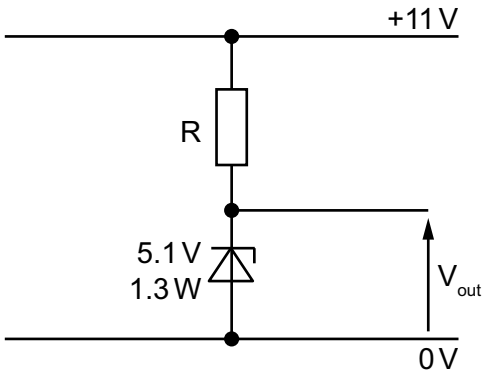


Fig. 10.3

(i) State the output voltage from the circuit in Fig. 10.3

..... [1]

(ii) Explain the meaning of the '1.3 W' rating of the Zener diode.

..... [1]

(iii) Calculate the maximum safe Zener current.

..... [3]

(iv) On Fig. 10.4, draw the characteristic graph of this Zener diode with the value of the breakdown voltage and axes clearly labelled.

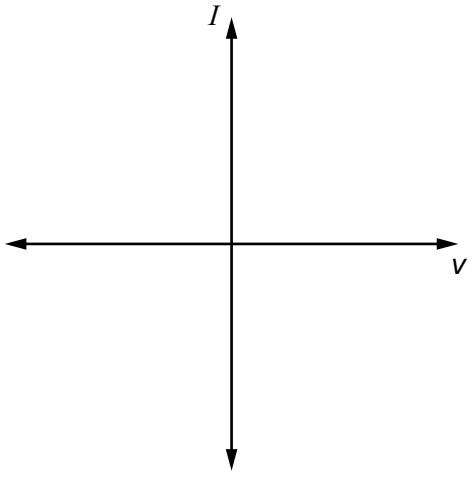


Fig. 10.4 [3]

11 **(a)** The water temperature in a tropical fish tank has to be kept at 27 °C.
The water temperature is controlled by switching on a heater or cooling fan. A system diagram for the temperature control unit is shown in Fig. 11.1.

System diagram

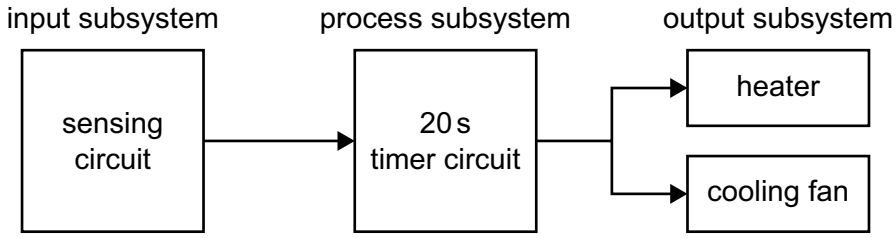


Fig. 11.1

When the sensing circuit detects that the water temperature is too cold or too hot, it will activate the timer circuit to switch on the heater or cooling fan for 20 seconds before checking the temperature again.
Explain why this time period is needed.

.....

.....

.....

..... [2]

(b) A thermistor in a waterproof casing is used to monitor the temperature.

(i) State why the thermistor must be in a waterproof casing.

.....

..... [1]

(ii) Part of the circuit diagram for the temperature control unit is shown in Fig. 11.2.

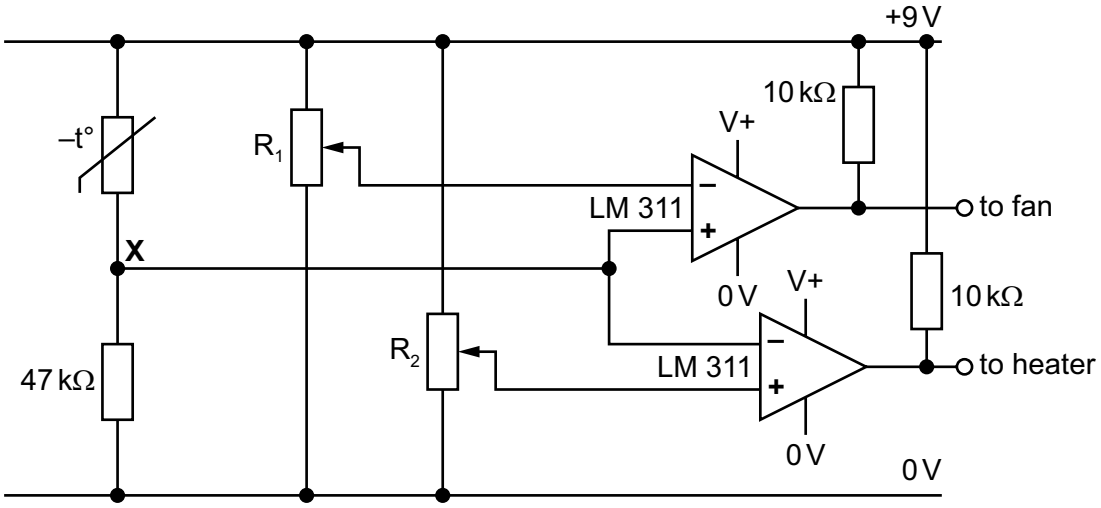


Fig. 11.2

The thermistor has a resistance of 59 kΩ at a temperature of 27 °C.
Using the information in Fig. 11.2, calculate the voltage at point **X** when the thermistor resistance is 59 kΩ.

..... [3]

(iii) The signal from the thermistor is connected to two LM311 voltage comparators.
Tick (✓) the two statements below that are true for a voltage comparator circuit.

If the + input is greater than the – input, the output is high	
If the – input is greater than the + input, the output is high	
If the + input is greater than the – input, the output is low	
If the – input is greater than the + input, the output is low	

[2]

(iv) Explain the changes that take place in the circuit in Fig. 11.2 so that the cooling fan switches on when the temperature rises above 27 °C.

.....

.....

.....

.....

..... [4]

(c) The heater used is rated at 12 V DC with a power rating of 50 W.

(i) Calculate the resistance in the heater circuit. Use the formula $P = V^2/R$

..... [2]

(ii) State what is meant by power.

.....

..... [1]