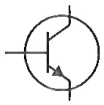
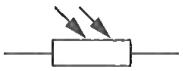
Candidate 1 evidence

Total marks — 60
Attempt ALL questions

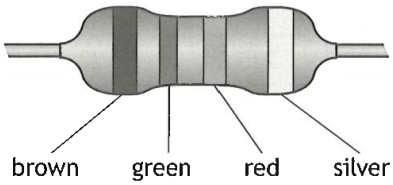
1. The table below gives information about some circuit components.
Some of the boxes have been left blank.

(a) Complete the table for the missing entries. 3

Component name	Symbol	Function
Bipolar transistor		electronic switch
Resistor		controls the current in a circuit
Ammeter		measures current in a circuit
Light dependent resistor (LDR)		Changes the resistance depending on light intensity.

1. **(continued)**

(b) The diagram below shows the colour coding for a resistor.



Using information from the data sheet, answer the questions below.

(i) Determine the resistance of the resistor. 1

1500Ω

(ii) State the percentage tolerance of this resistor. 1

±10%

(iii) Determine the maximum and minimum resistance of this resistor in ohms. 2

Resistance value:

$\frac{1500}{100} \times 10$

$= 150\Omega$

Maximum

$1500 + 150$

$= 1650\Omega$

Minimum

$1500 - 150$

$= 1350\Omega$

1. **(continued)**

(c) The table below shows possible values for the resistance of a resistor in different notations.

220 R	22
2.2 mΩ	2M2

← NOT IN RESISTOR NOTATION

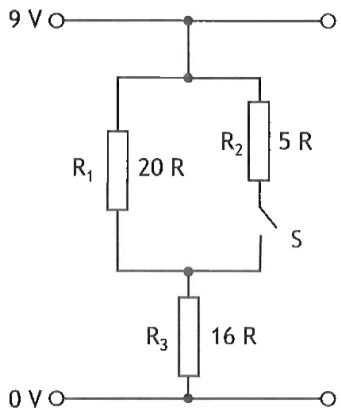
Identify which of the values shown is the **largest** value of resistance. **1**

220R ~~2M2~~ has the largest resistance value

2. State two safety precautions that must be taken when using a soldering iron. 2

Protection from fumes e.g. Open windows
Eye protection

3. A circuit diagram is shown below.



(a) Switch S is **open**.

(i) Calculate the total resistance of this circuit. 1

Space for working and answer

$R_T = R_1 + R_3$

$R_T = 20 + 16$

$R_T = 36\Omega$

(ii) Calculate the current in this circuit. 3

Space for working and answer

$V = 9V$

$R = 36\Omega$

$I = ?$

$V = IR$

$I = \frac{V}{R}$

$I = \frac{9}{36}$

$I = \frac{1}{4}$

$I = 0{\cdot}25A$

3. (a) (continued)

(iii) Calculate the power dissipated in resistor R_3. 3

Space for working and answer

$R = 16\Omega$ $P = I^2R$

$P = ?$ $P = 0.25^2 \times 16$

$I = 0.25\,A$ $P = 1\,W$

(b) Switch S is now **closed.**

(i) Calculate the effective resistance of the two resistors in parallel. 3

Space for working and answer

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$

$$\frac{1}{R_T} = \frac{1}{20} + \frac{1}{5} \quad (\times 4)$$

$$= \frac{1}{20} + \frac{4}{20}$$

$$= \frac{5}{20}$$

$$\frac{1}{R_T} = \frac{1}{4}$$

$$R_T = 4\,\Omega$$

(ii) Calculate the overall circuit resistance. 1

Space for working and answer

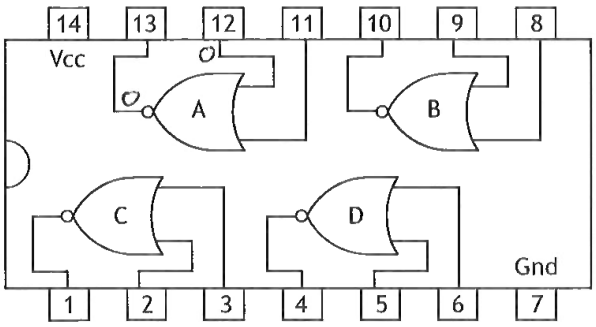
$R_T = R_T + R_3$

$R_T = 4 + 16$

$R_T = 20\Omega$

4. Logic gates are widely used in electronic circuits.

(a) A pinout for a 74 series logic chip is shown below.



(i) Using information from the data sheet, identify the **integrated circuit** (IC) shown. 1

NOR GATE

(ii) Identify an **output** pin on the integrated layout diagram above. 1

Pin 13

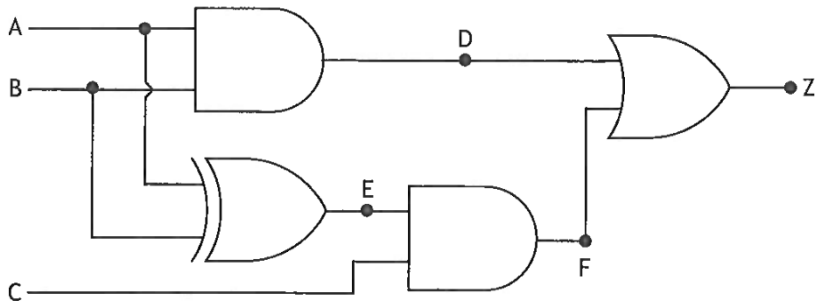
(iii) With reference to logic gate **A**, on the above pinout diagram, pins 12 and 13 have a logic state of 0.

State the logic state at pin 11. 1

Logic 1

4. **(continued)**

(b) Complete the truth table for the logic circuit shown below. **4**



A	B	C	D	E	F	Z
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	0	1	0	0
0	1	1	0	1	1	1
1	0	0	0	1	0	0
1	0	1	0	1	1	1
1	1	0	1	0	0	1
1	1	1	1	0	0	1

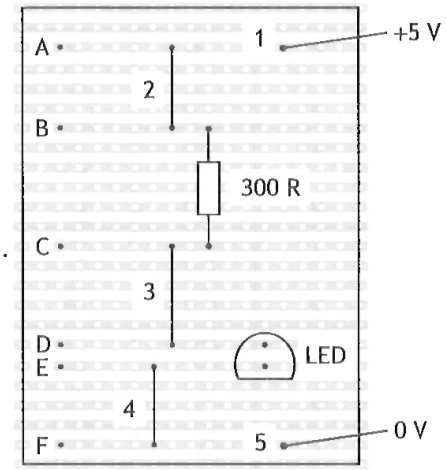
(An additional truth table, if required, can be found on *page 20*.)

5. (a) State an advantage of colour coding wires. 1

Easy to identify which are +V and which are 0V ~~Keep~~. wires.

(b) A student plans a stripboard layout of an LED in series with a resistor.

The layout, shown below, includes wires and test points. The wires are labelled one to five. The test points are marked A to F.



(i) The layout includes wires of different insulation colours: red, blue and black.

Identify the wire number that should have blue insulation. 1

Wire 3

5. (b) (continued)

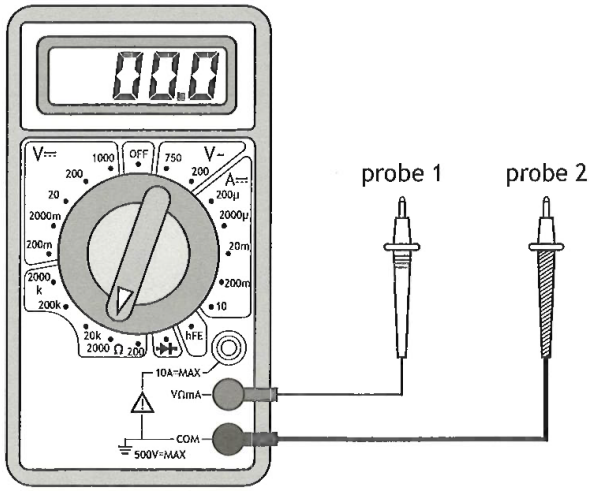
(ii) Explain the purpose of the resistor in the circuit. 1

Controls the current and protect the LED

(iii) The student now constructs the circuit from part (b).

Before connecting the stripboard to the supply, the student tests for continuity using a multimeter.

The multimeter used is shown below and will sound a 'beep' to indicate continuity.

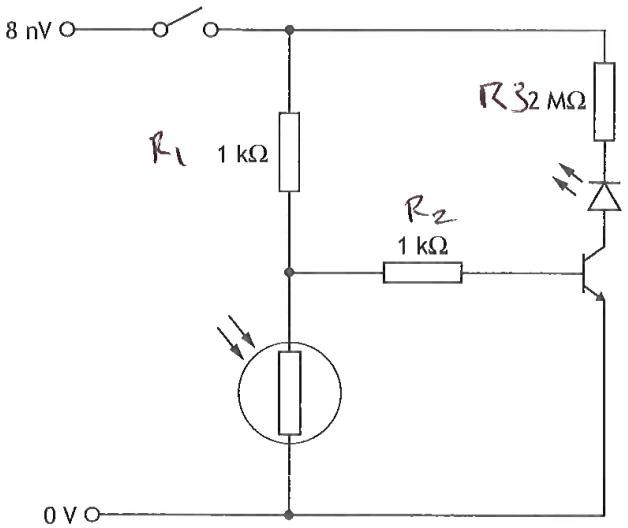


Describe how the above multimeter can be used to test for continuity between the LED and 0 V rail line on the student's stripboard. 3

Probe 1 touches the positive leg of the LED and probe 2 touches the negative leg of the LED. This will lead to the multimeter releasing a beep if there is no open loops in the circuit. The multimeter releases small amounts of voltage into the ~~circuit~~ component and ~~detected on the other~~ the other side will detect if the component works as it should.

[Turn over

6. A student simulated the circuit shown.



Identify three errors in this simulation. **3**

Error 1:

LED orientation is upside down

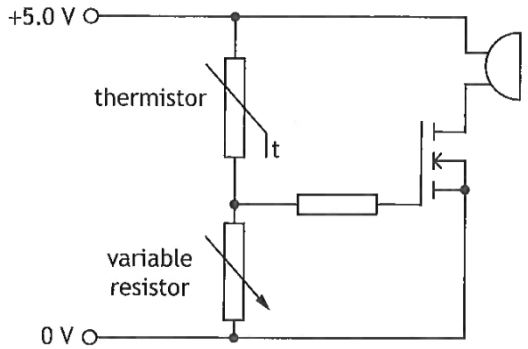
Error 2:

Voltage supply too low

Error 3:

Resistor 3 has too high a resistance value

7. An alarm circuit has a buzzer that sounds when the temperature is too high.
The circuit diagram for the buzzer system is shown below.



(a) At a certain temperature, the thermistor has a resistance of 1000 Ω.
The variable resistor is set at a resistance of 1500 Ω.
Calculate the voltage across the variable resistor. **3**
Space for working and answer

$V_2 = ?$
$V_S = 5V$
$R_1 = 1000\Omega$
$R_2 = 1500\Omega$

$V_2 = \frac{R_2}{R_1 + R_2} \times V_S$
$V_2 = \frac{1500}{2500} \times 5$
$V_2 = 3V$

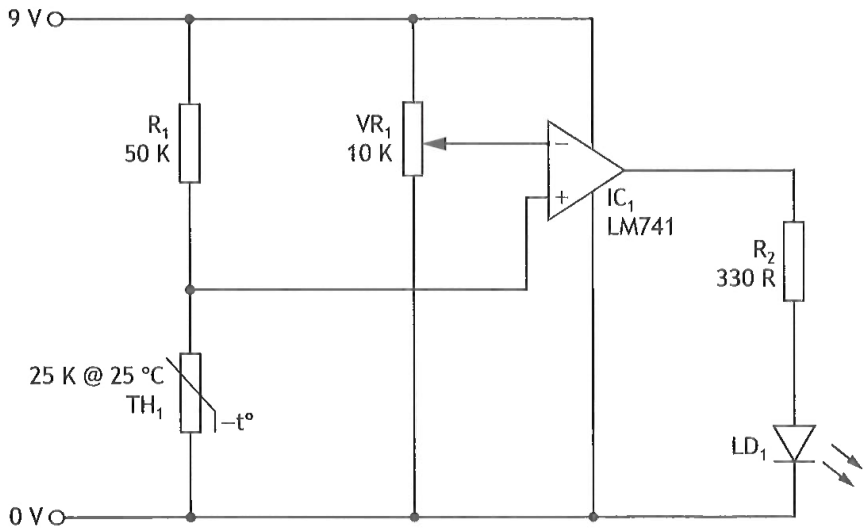
(b) Explain how the circuit operates to sound the buzzer. **3**

When temperature is too high the thermistors resistance ~~increases~~ and the voltage across the thermistor ~~do~~ increases. As the voltage reaches 1.8V ~~and~~ the mosfet ~~the~~ transistor allows the current to flow and allows the buzzer to go off.

(c) State the purpose of the variable resistor in this circuit. **1**

Allows the manual change of resistance in this circuit.

8. A student builds the circuit shown.



Using the information from the two suppliers' catalogues shown on the opposite page, complete the costings sheet below to produce the **lowest** cost for the circuit. 5

Supplier	Component	Product code	Cost (p)
JIMSON	LM741CN	TC 133	56
SWIFT	8 way DIL	SK-0080	10
SWIFT	LED 5 mm std	SC-0155	4
JIMSON	330 R	CR 656	1·2
JIMSON	50 K	CR 654	2·5
SWIFT	10 K potentiometer	PT-0744	55
JIMSON	thermistor	TH 116	22

(An additional costings sheet, if required, can be found on *page 20*.)

8. (continued)

Supplier — SWIFT				
	Component	Description	Product code	Cost
Integrated circuits	LM741CN	op-amp	IC-0258	75 p
	UA741CP	op-amp	IC-0267	41 p
	OP070CP	op-amp	IC-0234	110 p
	8 way DIL	IC socket	SK-0080	10 p
Semi-conductors	LED	5 mm std red	SC-0155	4 p
	LED	10 mm std red	SC-0177	10 p
Thermistor	thermistor	5 K @ 25 °C	BB-0545	65 p
	thermistor	10 K @ 25 °C	BB-0556	50 p
	thermistor	25 K @ 25 °C	BB-0568	28 p
Resistors	50 K	0.25 W carbon film 5%	FR-0855	2.8 p
	4K7	0.25 W carbon film 5%	FR-0856	2 p
	330 R	0.25 W carbon film 5%	FR-0857	1.5 p
Potentiometer	25 K	0.5 W trimmer	PT-0765	95 p
	10 K	0.5 W trimmer	PT-0744	55 p
	1 M	0.5 W trimmer	PT-0732	35 p

Supplier — JIMSON				
	Component	Description	Product code	Cost
Integrated circuits	LM741CN	op-amp	TC 133	56 p
	UA741CP	op-amp	TC 134	36 p
	OP070CP	op-amp	TC 135	105 p
	8 way DIL	IC socket	SK 090	30 p
Semi-conductors	LED	5 mm std red	LD 345	12 p
	LED	10 mm std red	LD 346	25 p
Thermistor	thermistor	5 K @ 25 °C	TH 114	32 p
	thermistor	10 K @ 25 °C	TH 115	45 p
	thermistor	25 K @ 25 °C	TH 116	22 p
Resistors	50 K	0.25 W carbon film 5%	CR 654	2.5 p
	4K7	0.25 W carbon film 5%	CR 655	1.7 p
	330 R	0.25 W carbon film 5%	CR 656	1.2 p
Potentiometer	25 K	0.5 W trimmer	VT 250	92 p
	10 K	0.5 W trimmer	VT 251	65 p
	1 M	0.5 W trimmer	VT 252	40 p

9. An engineer designs a system to control the temperature of the water in a tropical fish tank.

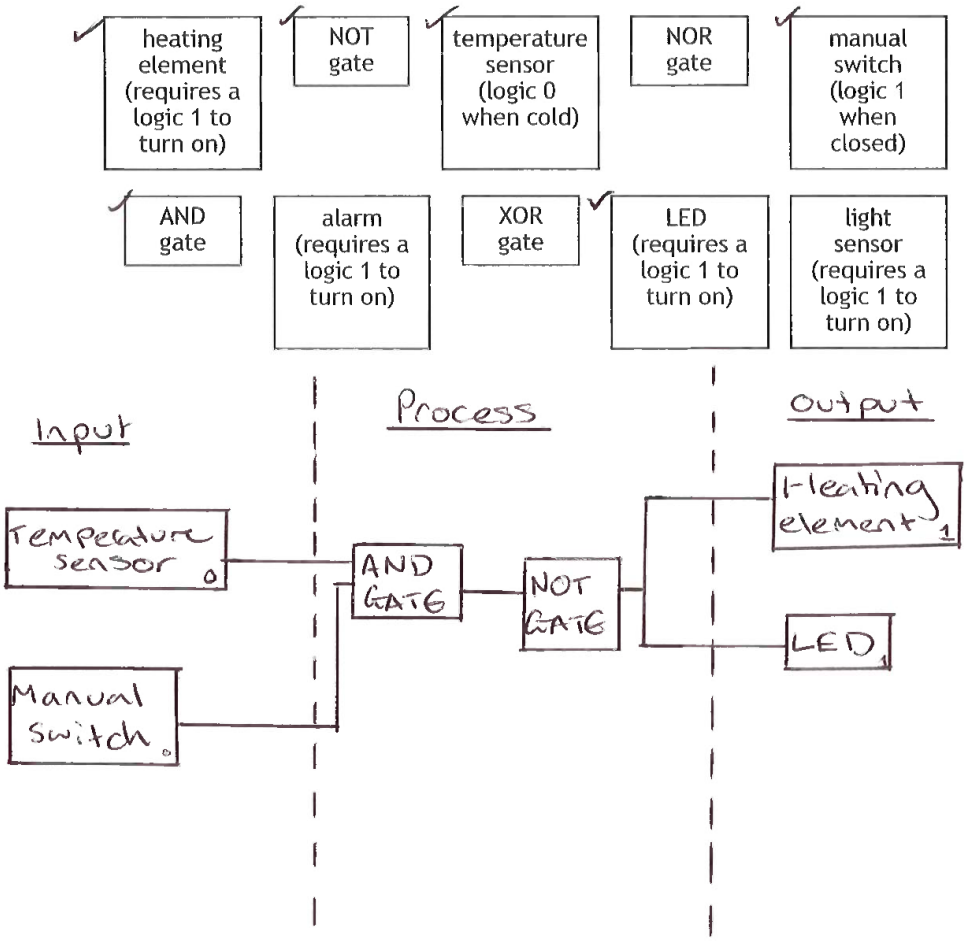
The system requires an electric heater to turn on when the temperature of the water becomes too cold.

An LED should switch on when the heater is on.

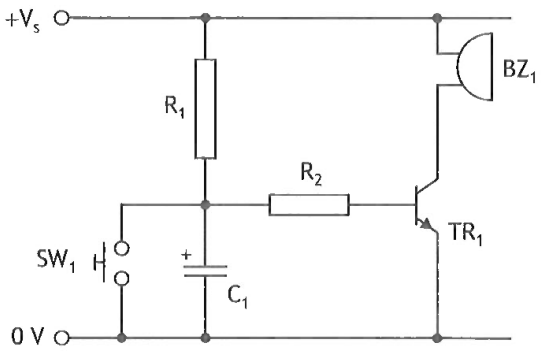
There is also a manual switch to turn the whole system on and off.

Selecting from the elements given, draw a block diagram of an electronic solution for this system.

On your diagram, clearly indicate the input, process and output sections of your solution. 6



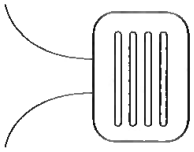
10. A time delay circuit is shown below.

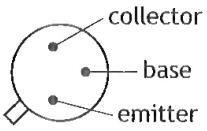


Component data

R_1 — carbon film 10 kΩ 0.25 W
R_2 — carbon film 1 kΩ 0.25 W
C_1 — 2200 mF **electrolytic** capacitor
SW_1 — push-to-make switch
TR_1 — BC108 npn bipolar
BZ_1 — buzzer 6 V dc
TR_1 pin connections

buzzer with connecting wires





electrolytic capacitor



push-to-make switch



On the opposite page, a layout diagram includes the power rails and components TR_1 and R_2.

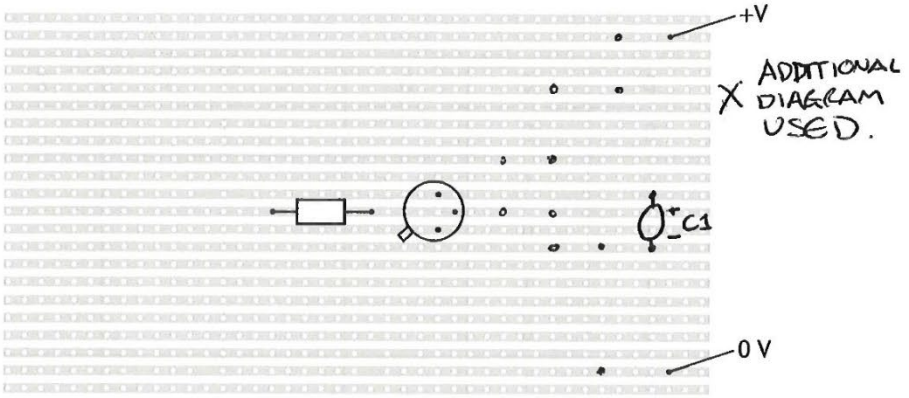
Complete the layout diagram with the remaining components.

Each component must be identified by a label.

Mark on the layout diagram, with an X, where a track has been cut. **5**

10. (continued)

layout diagram



X ADDITIONAL DIAGRAM USED.

(An additional layout diagram, if required, can be found on *page 21*.)

ADDITIONAL SPACE FOR ANSWERS

Additional truth table for question 4 (b)

A	B	C	D	E	F	Z
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

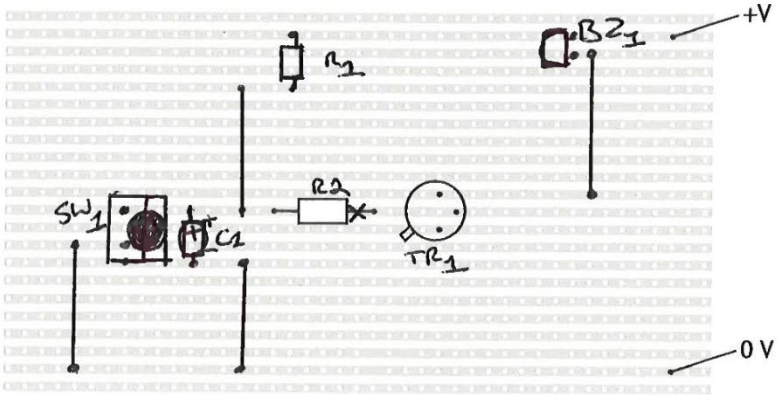
Additional costings sheet for question 8

Supplier	Component	Product code	Cost (p)
JIMSON	LM741CN	TC 133	56
SWIFT	8 way DIL	SK-0080	10
	LED 5 mm std		
	330 R		
	50 K		
	10 K potentiometer		
	thermistor		

ADDITIONAL SPACE FOR ANSWERS

Additional diagram for question 10

layout diagram

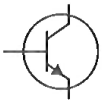
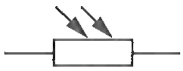


Candidate 2 evidence

Total marks — 60
Attempt ALL questions

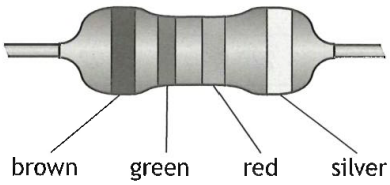
1. The table below gives information about some circuit components.
Some of the boxes have been left blank.

(a) Complete the table for the missing entries. 3

Component name	Symbol	Function
Bipolar transistor		electronic switch
Resistor		controls the current in a circuit
Ammeter		measures current in a circuit
Light dependent resistor (LDR)		Light level up Resistance down (LURD)

1. (continued)

(b) The diagram below shows the colour coding for a resistor.



Using information from the data sheet, answer the questions below.

(i) Determine the resistance of the resistor. **1**

1500Ω

(ii) State the percentage tolerance of this resistor. **1**

±10%

(iii) Determine the maximum and minimum resistance of this resistor in ohms. **2**

Max resistance = 1500 + 150 = 1650Ω

min resistance = 1500 - 150 = 1350Ω

1. **(continued)**

(c) The table below shows possible values for the resistance of a resistor in different notations.

220 R	22
2.2 mΩ	2M2

Identify which of the values shown is the **largest** value of resistance. 1

2.2 mΩ

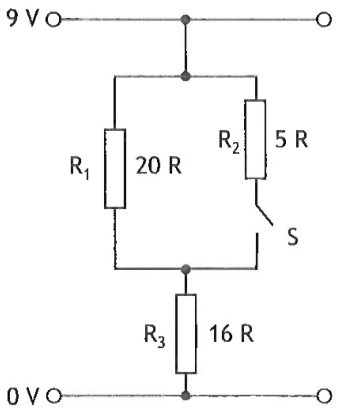
2. State two safety precautions that must be taken when using a soldering iron. 2

One safety precaution is to open the windows so the toxic fumes dont get inside you.

Another safety precaution is to make sure the stripboard is heald on correctly so it dosent fall over while soldering.

Another safety precaution you could do is to make sure you have gloves on so you dont burn your fingers/hands.

3. A circuit diagram is shown below.



(a) Switch S is **open**.

(i) Calculate the total resistance of this circuit. 1

Space for working and answer

$R_T = R_1 + R_3 = 20 + 16 = 36\,\Omega$

(ii) Calculate the current in this circuit. 3

Space for working and answer

$V = I \times R$

$I = V/R \quad I = 9/36 \quad I = 0.25\,A$

3. (a) (continued)

(iii) Calculate the power dissipated in resistor R_3. 3

Space for working and answer

$P = I^2 \times R \quad P = 0.25^2 \times 16 \quad P = 1W$

(b) Switch S is now **closed**.

(i) Calculate the effective resistance of the two resistors in parallel. 3

Space for working and answer

$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} \quad \frac{1}{R_T} = \frac{1}{20} + \frac{1}{5} = \frac{1}{0.25} = 4\Omega$

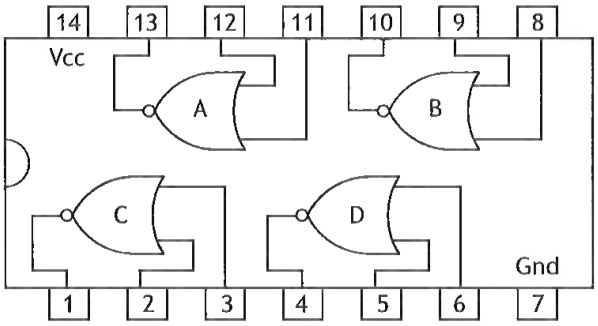
(ii) Calculate the overall circuit resistance. 1

Space for working and answer

$4 + 16 = 20\Omega$

4. Logic gates are widely used in electronic circuits.

(a) A pinout for a 74 series logic chip is shown below.



(i) Using information from the data sheet, identify the **integrated circuit** (IC) shown. 1

NOR Gate

(ii) Identify an **output** pin on the integrated layout diagram above. 1

Pin 1

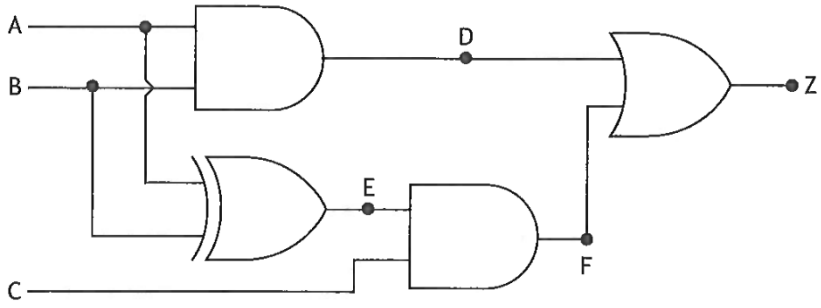
(iii) With reference to logic gate A, on the above pinout diagram, pins 12 and 13 have a logic state of 0.

State the logic state at pin 11. 1

0

4. **(continued)**

(b) Complete the truth table for the logic circuit shown below. **4**



A	B	C	D	E	F	Z
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	0	1	0	0
0	1	1	0	1	1	1
1	0	0	0	1	0	0
1	0	1	0	1	1	1
1	1	0	1	0	0	1
1	1	1	1	0	0	1

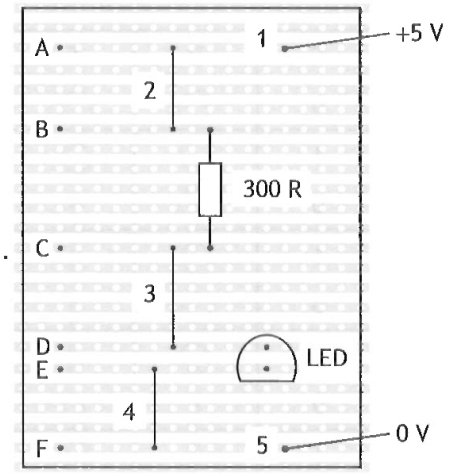
(An additional truth table, if required, can be found on *page 20*.)

5. (a) State an advantage of colour coding wires. 1

One Advantage is it's easier to

(b) A student plans a stripboard layout of an LED in series with a resistor.

The layout, shown below, includes wires and test points. The wires are labelled one to five. The test points are marked A to F.



(i) The layout includes wires of different insulation colours: red, blue and black.

Identify the wire number that should have blue insulation. 1

wire 3 should have blue insulation

5. (b) (continued)

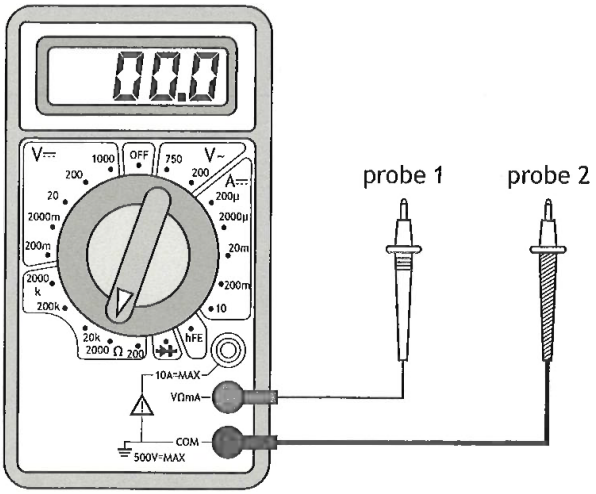
(ii) Explain the purpose of the resistor in the circuit. 1

To control the current in the circuit

(iii) The student now constructs the circuit from part (b).

Before connecting the stripboard to the supply, the student tests for continuity using a multimeter.

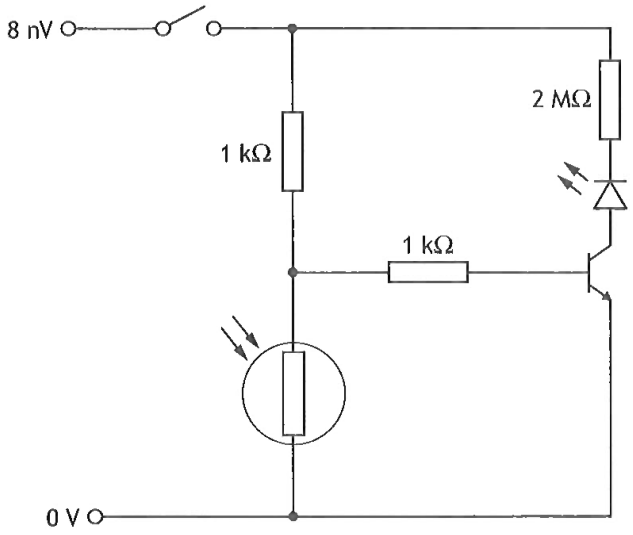
The multimeter used is shown below and will sound a 'beep' to indicate continuity.



Describe how the above multimeter can be used to test for continuity between the LED and 0 V rail line on the student's stripboard. 3

Probe 1 would go to D
and
Probe 2 would go to F
and that would test the continuity
in between the LED and the 0V rail

6. A student simulated the circuit shown.



Identify three errors in this simulation. **3**

Error 1:

The LED is facing the wrong way ✗ ✓

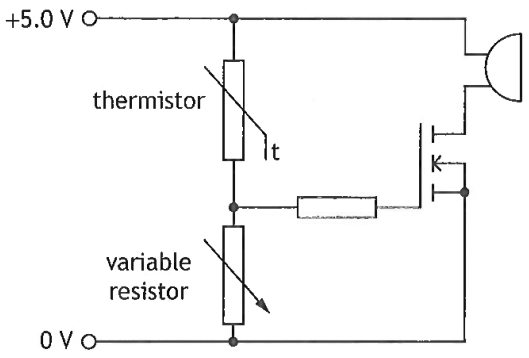
Error 2:

The Voltage is wrong 8nV ✗ 6V ✓

Error 3:

The Resistance is too high 2MΩ ✗ 2kΩ ✓

7. An alarm circuit has a buzzer that sounds when the temperature is too high.
The circuit diagram for the buzzer system is shown below.



(a) At a certain temperature, the thermistor has a resistance of 1000 Ω.
The variable resistor is set at a resistance of 1500 Ω.
Calculate the voltage across the variable resistor. 3
Space for working and answer

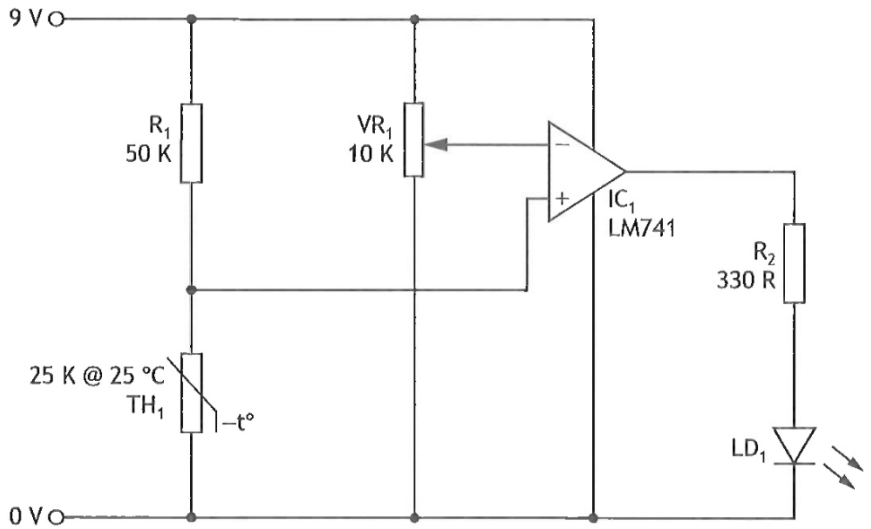
$$V2 = \frac{R2}{R1+R2} \times V_S \qquad V2 = \frac{1500}{1000+1500} \times 5 \qquad V2 = 3V$$

(b) Explain how the circuit operates to sound the buzzer. 3

When the tempreture goes up the resistance goes down and then reaches the buzzer which activates it

(c) State the purpose of the variable resistor in this circuit. 1

8. A student builds the circuit shown.



Using the information from the two suppliers' catalogues shown on the opposite page, complete the costings sheet below to produce the **lowest** cost for the circuit. **5**

Supplier	Component	Product code	Cost (p)
JIMSON	LM741CN	TC 133	56
SWIFT	8 way DIL	SK-0080	10
SWIFT	LED 5 mm std	SC-0155	4
JIMSON	330 R	CR 656	1.2
JIMSON	50 K	CR 654	2.5
SWIFT	10 K potentiometer	PT-0744	55
JIMSON	thermistor	TH 116	22

(An additional costings sheet, if required, can be found on *page 20*.)

8. (continued)

Supplier — SWIFT				
	Component	Description	Product code	Cost
Integrated circuits	LM741CN	op-amp	IC-0258	75 p
	UA741CP	op-amp	IC-0267	41 p
	OP070CP	op-amp	IC-0234	110 p
	8 way DIL	IC socket	SK-0080	10 p
Semi-conductors	LED	5 mm std red	SC-0155	4 p
	LED	10 mm std red	SC-0177	10 p
Thermistor	thermistor	5 K @ 25 °C	BB-0545	65 p
	thermistor	10 K @ 25 °C	BB-0556	50 p
	thermistor	25 K @ 25 °C	BB-0568	28 p
Resistors	50 K	0.25 W carbon film 5%	FR-0855	2.8 p
	4K7	0.25 W carbon film 5%	FR-0856	2 p
	330 R	0.25 W carbon film 5%	FR-0857	1.5 p
Potentiometer	25 K	0.5 W trimmer	PT-0765	95 p
	10 K	0.5 W trimmer	PT-0744	55 p
	1 M	0.5 W trimmer	PT-0732	35 p
Supplier — JIMSON				
	Component	Description	Product code	Cost
Integrated circuits	LM741CN	op-amp	TC 133	56 p
	UA741CP	op-amp	TC 134	36 p
	OP070CP	op-amp	TC 135	105 p
	8 way DIL	IC socket	SK 090	30 p
Semi-conductors	LED	5 mm std red	LD 345	12 p
	LED	10 mm std red	LD 346	25 p
Thermistor	thermistor	5 K @ 25 °C	TH 114	32 p
	thermistor	10 K @ 25 °C	TH 115	45 p
	thermistor	25 K @ 25 °C	TH 116	22 p
Resistors	50 K	0.25 W carbon film 5%	CR 654	2.5 p
	4K7	0.25 W carbon film 5%	CR 655	1.7 p
	330 R	0.25 W carbon film 5%	CR 656	1.2 p
Potentiometer	25 K	0.5 W trimmer	VT 250	92 p
	10 K	0.5 W trimmer	VT 251	65 p
	1 M	0.5 W trimmer	VT 252	40 p

9. An engineer designs a system to control the temperature of the water in a tropical fish tank.

The system requires an electric heater to turn on when the temperature of the water becomes too cold.

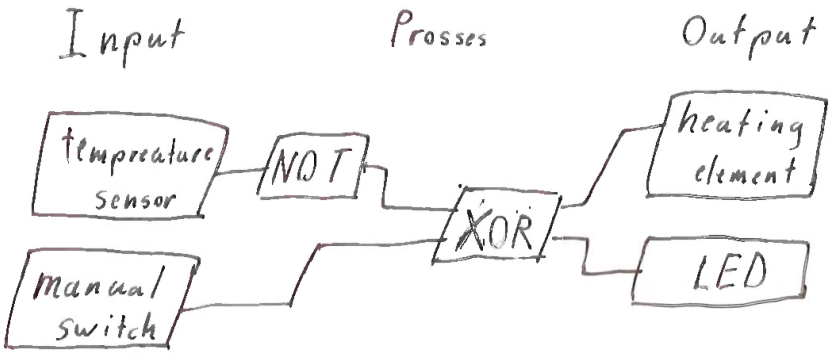
An LED should switch on when the heater is on.

There is also a manual switch to turn the whole system on and off.

Selecting from the elements given, draw a block diagram of an electronic solution for this system.

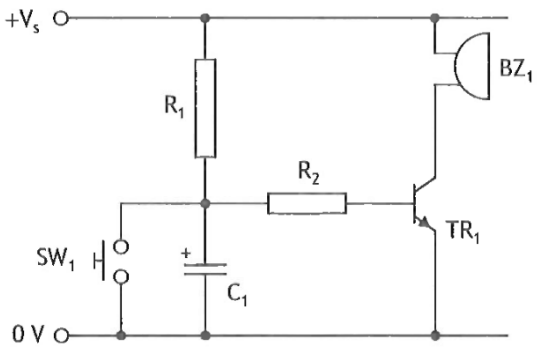
On your diagram, clearly indicate the input, process and output sections of your solution. **6**

heating element (requires a logic 1 to turn on)	NOT gate	temperature sensor (logic 0 when cold)	NOR gate	manual switch (logic 1 when closed)
AND gate	alarm (requires a logic 1 to turn on)	XOR gate	LED (requires a logic 1 to turn on)	light sensor (requires a logic 1 to turn on)



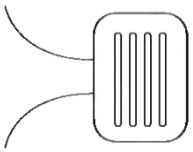
T,S	m,s	h,e	LED
0	0	1	1
1	0	0	0
0	1	1	1
1	1	0	0

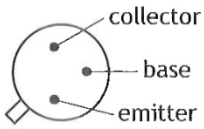
10. A time delay circuit is shown below.



Component data
R$_1$ — carbon film 10 kΩ 0.25 W
R$_2$ — carbon film 1 kΩ 0.25 W
C$_1$ — 2200 mF **electrolytic** capacitor
SW$_1$ — push-to-make switch
TR$_1$ — BC108 npn bipolar
BZ$_1$ — buzzer 6 V dc
TR$_1$ pin connections

buzzer with connecting wires





electrolytic capacitor



push-to-make switch



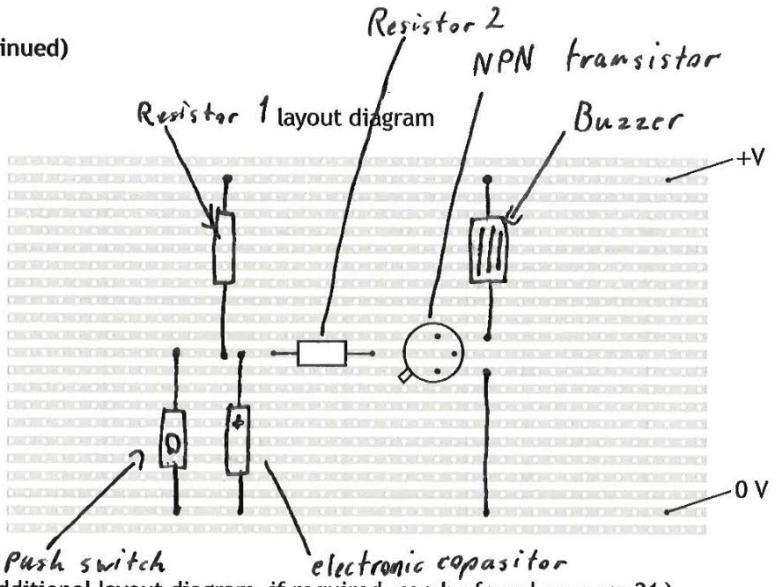
On the opposite page, a layout diagram includes the power rails and components TR$_1$ and R$_2$.

Complete the layout diagram with the remaining components.

Each component must be identified by a label.

Mark on the layout diagram, with an X, where a track has been cut. **5**

10. **(continued)**



(An additional layout diagram, if required, can be found on *page 21*.)

[END OF QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS

Additional truth table for question 4 (b)

A	B	C	D	E	F	Z
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

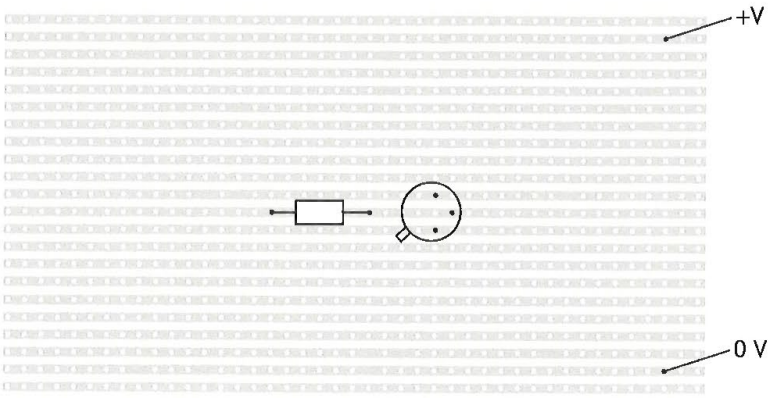
Additional costings sheet for question 8

Supplier	Component	Product code	Cost (p)
JIMSON	LM741CN	TC 133	56
SWIFT	8 way DIL	SK-0080	10
	LED 5 mm std		
	330 R		
	50 K		
	10 K potentiometer		
	thermistor		

ADDITIONAL SPACE FOR ANSWERS

Additional diagram for question 10

layout diagram

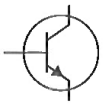


Candidate 3 evidence

Total marks — 60
Attempt ALL questions

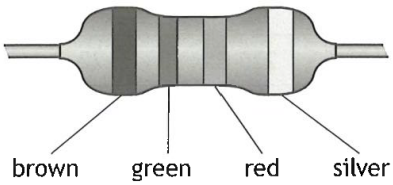
1. The table below gives information about some circuit components.
Some of the boxes have been left blank.

(a) Complete the table for the missing entries. 3

Component name	Symbol	Function
Bipolar transistor		electronic switch
Resistor		controls the current in a circuit
Ammeter		measures current in a circuit
Light dependent resistor (LDR)		As light increases, resistance decreases (vice versa)

1. **(continued)**

(b) The diagram below shows the colour coding for a resistor.



Using information from the data sheet, answer the questions below.

(i) Determine the resistance of the resistor. 1

1.5 KΩ

(ii) State the percentage tolerance of this resistor. 1

± 10%

(iii) Determine the maximum and minimum resistance of this resistor in ohms. 2

Max = 1500 x (1+0.1) = 1650Ω

Min = 1500 x (1-0.1) = 1350Ω

1. **(continued)**

(c) The table below shows possible values for the resistance of a resistor in different notations.

220 R	22
2.2 mΩ	2M2

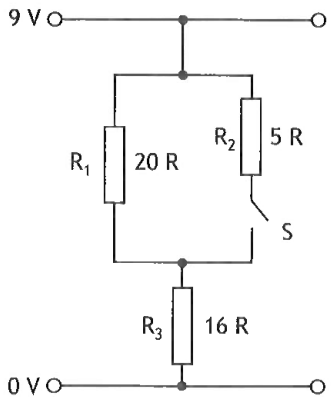
Identify which of the values shown is the **largest** value of resistance. 1

2M2

2. State two safety precautions that must be taken when using a soldering iron. 2

- Wear safety goggles
- Avoid breathing in fumes
- Use a heat mat

3. A circuit diagram is shown below.



(a) Switch S is **open**.

(i) Calculate the total resistance of this circuit. 1

Space for working and answer

36Ω

(ii) Calculate the current in this circuit. 3

Space for working and answer

V = 9V
I = ?
R = 36Ω

V = I R
9 = I × 36
÷36 ÷36

0.25A = I

. (a) **(continued)**

(iii) Calculate the power dissipated in resistor R_3. **3**

Space for working and answer

$P = ?$
$I = 0.25$
$R = 16\,\Omega$

$P = I^2R$
$P = 0.25^2 \times 16$
$P = 1\,W$

(b) Switch S is now **closed.**

(i) Calculate the effective resistance of the two resistors in parallel. **3**

Space for working and answer

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$$
$$\frac{1}{R_T} = \frac{1}{20} + \frac{1}{5} \quad \times 4 \quad \times 4$$
$$\frac{1}{R_T} = \frac{1}{20} + \frac{4}{20}$$
$$\frac{1}{R_T} = \frac{5}{20}$$
$$R_T = \frac{20}{5} = 4\,\Omega$$

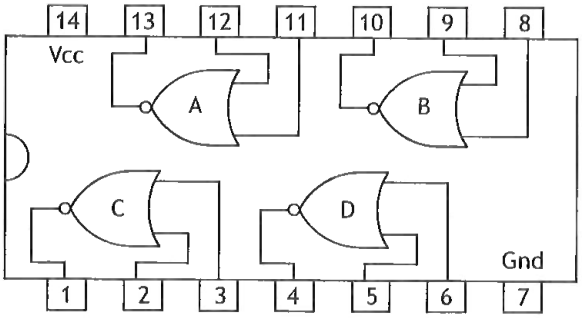
(ii) Calculate the overall circuit resistance. **1**

Space for working and answer

$20\,\Omega$

4. Logic gates are widely used in electronic circuits.

(a) A pinout for a 74 series logic chip is shown below.



(i) Using information from the data sheet, identify the **integrated circuit** (IC) shown. 1

NOR IC

(ii) Identify an **output** pin on the integrated layout diagram above. 1

7

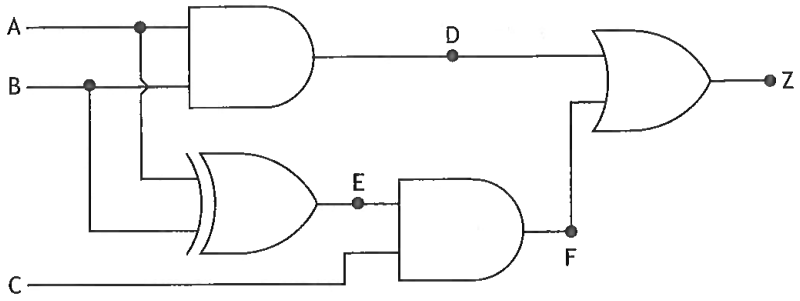
(iii) With reference to logic gate **A**, on the above pinout diagram, pins 12 and 13 have a logic state of 0.

State the logic state at pin 11. 1

1

4. **(continued)**

(b) Complete the truth table for the logic circuit shown below. 4



A	B	C	D	E	F	Z
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	0	1	0	0
0	1	1	0	1	1	1
1	0	0	0	1	0	0
1	0	1	0	1	1	1
1	1	0	1	0	0	1
1	1	1	1	0	0	1

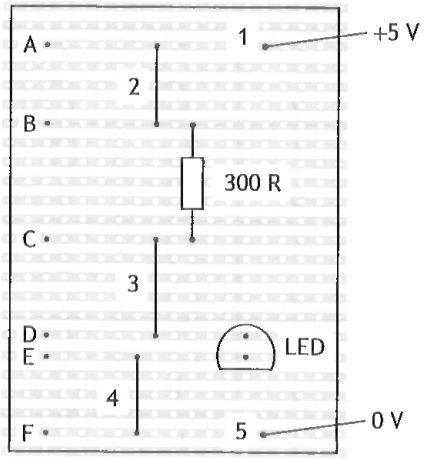
(An additional truth table, if required, can be found on *page 20*.)

5. (a) State an advantage of colour coding wires. 1

Easier To know what wire goes to Vsupply & OV rail.

(b) A student plans a stripboard layout of an LED in series with a resistor.

The layout, shown below, includes wires and test points. The wires are labelled one to five. The test points are marked A to F.



(i) The layout includes wires of different insulation colours: red, blue and black.

Identify the wire number that should have blue insulation. 1

3

5. (b) (continued)

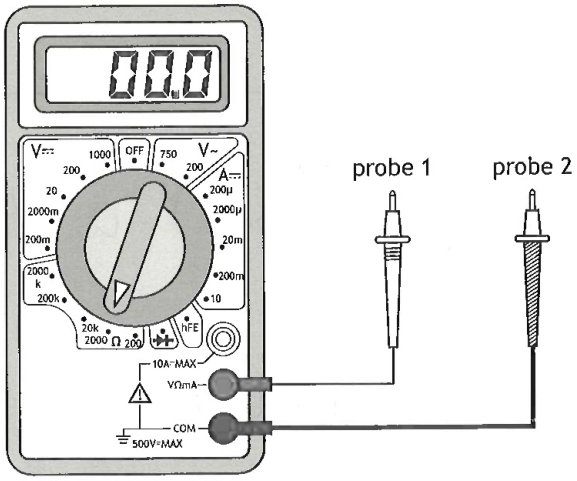
(ii) Explain the purpose of the resistor in the circuit. 1

To limit current in the circuit.

(iii) The student now constructs the circuit from part (b).

Before connecting the stripboard to the supply, the student tests for continuity using a multimeter.

The multimeter used is shown below and will sound a 'beep' to indicate continuity.

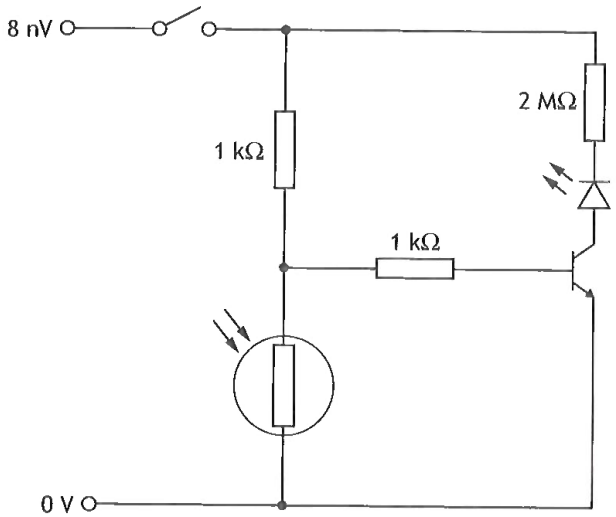


Describe how the above multimeter can be used to test for continuity between the LED and 0 V rail line on the student's stripboard. 3

- Can update components if not the same
- Multiple tests can show if results are the same / similar
- Can check voltage, resistance and current
- Check if Voltage supply is working properly

[Turn over

6. A student simulated the circuit shown.



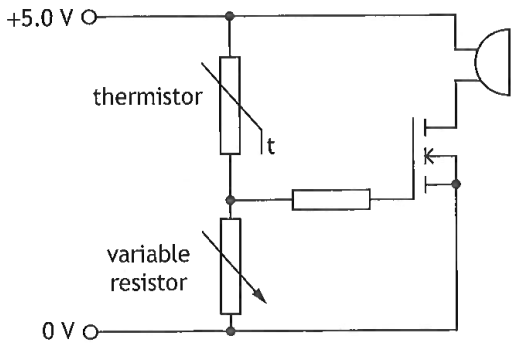
Identify three errors in this simulation. 3

Error 1: Vsupply (8nV) is too low

Error 2: LED orientation is wrong

Error 3: 2MΩ resistor value is too high

7. An alarm circuit has a buzzer that sounds when the temperature is too high.
The circuit diagram for the buzzer system is shown below.



(a) At a certain temperature, the thermistor has a resistance of 1000 Ω.
The variable resistor is set at a resistance of 1500 Ω.
Calculate the voltage across the variable resistor. 3
Space for working and answer

$$V_2 = \frac{R_2}{R_1 + R_2} \times V_S$$

$$V_2 = \frac{1500}{1000 + 1500} \times 5$$

$$V_2 = 3\,V$$

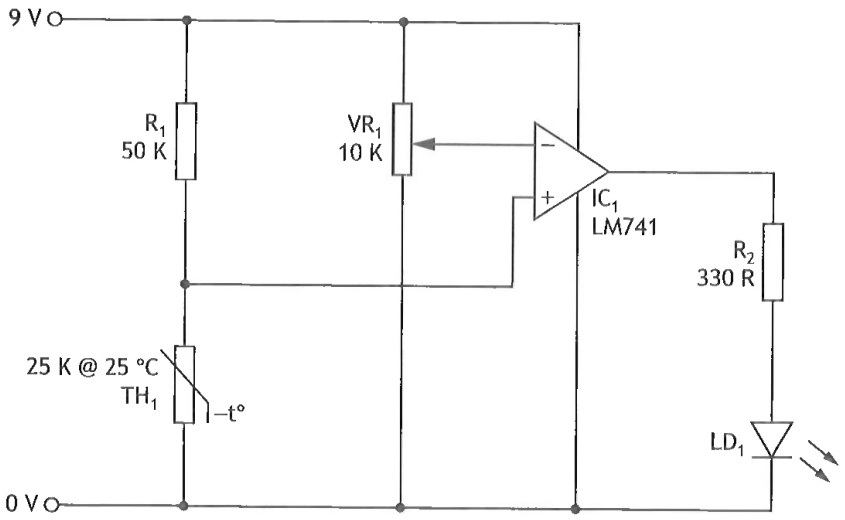
(b) Explain how the circuit operates to sound the buzzer. 3

- As the temperature of the thermistor increases, the thermistors resistance decreases
- As the resistance of the thermistor decreases, the thermistors voltage decreases
- The mosfet activates (activating the buzzer)

(c) State the purpose of the variable resistor in this circuit. 1

To vary the current in the circuit.

8. A student builds the circuit shown.



Using the information from the two suppliers' catalogues shown on the opposite page, complete the costings sheet below to produce the lowest cost for the circuit. 5

Supplier	Component	Product code	Cost (p)
JIMSON	LM741CN	TC 133	56
SWIFT	8 way DIL	SK-0080	10
SWIFT	LED 5 mm std	SC-0155	4
JIMSON	330 R	CR 656	1.2
JIMSON	50 K	CR 654	2.5
SWIFT	10 K potentiometer	PT-0744	55
JIMSON	thermistor	TH 116	22

(An additional costings sheet, if required, can be found on *page 20*.)

8. (continued)

Supplier — SWIFT				
	Component	Description	Product code	Cost
Integrated circuits	LM741CN	op-amp	IC-0258	75 p
	UA741CP	op-amp	IC-0267	41 p
	OP070CP	op-amp	IC-0234	110 p
	8 way DIL	IC socket	SK-0080	10 p
Semi-conductors	LED	5 mm std red	SC-0155	4 p
	LED	10 mm std red	SC-0177	10 p
Thermistor	thermistor	5 K @ 25 °C	BB-0545	65 p
	thermistor	10 K @ 25 °C	BB-0556	50 p
	thermistor	25 K @ 25 °C	BB-0568	28 p
Resistors	50 K	0.25 W carbon film 5%	FR-0855	2.8 p
	4K7	0.25 W carbon film 5%	FR-0856	2 p
	330 R	0.25 W carbon film 5%	FR-0857	1.5 p
Potentiometer	25 K	0.5 W trimmer	PT-0765	95 p
	10 K	0.5 W trimmer	PT-0744	55 p
	1 M	0.5 W trimmer	PT-0732	35 p

Supplier — JIMSON				
	Component	Description	Product code	Cost
Integrated circuits	LM741CN	op-amp	TC 133	56 p
	UA741CP	op-amp	TC 134	36 p
	OP070CP	op-amp	TC 135	105 p
	8 way DIL	IC socket	SK 090	30 p
Semi-conductors	LED	5 mm std red	LD 345	12 p
	LED	10 mm std red	LD 346	25 p
Thermistor	thermistor	5 K @ 25 °C	TH 114	32 p
	thermistor	10 K @ 25 °C	TH 115	45 p
	thermistor	25 K @ 25 °C	TH 116	22 p
Resistors	50 K	0.25 W carbon film 5%	CR 654	2.5 p
	4K7	0.25 W carbon film 5%	CR 655	1.7 p
	330 R	0.25 W carbon film 5%	CR 656	1.2 p
Potentiometer	25 K	0.5 W trimmer	VT 250	92 p
	10 K	0.5 W trimmer	VT 251	65 p
	1 M	0.5 W trimmer	VT 252	40 p

9. An engineer designs a system to control the temperature of the water in a tropical fish tank.

The system requires an electric heater to turn on when the temperature of the water becomes too cold.

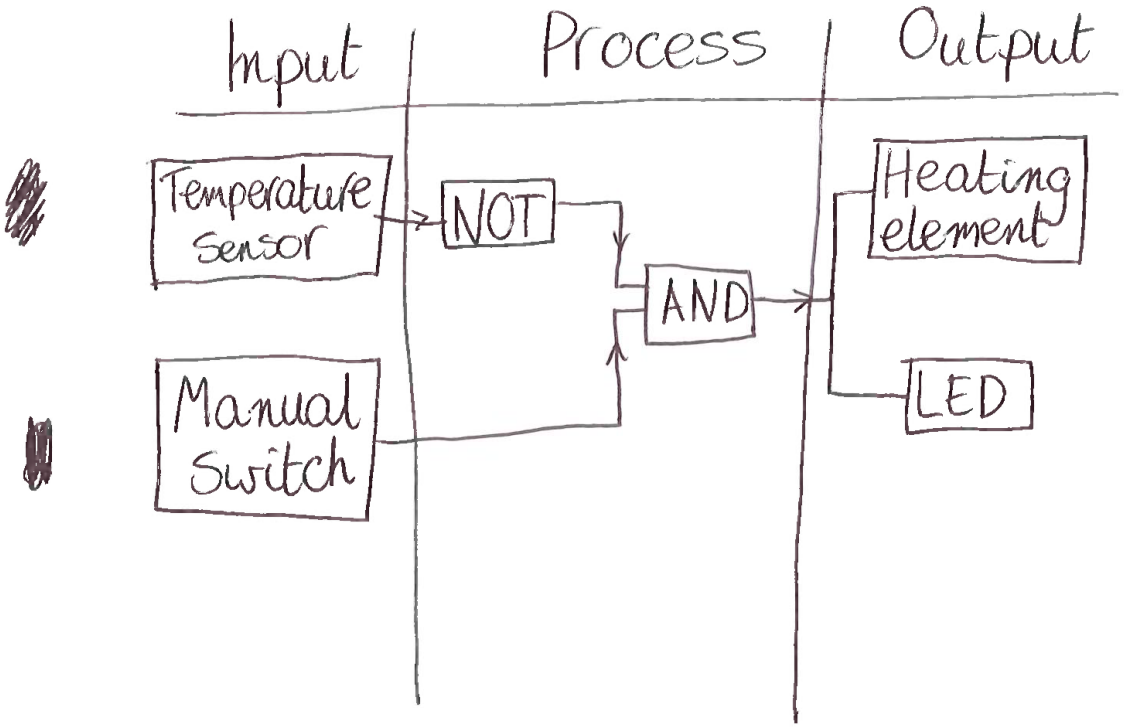
An LED should switch on when the heater is on.

There is also a manual switch to turn the whole system on and off.

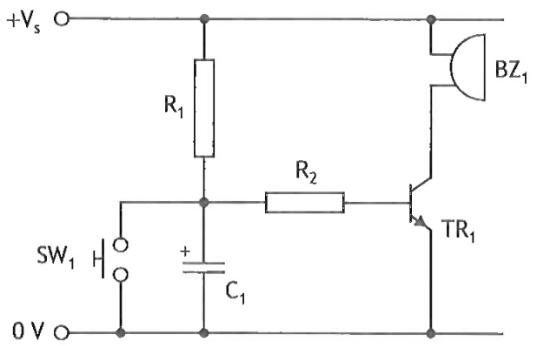
Selecting from the elements given, draw a block diagram of an electronic solution for this system.

On your diagram, clearly indicate the input, process and output sections of your solution. 6

heating element (requires a logic 1 to turn on)	NOT gate	temperature sensor (logic 0 when cold)	NOR gate	manual switch (logic 1 when closed)
AND gate	alarm (requires a logic 1 to turn on)	XOR gate	LED (requires a logic 1 to turn on)	light sensor (requires a logic 1 to turn on)

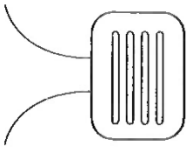


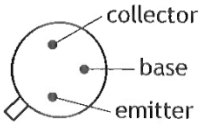
10. A time delay circuit is shown below.



Component data
R_1 — carbon film 10 kΩ 0.25 W
R_2 — carbon film 1 kΩ 0.25 W
C_1 — 2200 mF **electrolytic** capacitor
SW_1 — push-to-make switch
TR_1 — BC108 npn bipolar
BZ_1 — buzzer 6 V dc
TR_1 pin connections

buzzer with connecting wires





electrolytic capacitor



push-to-make switch



On the opposite page, a layout diagram includes the power rails and components TR_1 and R_2.

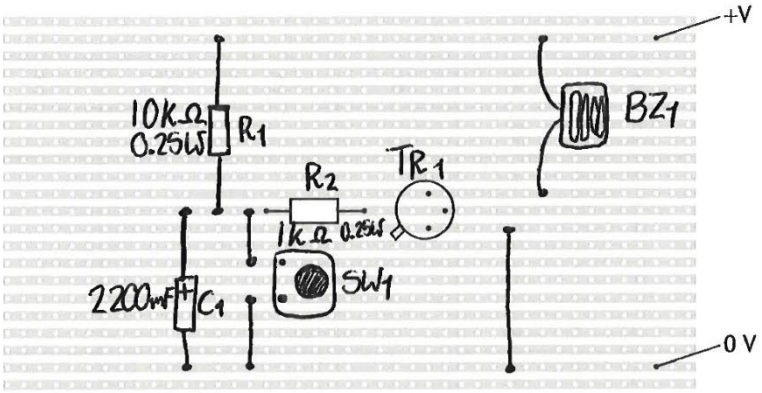
Complete the layout diagram with the remaining components.

Each component must be identified by a label.

Mark on the layout diagram, with an X, where a track has been cut. **5**

10. (continued)

layout diagram



(An additional layout diagram, if required, can be found on *page 21*.)

ADDITIONAL SPACE FOR ANSWERS

Additional truth table for question 4 (b)

A	B	C	D	E	F	Z
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

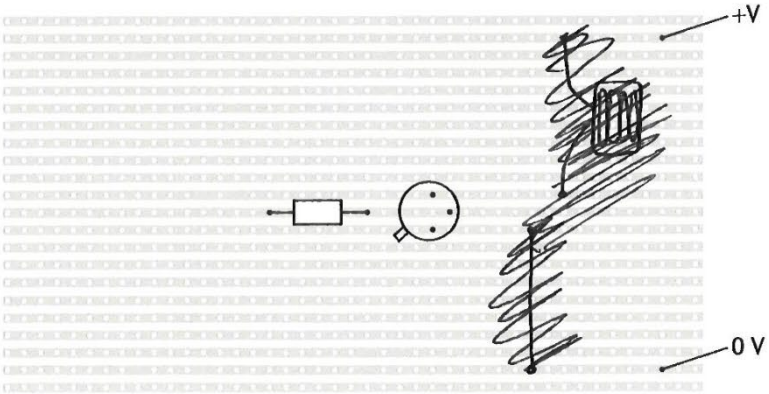
Additional costings sheet for question 8

Supplier	Component	Product code	Cost (p)
JIMSON	LM741CN	TC 133	56
SWIFT	8 way DIL	SK-0080	10
	LED 5 mm std		
	330 R		
	50 K		
	10 K potentiometer		
	thermistor		

ADDITIONAL SPACE FOR ANSWERS

Additional diagram for question 10

layout diagram



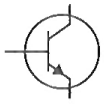
Candidate 4 evidence

Total marks — 60

Attempt ALL questions

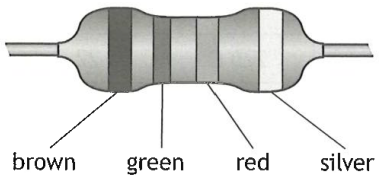
1. The table below gives information about some circuit components.
Some of the boxes have been left blank.

(a) Complete the table for the missing entries. 3

Component name	Symbol	Function
Bipolar transistor		electronic switch
Resistor		controls the current in a circuit
Ammeter		measures current in a circuit
Light dependent resistor (LDR)		Light intensity The higher the light intensity the resistance decreases LHD

1. **(continued)**

(b) The diagram below shows the colour coding for a resistor.



Using information from the data sheet, answer the questions below.

(i) Determine the resistance of the resistor. 1

1500Ω

(ii) State the percentage tolerance of this resistor. 1

±10%

(iii) Determine the maximum and minimum resistance of this resistor in ohms. 2

Maximum = 1650Ω

Minimum = 1350Ω

1. (continued)

(c) The table below shows possible values for the resistance of a resistor in different notations.

220 R	22
2.2 mΩ	2M2

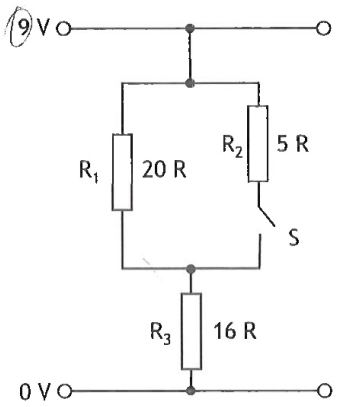
Identify which of the values shown is the largest value of resistance. **1**

2M2R is higher as 2,200,000R is more than 220R

2. State two safety precautions that must be taken when using a soldering iron. 2

Must be in a well ventilated room
Wear safety goggles
Ensure a heat proof mat is used
under ~~the~~ the equipment.

3. A circuit diagram is shown below.



(a) Switch S is **open.**

(i) Calculate the total resistance of this circuit. 1

Space for working and answer

$20 + 16$

$36\ \Omega$

(ii) Calculate the current in this circuit. 3

Space for working and answer

$V = I R$

$9 = I \mid 6$

$I = \frac{9}{16} = 1{\cdot}77\ A$

3. (a) (continued)

(iii) Calculate the power dissipated in resistor R_3. 3

Space for working and answer

$P = I^2R$

$P = (1.77)^2 16 = 50W$

(b) Switch S is now **closed.**

(i) Calculate the effective resistance of the two resistors in parallel. 3

Space for working and answer

$\frac{1}{R_T} = \frac{1}{20} + \frac{1}{5} = \frac{1}{20} + \frac{4}{20} = \frac{5}{20} = \frac{1}{4}$

4Ω

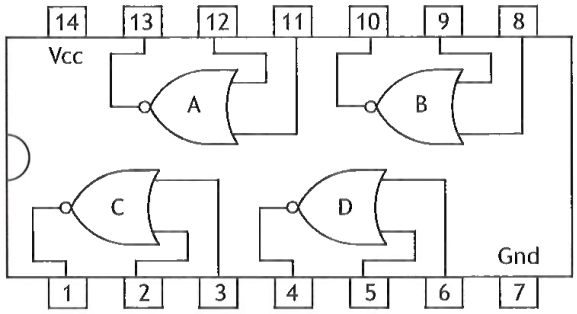
(ii) Calculate the overall circuit resistance. 1

Space for working and answer

20Ω

4. Logic gates are widely used in electronic circuits.

(a) A pinout for a 74 series logic chip is shown below.



(i) Using information from the data sheet, identify the **integrated circuit** (IC) shown. 1

7402 quad 2 input NOR gates

(ii) Identify an **output** pin on the integrated layout diagram above. 1

4

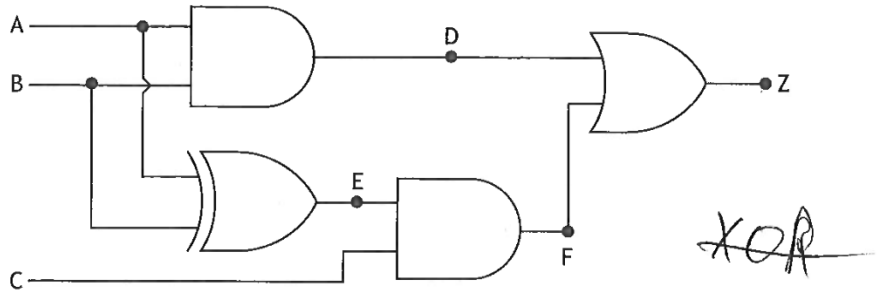
(iii) With reference to logic gate **A**, on the above pinout diagram, pins 12 and 13 have a logic state of 0.

State the logic state at pin 11. 1

1

4. **(continued)**

(b) Complete the truth table for the logic circuit shown below. 4



A	B	C	D	E	F	Z
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	0	1	0	0
0	1	1	0	1	1	1
1	0	0	0	1	0	0
1	0	1	0	1	1	1
1	1	0	1	0	0	1
1	1	1	1	0	0	1

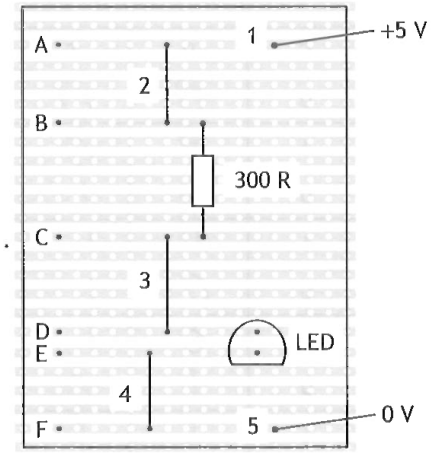
(An additional truth table, if required, can be found on *page 20*.)

5. (a) State an advantage of colour coding wires. **1**

Helps you identify which wires are the from +Vs and from the ground rail

(b) A student plans a stripboard layout of an LED in series with a resistor.

The layout, shown below, includes wires and test points. The wires are labelled one to five. The test points are marked A to F.



(i) The layout includes wires of different insulation colours: red, blue and black.

Identify the wire number that should have blue insulation. **1**

3

5. (b) (continued)

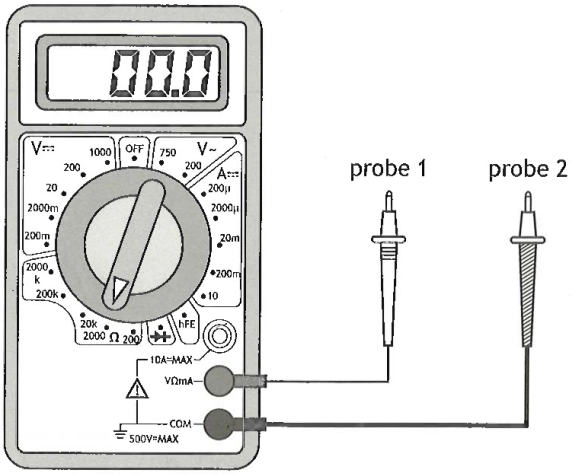
(ii) Explain the purpose of the resistor in the circuit. **1**

To prevent the LED from recieving too Much ~~Power~~ volts

(iii) The student now constructs the circuit from part (b).

Before connecting the stripboard to the supply, the student tests for continuity using a multimeter.

The multimeter used is shown below and will sound a 'beep' to indicate continuity.

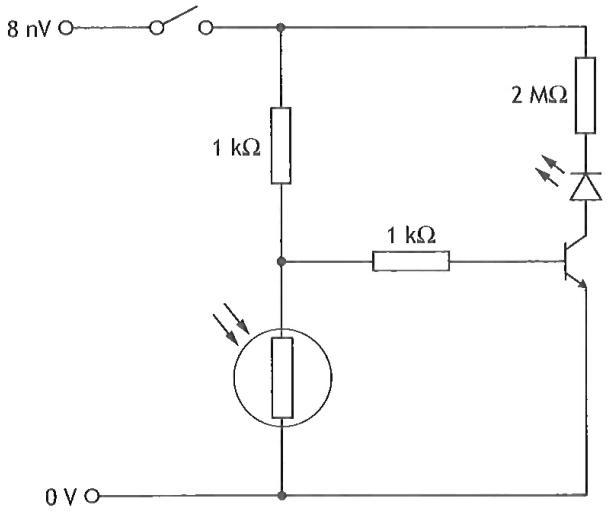


Describe how the above multimeter can be used to test for continuity between the LED and 0 V rail line on the student's stripboard. **3**

use additional answer -

The multimeter has to be set to the ⊶ (continuity) setting and probe one gets put on a selected place on that rail and probe 2 has to be puton the same rail. if it beeps' then the rail is connected and it is not broken.

6. A student simulated the circuit shown.



Identify three errors in this simulation. 3

Error 1:

Incorrect voltage supply as it is too low.

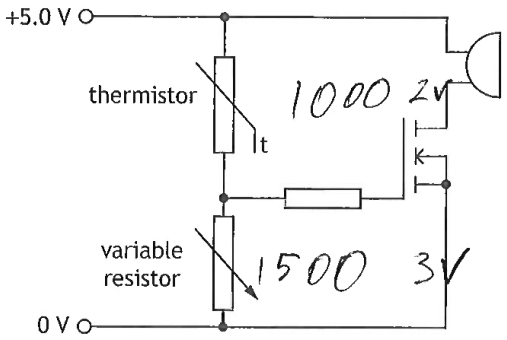
Error 2:

LED has the wrong orientation

Error 3:

Protective resistor resistance value is too high

7. An alarm circuit has a buzzer that sounds when the temperature is too high.
The circuit diagram for the buzzer system is shown below.



(a) At a certain temperature, the thermistor has a resistance of 1000 Ω.
The variable resistor is set at a resistance of 1500 Ω.
Calculate the voltage across the variable resistor. **3**
Space for working and answer

$$V_x = \frac{R_2}{R_1 + R_2} \times V_S$$

$$\frac{1500}{2500} \times 5 = 3V$$

(b) Explain how the circuit operates to sound the buzzer. **3**

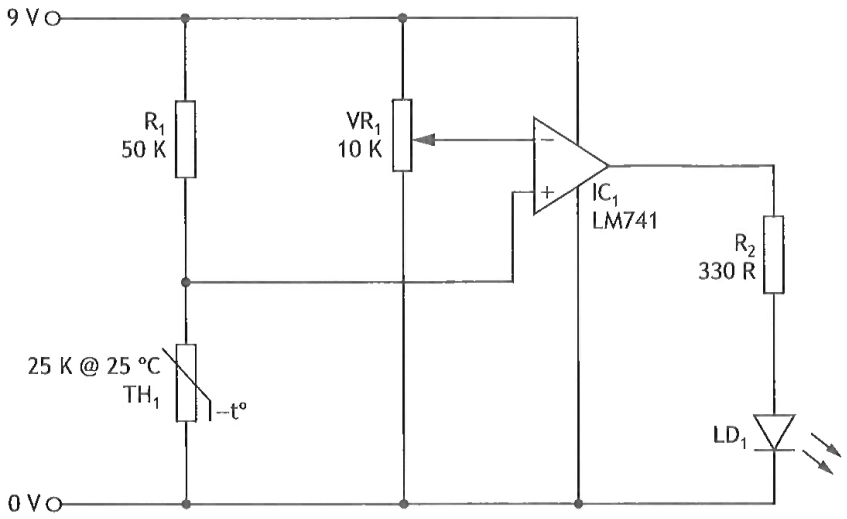
TVAD

~~*~~ when the thermistor's temperature goes up, the resistance decreases which ~~turns on the base~~ MOSFET allows voltage through the mosfet turning ~~on the buzzer~~ however if the temperature is low the resistance is high which does not turn on the buzzer

(c) State the purpose of the variable resistor in this circuit. **1**

It allows ~~the~~ to set the sensitivity of the ~~temperature~~ MOSFET allowing the buzzer to turn on at either higher or lower temperatures

8. A student builds the circuit shown.



Using the information from the two suppliers' catalogues shown on the opposite page, complete the costings sheet below to produce the **lowest** cost for the circuit. **5**

Supplier	Component	Product code	Cost (p)
JIMSON	LM741CN	TC 133	56
SWIFT	8 way DIL	SK-0080	10
SWIFT	LED 5 mm std	SC-0155	4
JIMSON	330 R	CR656	1·2
JIMSON	50 K	CR654	2·5
SWIFT	10 K potentiometer	PT-0744	55
JIMSON	thermistor	TH 116	22

(An additional costings sheet, if required, can be found on *page 20*.)

8. (continued)

Supplier — SWIFT				
	Component	Description	Product code	Cost
Integrated circuits	LM741CN	op-amp	IC-0258	75 p
	UA741CP	op-amp	IC-0267	41 p
	OP070CP	op-amp	IC-0234	110 p
	8 way DIL	IC socket	SK-0080	10 p
Semi-conductors	LED	5 mm std red	SC-0155	4 p
	LED	10 mm std red	SC-0177	10 p
Thermistor	thermistor	5 K @ 25 °C	BB-0545	65 p
	thermistor	10 K @ 25 °C	BB-0556	50 p
	thermistor	25 K @ 25 °C	BB-0568	28 p
Resistors	50 K	0.25 W carbon film 5%	FR-0855	2.8 p
	4K7	0.25 W carbon film 5%	FR-0856	2 p
	330 R	0.25 W carbon film 5%	FR-0857	1.5 p
Potentiometer	25 K	0.5 W trimmer	PT-0765	95 p
	10 K	0.5 W trimmer	PT-0744	55 p
	1 M	0.5 W trimmer	PT-0732	35 p

Supplier — JIMSON				
	Component	Description	Product code	Cost
Integrated circuits	LM741CN	op-amp	TC 133	56 p
	UA741CP	op-amp	TC 134	36 p
	OP070CP	op-amp	TC 135	105 p
	8 way DIL	IC socket	SK 090	30 p
Semi-conductors	LED	5 mm std red	LD 345	12 p
	LED	10 mm std red	LD 346	25 p
Thermistor	thermistor	5 K @ 25 °C	TH 114	32 p
	thermistor	10 K @ 25 °C	TH 115	45 p
	thermistor	25 K @ 25 °C	TH 116	22 p
Resistors	50 K	0.25 W carbon film 5%	CR 654	2.5 p
	4K7	0.25 W carbon film 5%	CR 655	1.7 p
	330 R	0.25 W carbon film 5%	CR 656	1.2 p
Potentiometer	25 K	0.5 W trimmer	VT 250	92 p
	10 K	0.5 W trimmer	VT 251	65 p
	1 M	0.5 W trimmer	VT 252	40 p

9. An engineer designs a system to control the temperature of the water in a tropical fish tank.

The system requires an electric heater to turn on when the temperature of the water becomes too cold.

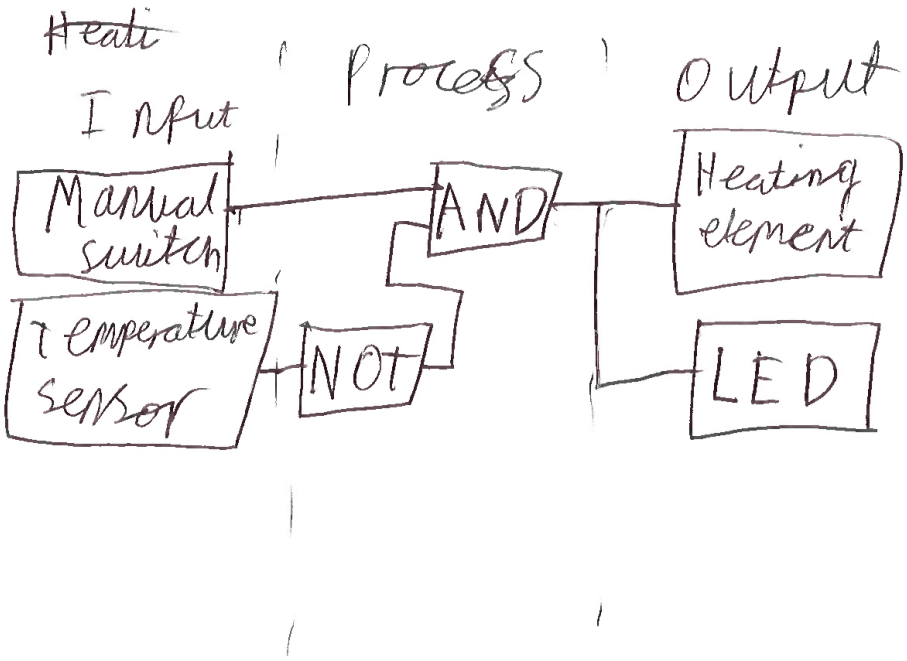
An LED should switch on when the heater is on.

There is also a manual switch to turn the whole system on and off.

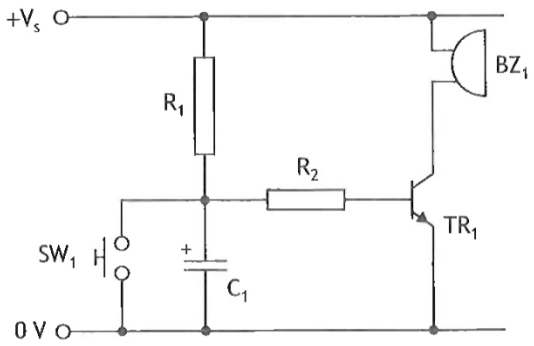
Selecting from the elements given, draw a block diagram of an electronic solution for this system.

On your diagram, clearly indicate the input, process and output sections of your solution. **6**

heating element (requires a logic 1 to turn on)	NOT gate	temperature sensor (logic 0 when cold)	NOR gate	manual switch (logic 1 when closed)
AND gate	alarm (requires a logic 1 to turn on)	XOR gate	LED (requires a logic 1 to turn on)	light sensor (requires a logic 1 to turn on)

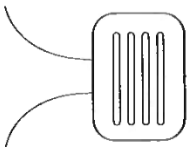


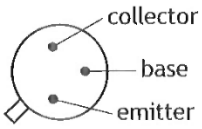
10. A time delay circuit is shown below.



Component data
R$_1$ — carbon film 10 kΩ 0.25 W
R$_2$ — carbon film 1 kΩ 0.25 W
C$_1$ — 2200 mF **electrolytic** capacitor
SW$_1$ — push-to-make switch
TR$_1$ — BC108 npn bipolar
BZ$_1$ — buzzer 6 V dc
TR$_1$ pin connections

buzzer with connecting wires





electrolytic capacitor



push-to-make switch



On the opposite page, a layout diagram includes the power rails and components TR$_1$ and R$_2$.

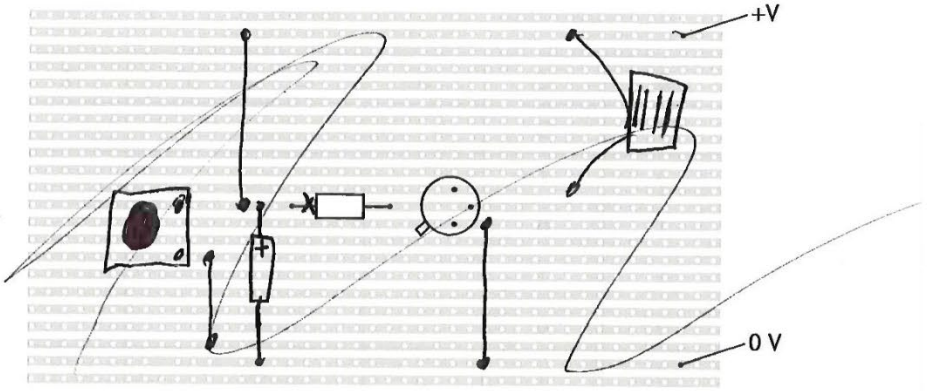
Complete the layout diagram with the remaining components.

Each component must be identified by a label.

Mark on the layout diagram, with an X, where a track has been cut. **5**

10. (continued)

layout diagram



(An additional layout diagram, if required, can be found on *page 21*.)

use additional diagram

[END OF QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS

Additional truth table for question 4 (b)

A	B	C	D	E	F	Z
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

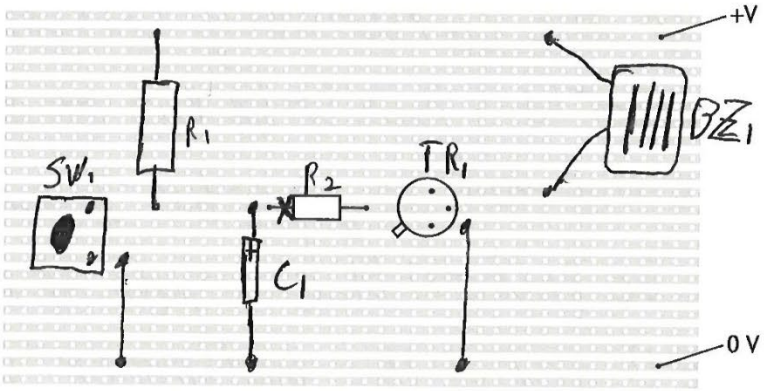
Additional costings sheet for question 8

Supplier	Component	Product code	Cost (p)
JIMSON	LM741CN	TC 133	56
SWIFT	8 way DIL	SK-0080	10
	LED 5 mm std		
	330 R		
	50 K		
	10 K potentiometer		
	thermistor		

ADDITIONAL SPACE FOR ANSWERS

Additional diagram for question 10

layout diagram



ADDITIONAL SPACE FOR ANSWERS

5 b (iii) The multimeter has to be set to the continuity setting and probe 1 has to be put on the ground rail and probe 2 needs to be put on the + side of the LED and if the multimeter 'beeps' then there is continuity and the LED has the correct orientation.

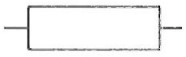
Candidate 5 evidence

Total marks — 60

Attempt ALL questions

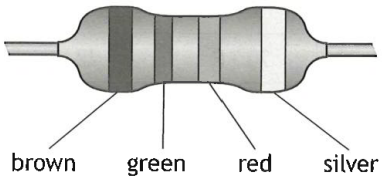
1. The table below gives information about some circuit components.
Some of the boxes have been left blank.

(a) Complete the table for the missing entries. 3

Component name	Symbol	Function
Bipolar transistor		electronic switch
Resistor		controls the current in a circuit
Ammeter		measures current in a circuit
Light dependent resistor (LDR)		Senses dot a change in light level

1. **(continued)**

(b) The diagram below shows the colour coding for a resistor.



Using information from the data sheet, answer the questions below.

(i) Determine the resistance of the resistor. 1

1500 Ω

(ii) State the percentage tolerance of this resistor. 1

± 5%

(iii) Determine the maximum and minimum resistance of this resistor in ohms. 2

Max 1575 Ω

Min 1425 Ω

1. **(continued)**

(c) The table below shows possible values for the resistance of a resistor in different notations.

220 R	22
2.2 mΩ	2M2

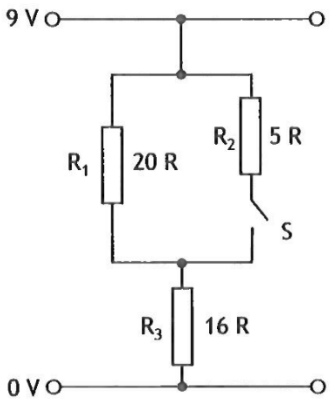
Identify which of the values shown is the **largest** value of resistance. **1**

2 M2 Ω

2. State two safety precautions that must be taken when using a soldering iron. 2

make sure there is ventilation
make sure you have a soldering iron stand and make sure you have a heat pad and your wire is secure and out the way

3. A circuit diagram is shown below.



(a) Switch S is **open**.

(i) Calculate the total resistance of this circuit. **1**

Space for working and answer

$20 + 16$

$= 36\ \Omega$

(ii) Calculate the current in this circuit. **3**

Space for working and answer

$V = I R$

$I = \frac{V}{R}$

$I = \frac{9}{36} = 4\ A$

3. (a) (continued)

(iii) Calculate the power dissipated in resistor R_3. **3**

Space for working and answer

$P = 1 V$

$P = 4 \times 9$

$P = 36 W$

(b) Switch S is now **closed**.

(i) Calculate the effective resistance of the two resistors in parallel. **3**

Space for working and answer

$\frac{1}{RT} = \frac{1}{20} + \frac{1}{5}$

$RT = 4 \Omega$

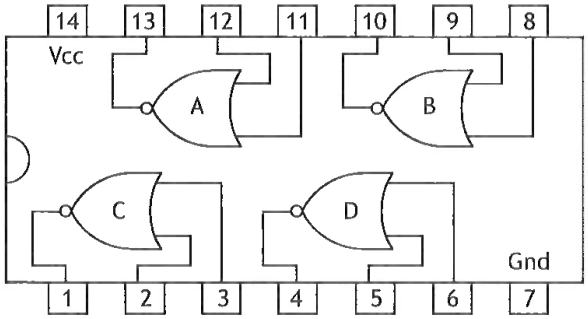
(ii) Calculate the overall circuit resistance. **1**

Space for working and answer

$16 + 4 = 20 \Omega$

4. Logic gates are widely used in electronic circuits.

(a) A pinout for a 74 series logic chip is shown below.



(i) Using information from the data sheet, identify the **integrated circuit** (IC) shown. 1

7402 quad 2 input NOR Gates

(ii) Identify an **output** pin on the integrated layout diagram above. 1

Pin 1

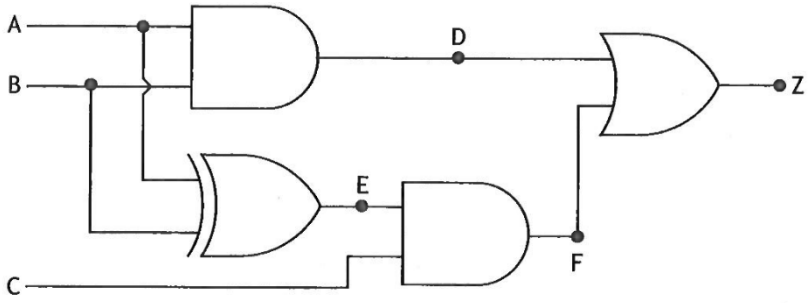
(iii) With reference to logic gate **A**, on the above pinout diagram, pins 12 and 13 have a logic state of 0.

State the logic state at pin 11. 1

1

4. (continued)

(b) Complete the truth table for the logic circuit shown below. **4**



A	B	C	D	E	F	Z
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	0	1	0	0
0	1	1	0	1	1	1
1	0	0	0	1	0	0
1	0	1	0	1	1	1
1	1	0	1	0	0	1
1	1	1	1	0	0	1

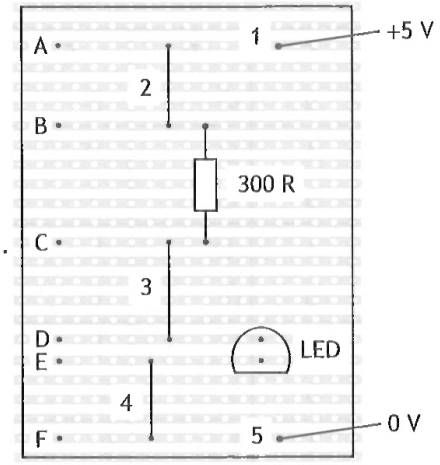
(An additional truth table, if required, can be found on *page 20.*)

5. (a) State an advantage of colour coding wires. 1

you are able to see which wires go where and their purpose

(b) A student plans a stripboard layout of an LED in series with a resistor.

The layout, shown below, includes wires and test points. The wires are labelled one to five. The test points are marked A to F.



(i) The layout includes wires of different insulation colours: red, blue and black.

Identify the wire number that should have blue insulation. 1

3

5. (b) (continued)

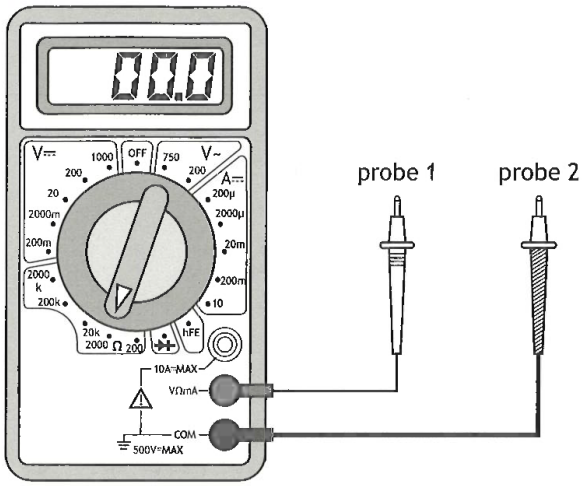
(ii) Explain the purpose of the resistor in the circuit. 1

protects the led

(iii) The student now constructs the circuit from part (b).

Before connecting the stripboard to the supply, the student tests for continuity using a multimeter.

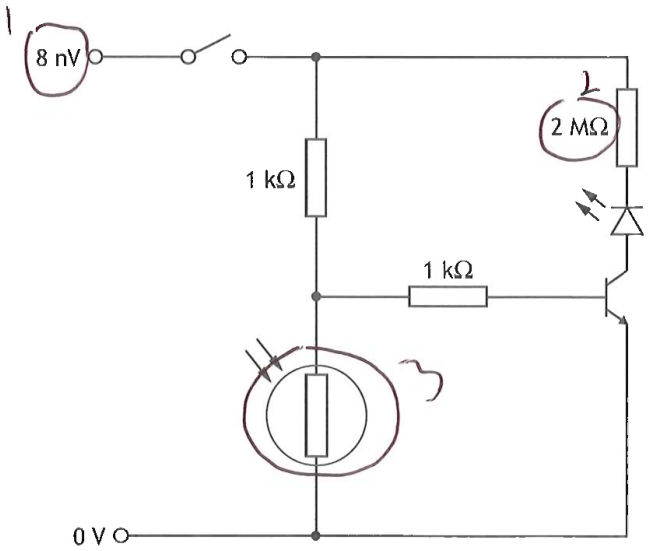
The multimeter used is shown below and will sound a 'beep' to indicate continuity.



Describe how the above multimeter can be used to test for continuity between the LED and 0 V rail line on the student's stripboard. 3

Checking it actual
Sums
Place the Probes at the
Led and 0V Rail

6. A student simulated the circuit shown.



Identify three errors in this simulation. **3**

Error 1:

Voltage too low

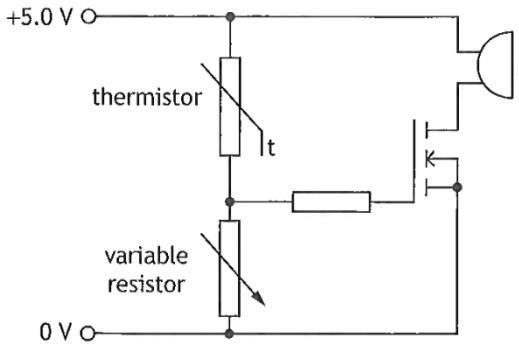
Error 2:

Resistance too high on the protective resistor

Error 3:

wrong symbol for LDR

7. An alarm circuit has a buzzer that sounds when the temperature is too high.
The circuit diagram for the buzzer system is shown below.



(a) At a certain temperature, the thermistor has a resistance of 1000 Ω.
The variable resistor is set at a resistance of 1500 Ω.
Calculate the voltage across the variable resistor. **3**
Space for working and answer

$V2 = \frac{R2}{R1+R2} \times V_S$ $= 3V$

$V2 = \frac{1500}{1000+1500} \times 5$

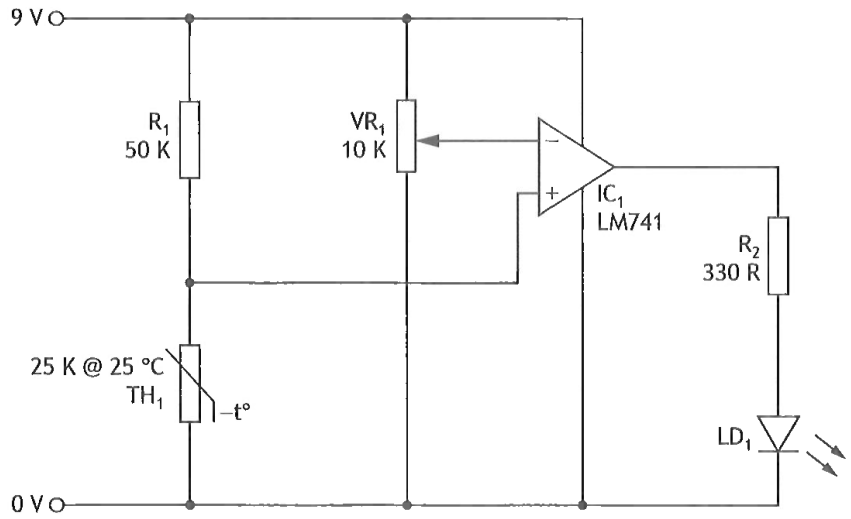
(b) Explain how the circuit operates to sound the buzzer. **3**

the thermistor senses too high a temperature which then the variable resistor resistance goes down then V in increases push to make saturates and buzzer sounds

(c) State the purpose of the variable resistor in this circuit. **1**

Change resistance to saturate other protective resistor

8. A student builds the circuit shown.



Using the information from the two suppliers' catalogues shown on the opposite page, complete the costings sheet below to produce the **lowest** cost for the circuit. **5**

Supplier	Component	Product code	Cost (p)
JIMSON	LM741CN	TC 133	56
SWIFT	8 way DIL	SK-0080	10
Swift	LED 5 mm std	SC-0155	4
Jimson	330 R	CR656	1.2
Jimson	50 K	CR659	2.5
Swift	10 K potentiometer	PT-0749	55
Jimson	thermistor	TH 116	22

(An additional costings sheet, if required, can be found on *page 20*.)

8. (continued)

Supplier — SWIFT				
	Component	Description	Product code	Cost
Integrated circuits	LM741CN	op-amp	IC-0258	75 p
	UA741CP	op-amp	IC-0267	41 p
	OP070CP	op-amp	IC-0234	110 p
	8 way DIL	IC socket	SK-0080	10 p
Semi-conductors	LED	5 mm std red	SC-0155	4 p
	LED	10 mm std red	SC-0177	10 p
Thermistor	thermistor	5 K @ 25 °C	BB-0545	65 p
	thermistor	10 K @ 25 °C	BB-0556	50 p
	thermistor	25 K @ 25 °C	BB-0568	28 p
Resistors	50 K	0.25 W carbon film 5%	FR-0855	2.8 p
	4K7	0.25 W carbon film 5%	FR-0856	2 p
	330 R	0.25 W carbon film 5%	FR-0857	1.5 p
Potentiometer	25 K	0.5 W trimmer	PT-0765	95 p
	10 K	0.5 W trimmer	PT-0744	55 p
	1 M	0.5 W trimmer	PT-0732	35 p

Supplier — JIMSON				
	Component	Description	Product code	Cost
Integrated circuits	LM741CN	op-amp	TC 133	56 p
	UA741CP	op-amp	TC 134	36 p
	OP070CP	op-amp	TC 135	105 p
	8 way DIL	IC socket	SK 090	30 p
Semi-conductors	LED	5 mm std red	LD 345	12 p
	LED	10 mm std red	LD 346	25 p
Thermistor	thermistor	5 K @ 25 °C	TH 114	32 p
	thermistor	10 K @ 25 °C	TH 115	45 p
	thermistor	25 K @ 25 °C	TH 116	22 p
Resistors	50 K	0.25 W carbon film 5%	CR 654	2.5 p
	4K7	0.25 W carbon film 5%	CR 655	1.7 p
	330 R	0.25 W carbon film 5%	CR 656	1.2 p
Potentiometer	25 K	0.5 W trimmer	VT 250	92 p
	10 K	0.5 W trimmer	VT 251	65 p
	1 M	0.5 W trimmer	VT 252	40 p

9. An engineer designs a system to control the temperature of the water in a tropical fish tank.

The system requires an electric heater to turn on when the temperature of the water becomes too cold.

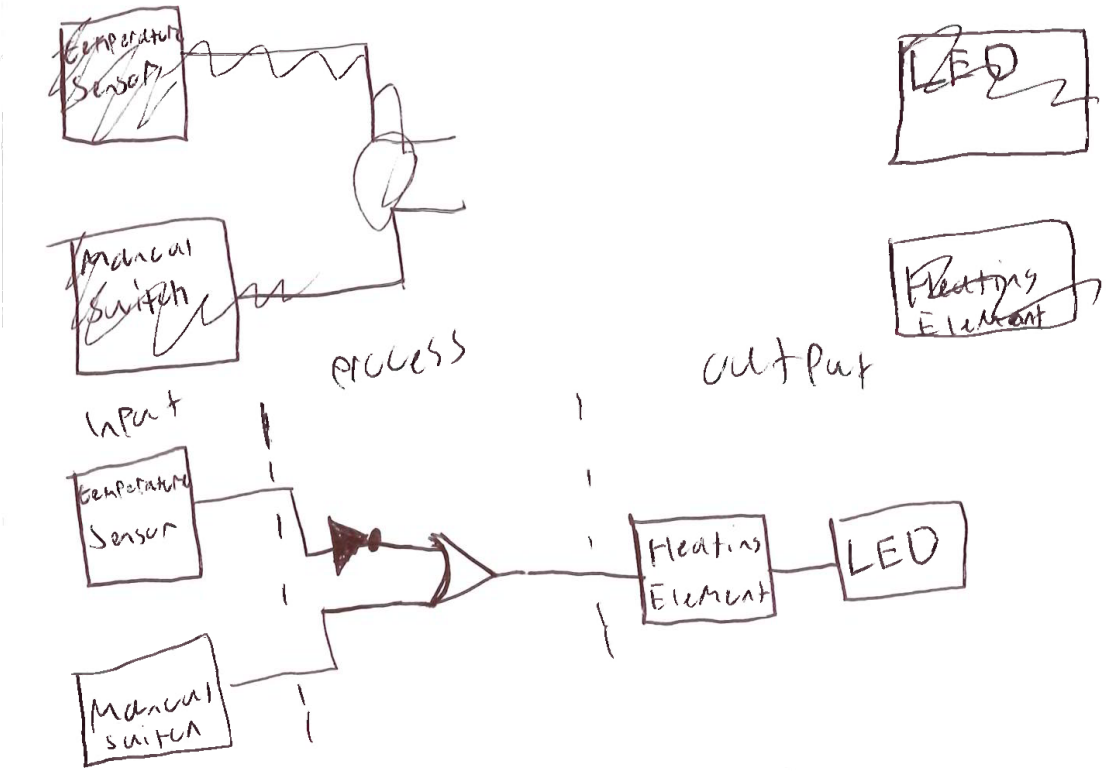
An LED should switch on when the heater is on.

There is also a manual switch to turn the whole system on and off.

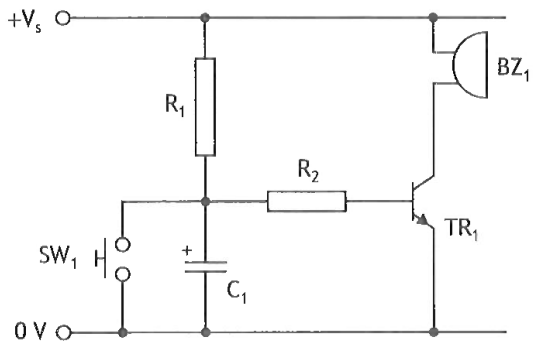
Selecting from the elements given, draw a block diagram of an electronic solution for this system.

On your diagram, clearly indicate the input, process and output sections of your solution. 6

heating element (requires a logic 1 to turn on)	NOT gate	temperature sensor (logic 0 when cold)	NOR gate	manual switch (logic 1 when closed)
AND gate	alarm (requires a logic 1 to turn on)	XOR gate	LED (requires a logic 1 to turn on)	light sensor (requires a logic 1 to turn on)

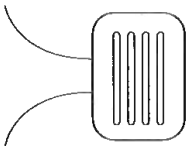


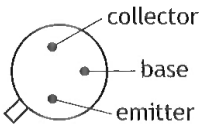
10. A time delay circuit is shown below.



Component data
R$_1$ — carbon film 10 kΩ 0.25 W
R$_2$ — carbon film 1 kΩ 0.25 W
C$_1$ — 2200 mF **electrolytic** capacitor
SW$_1$ — push-to-make switch
TR$_1$ — BC108 npn bipolar
BZ$_1$ — buzzer 6 V dc
TR$_1$ pin connections

buzzer with connecting wires





electrolytic capacitor



push-to-make switch



On the opposite page, a layout diagram includes the power rails and components TR$_1$ and R$_2$.

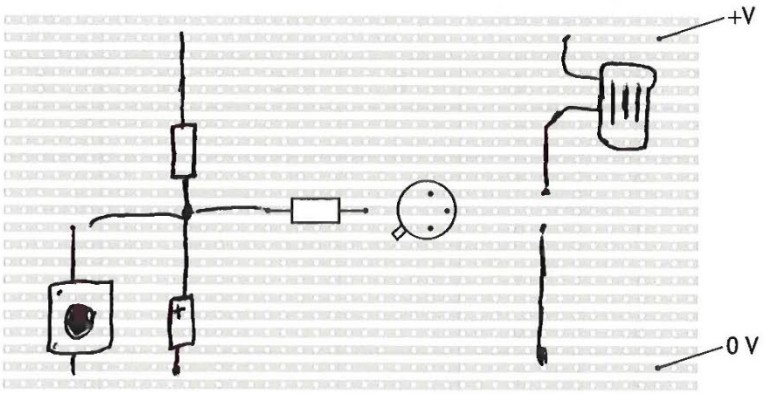
Complete the layout diagram with the remaining components.

Each component must be identified by a label.

Mark on the layout diagram, with an X, where a track has been cut. **5**

10. (continued)

layout diagram



(An additional layout diagram, if required, can be found on *page 21.*)

ADDITIONAL SPACE FOR ANSWERS

Additional truth table for question 4 (b)

A	B	C	D	E	F	Z
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

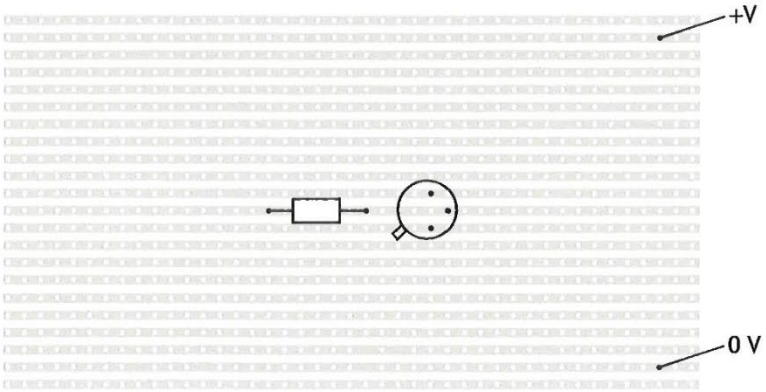
Additional costings sheet for question 8

Supplier	Component	Product code	Cost (p)
JIMSON	LM741CN	TC 133	56
SWIFT	8 way DIL	SK-0080	10
	LED 5 mm std		
	330 R		
	50 K		
	10 K potentiometer		
	thermistor		

ADDITIONAL SPACE FOR ANSWERS

Additional diagram for question 10

layout diagram

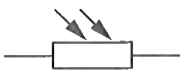


Candidate 6 evidence

Total marks — 60
Attempt ALL questions

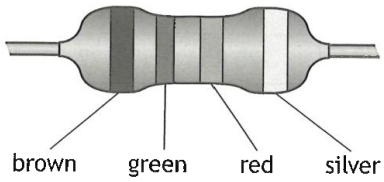
1. The table below gives information about some circuit components.
Some of the boxes have been left blank.

(a) Complete the table for the missing entries. 3

Component name	Symbol	Function
Bipolar transistor		electronic switch
Resistor		controls the current in a circuit
Ammeter		measures current in a circuit
Light dependent resistor (LDR)		changes resistance depending on light level

1. (continued)

(b) The diagram below shows the colour coding for a resistor.



Using information from the data sheet, answer the questions below.

(i) Determine the resistance of the resistor. **1**

15×10^2

$= 1500\ \Omega$

(ii) State the percentage tolerance of this resistor. **1**

$\pm 10\%$

(iii) Determine the maximum and minimum resistance of this resistor in ohms. **2**

Max. $= 1500 \times \frac{110}{100} = 1650\ \Omega$

Min. $= 1500 \times \frac{90}{100} = 1350\ \Omega$

1. **(continued)**

(c) The table below shows possible values for the resistance of a resistor in different notations.

220 R	22
2.2 mΩ	2M2

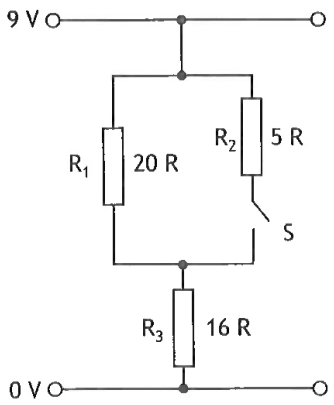
Identify which of the values shown is the **largest** value of resistance. 1

2M2

2. State two safety precautions that must be taken when using a soldering iron. 2

- Using an extractor fan
- Wearing safety glasses

3. A circuit diagram is shown below.



(a) Switch S is **open**.

(i) Calculate the total resistance of this circuit. 1

Space for working and answer

$20 + 16$

$= 36\ \Omega$

(ii) Calculate the current in this circuit. 3

Space for working and answer

$V = IR$

$I = \frac{V}{R} = \frac{9}{36} = \frac{1}{4} = 0.25\ A$

3. (a) (continued)

(iii) Calculate the power dissipated in resistor R_3. **3**

Space for working and answer

$P = I^2 R$

$= 0.25^2 \times 16$

$= 1W$

(b) Switch S is now **closed**.

(i) Calculate the effective resistance of the two resistors in parallel. **3**

Space for working and answer

$\frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2}$

$= \frac{1}{20} + \frac{1}{5}$

$= \frac{1}{20} + \frac{4}{20}$

$= \frac{5}{20} = \frac{1}{4}$ $\therefore R_t = 4\Omega$

(ii) Calculate the overall circuit resistance. **1**

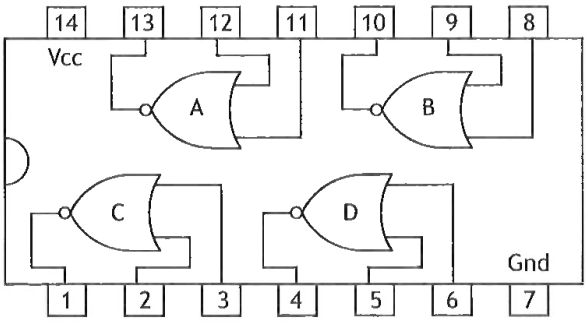
Space for working and answer

$4 + 16$

$= 20\Omega$

4. Logic gates are widely used in electronic circuits.

(a) A pinout for a 74 series logic chip is shown below.



(i) Using information from the data sheet, identify the **integrated circuit** (IC) shown. 1

7402 Quad 2-Input NOR gates

(ii) Identify an **output** pin on the integrated layout diagram above. 1

Pin 1

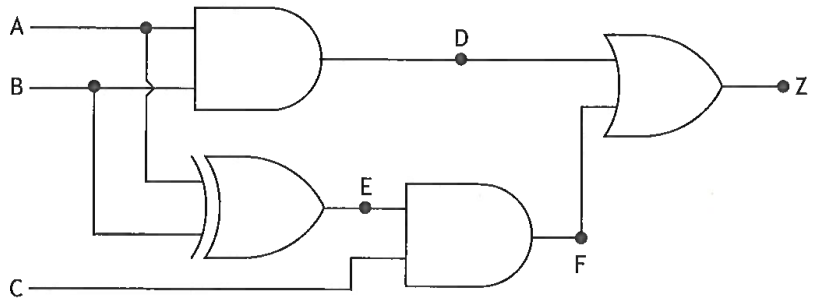
(iii) With reference to logic gate **A**, on the above pinout diagram, pins 12 and 13 have a logic state of 0.

State the logic state at pin 11. 1

logic level 1

4. **(continued)**

(b) Complete the truth table for the logic circuit shown below. 4



A	B	C	D	E	F	Z
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	0	1	0	0
0	1	1	0	1	1	1
1	0	0	0	1	0	0
1	0	1	0	1	1	1
1	1	0	1	0	0	1
1	1	1	1	0	0	1

(An additional truth table, if required, can be found on *page 20*.)

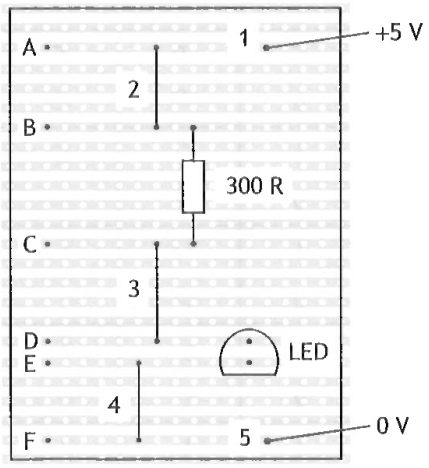
5. (a) State an advantage of colour coding wires. 1

~~It is easy to identify cables after passing them through spiral wrap.~~

Identifying signals during testing is made easier

(b) A student plans a stripboard layout of an LED in series with a resistor.

The layout, shown below, includes wires and test points. The wires are labelled one to five. The test points are marked A to F.



(i) The layout includes wires of different insulation colours: red, blue and black.

Identify the wire number that should have blue insulation. 1

Wire 3

5. (b) (continued)

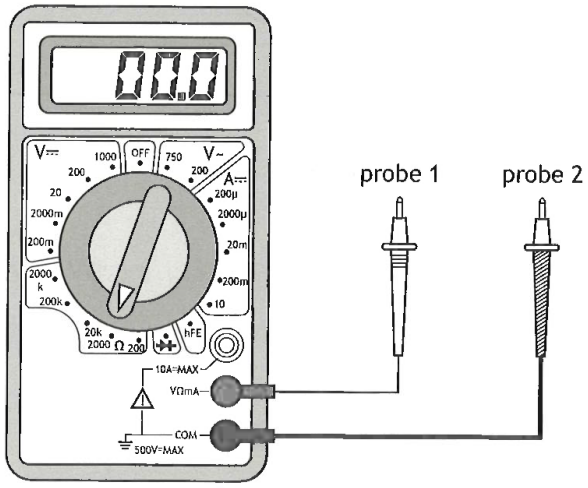
(ii) Explain the purpose of the resistor in the circuit. 1

To limit the current flowing through the LED to avoid burning it out.

(iii) The student now constructs the circuit from part (b).

Before connecting the stripboard to the supply, the student tests for continuity using a multimeter.

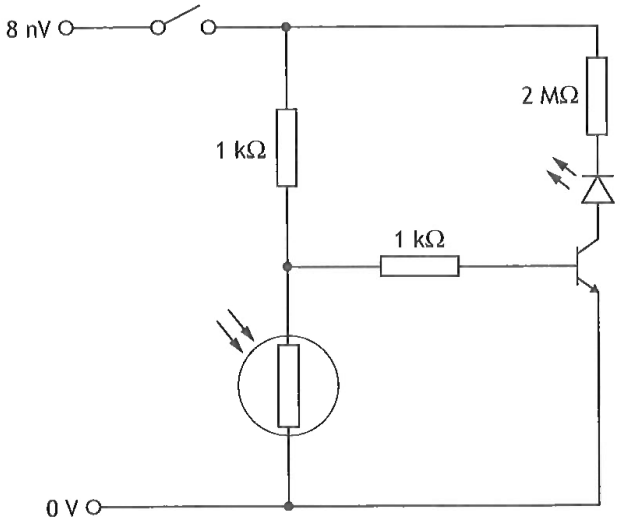
The multimeter used is shown below and will sound a 'beep' to indicate continuity.



Describe how the above multimeter can be used to test for continuity between the LED and 0 V rail line on the student's stripboard. 3

Probe 1 would be placed on test point E,
and probe 2 on test point F.
The mode would be changed to the marking "⏩"
~~If the reading drops from 1 to near-zero,~~
A beep will sound if continuity is present and the reading will drop from 1 to near zero.

6. A student simulated the circuit shown.



Identify three errors in this simulation. 3

Error 1:

The voltage of the power supply should be 8V not 8nV.

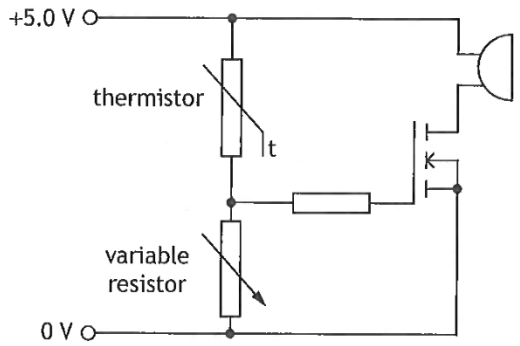
Error 2:

The LED's orientation is incorrect.

Error 3:

A 2MΩ protective resistor is far too high in value to be used here. 200Ω would be more suitable.

7. An alarm circuit has a buzzer that sounds when the temperature is too high.
The circuit diagram for the buzzer system is shown below.



(a) At a certain temperature, the thermistor has a resistance of 1000 Ω.
The variable resistor is set at a resistance of 1500 Ω.
Calculate the voltage across the variable resistor. **3**
Space for working and answer

$V_2 = \frac{R_2}{R_1 + R_2} \times V_S$

$= \frac{1500}{1500 + 1000} \times 5.0$

$= 3V$

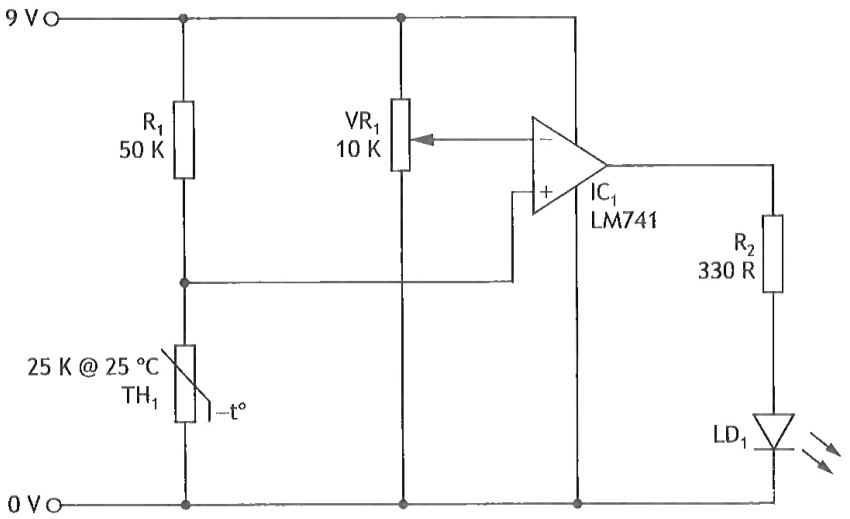
(b) Explain how the circuit operates to sound the buzzer. **3**

As the temperature increases, the thermistor's resistance decreases.
As a result, the voltage across the thermistor decreases and the voltage across the variable resistor increases.
and therefore the mosfet gate.
When the base voltage of the MOSFET passes 2V, it becomes on conducting and allows current to flow through the buzzer.

(c) State the purpose of the variable resistor in this circuit. **1**

To calibrate the circuit to trigger at the right temperature.

8. A student builds the circuit shown.



Using the information from the two suppliers' catalogues shown on the opposite page, complete the costings sheet below to produce the lowest cost for the circuit. 5

Supplier	Component	Product code	Cost (p)
JIMSON	LM741CN	TC 133	56
SWIFT	8 way DIL	SK-0080	10
SWIFT	LED 5 mm std	SC-0155	4
JIMSON	330 R	CR 656	1.2
JIMSON	50 K	CR 654	2.5
SWIFT	10 K potentiometer	PT-0704	55
JIMSON	thermistor	TH 116	22

(An additional costings sheet, if required, can be found on *page 20*.)

8. (continued)

Supplier — SWIFT				
	Component	**Description**	**Product code**	**Cost**
Integrated circuits	LM741CN	op-amp	IC-0258	75 p
	UA741CP	op-amp	IC-0267	41 p
	OP070CP	op-amp	IC-0234	110 p
	8 way DIL	IC socket	SK-0080	10 p
Semi-conductors	LED	5 mm std red	SC-0155	4 p
	LED	10 mm std red	SC-0177	10 p
Thermistor	thermistor	5 K @ 25 °C	BB-0545	65 p
	thermistor	10 K @ 25 °C	BB-0556	50 p
	thermistor	25 K @ 25 °C	BB-0568	28 p
Resistors	50 K	0.25 W carbon film 5%	FR-0855	2.8 p
	4K7	0.25 W carbon film 5%	FR-0856	2 p
	330 R	0.25 W carbon film 5%	FR-0857	1.5 p
Potentiometer	25 K	0.5 W trimmer	PT-0765	95 p
	10 K	0.5 W trimmer	PT-0744	55 p
	1 M	0.5 W trimmer	PT-0732	35 p

Supplier — JIMSON				
	Component	**Description**	**Product code**	**Cost**
Integrated circuits	LM741CN	op-amp	TC 133	56 p
	UA741CP	op-amp	TC 134	36 p
	OP070CP	op-amp	TC 135	105 p
	8 way DIL	IC socket	SK 090	30 p
Semi-conductors	LED	5 mm std red	LD 345	12 p
	LED	10 mm std red	LD 346	25 p
Thermistor	thermistor	5 K @ 25 °C	TH 114	32 p
	thermistor	10 K @ 25 °C	TH 115	45 p
	thermistor	25 K @ 25 °C	TH 116	22 p
Resistors	50 K	0.25 W carbon film 5%	CR 654	2.5 p
	4K7	0.25 W carbon film 5%	CR 655	1.7 p
	330 R	0.25 W carbon film 5%	CR 656	1.2 p
Potentiometer	25 K	0.5 W trimmer	VT 250	92 p
	10 K	0.5 W trimmer	VT 251	65 p
	1 M	0.5 W trimmer	VT 252	40 p

9. An engineer designs a system to control the temperature of the water in a tropical fish tank.

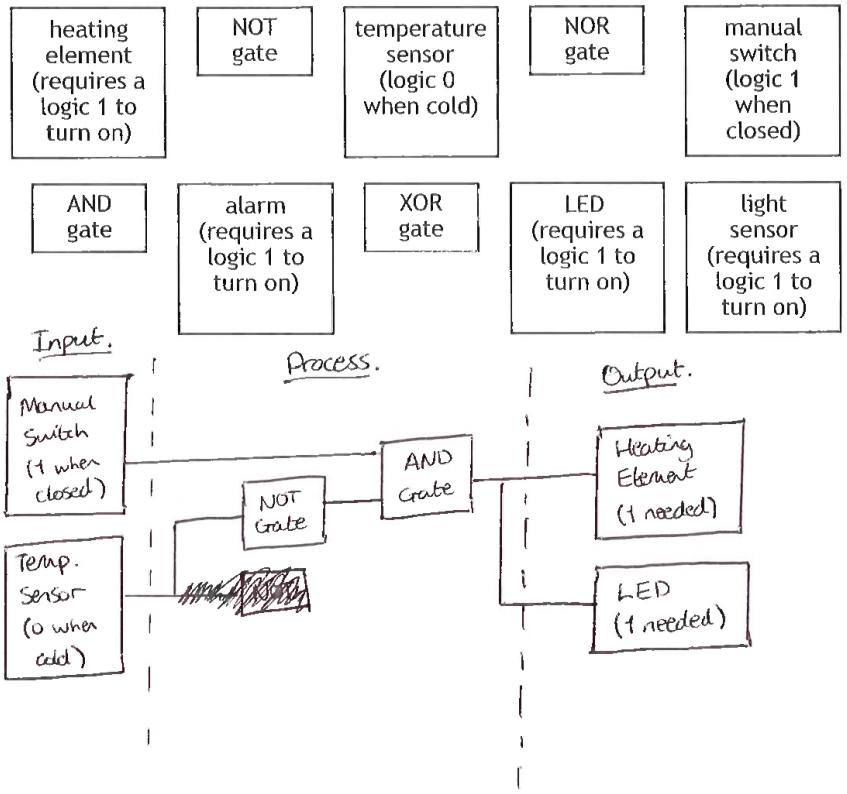
The system requires an electric heater to turn on when the temperature of the water becomes too cold.

An LED should switch on when the heater is on.

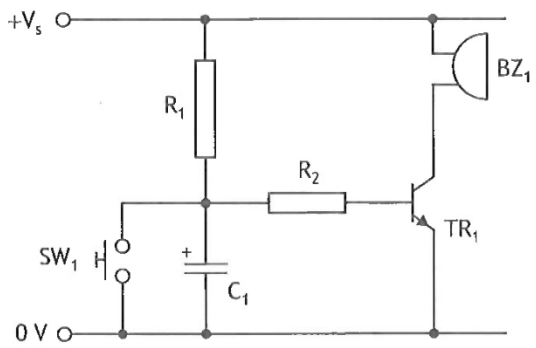
There is also a manual switch to turn the whole system on and off.

Selecting from the elements given, draw a block diagram of an electronic solution for this system.

On your diagram, clearly indicate the input, process and output sections of your solution. 6

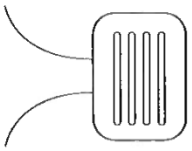


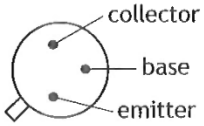
10. A time delay circuit is shown below.



Component data
R$_1$ — carbon film 10 kΩ 0.25 W
R$_2$ — carbon film 1 kΩ 0.25 W
C$_1$ — 2200 mF electrolytic capacitor
SW$_1$ — push-to-make switch
TR$_1$ — BC108 npn bipolar
BZ$_1$ — buzzer 6 V dc
TR$_1$ pin connections

buzzer with connecting wires





electrolytic capacitor



push-to-make switch



On the opposite page, a layout diagram includes the power rails and components TR$_1$ and R$_2$.

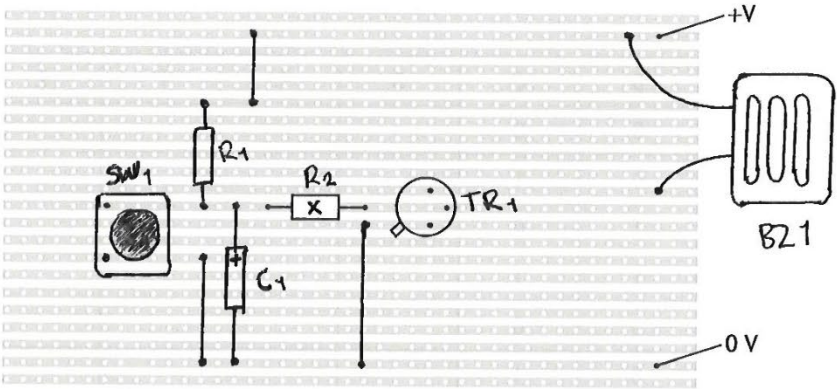
Complete the layout diagram with the remaining components.

Each component must be identified by a label.

Mark on the layout diagram, with an X, where a track has been cut. **5**

10. (continued)

layout diagram



(An additional layout diagram, if required, can be found on *page 21*.)

[END OF QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS

Additional truth table for question 4 (b)

A	B	C	D	E	F	Z
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

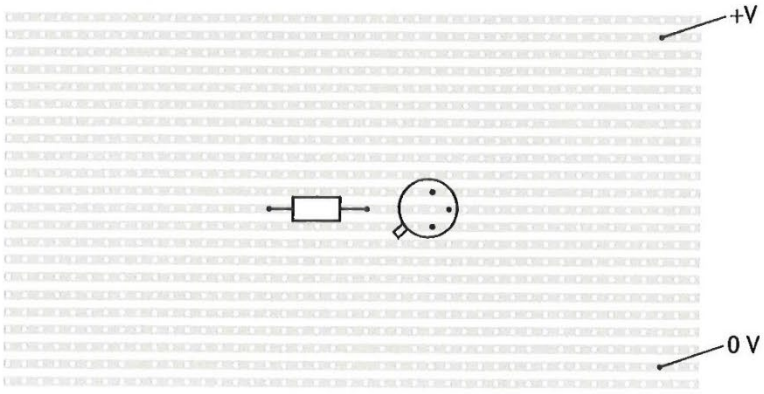
Additional costings sheet for question 8

Supplier	Component	Product code	Cost (p)
JIMSON	LM741CN	TC 133	56
SWIFT	8 way DIL	SK-0080	10
	LED 5 mm std		
	330 R		
	50 K		
	10 K potentiometer		
	thermistor		

ADDITIONAL SPACE FOR ANSWERS

Additional diagram for question 10

layout diagram

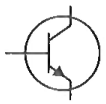


Candidate 7 evidence

Total marks — 60
Attempt ALL questions

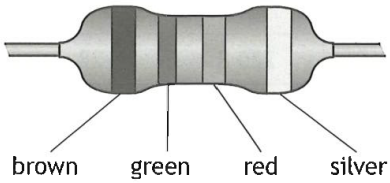
1. The table below gives information about some circuit components.
Some of the boxes have been left blank.

(a) Complete the table for the missing entries. 3

Component name	Symbol	Function
Bipolar transistor		electronic switch
Resistor		controls the current in a circuit
Ammeter		measures current in a circuit
Light dependent resistor (LDR)		Changes the Current in a Circuit depending on light level

1. **(continued)**

(b) The diagram below shows the colour coding for a resistor.



Using information from the data sheet, answer the questions below.

(i) Determine the resistance of the resistor. 1

1500 Ω

(ii) State the percentage tolerance of this resistor. 1

±10%.

(iii) Determine the maximum and minimum resistance of this resistor in ohms. 2

min 1350 Ω

max 1650 Ω

1. (continued)

(c) The table below shows possible values for the resistance of a resistor in different notations.

220 R	22
2.2 mΩ	2M2

Identify which of the values shown is the **largest** value of resistance. 1

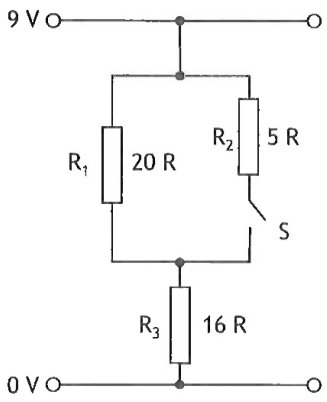
2M2

2. State two safety precautions that must be taken when using a soldering iron. **2**

. make Sure not to make Contact with the iron while its on.

. Always ~~with~~ wear Saftey goggles while Soldering.

3. A circuit diagram is shown below.



(a) Switch S is **open**.

(i) Calculate the total resistance of this circuit. **1**

Space for working and answer

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

$\frac{1}{R_T} = \frac{1}{20} + \frac{1}{5}$

$\frac{1}{R_T} = 0.25$

~~$R_T = 4\,\Omega$~~

$R_1 + R_2$

$4 + 16$

$= 20\,\Omega$

$R_1 + R_2$

$20 + 16$

$= 36\,\Omega$

(ii) Calculate the current in this circuit. **3**

Space for working and answer

$V = IR$

$V = 9$

$I = ?$

$R = 20$

$9 = I \times 20$

$\frac{9}{20} = I$

$I = 0.45\,A$

1. (a) (continued)

(iii) Calculate the power dissipated in resistor R_3. 3

Space for working and answer

$P = \frac{V^2}{R}$ $P = \frac{9^2}{36}$

$P = ?$ $P = 2.25W$

$V^2 = 9^2$

$R = 36$

(b) Switch S is now **closed**.

(i) Calculate the effective resistance of the two resistors in parallel. 3

Space for working and answer

$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} \cdots$

$\frac{1}{R_T} = \frac{1}{20} + \frac{1}{5}$

$\frac{1}{R_T} = 0.25$

$R_T = 4\Omega$



(ii) Calculate the overall circuit resistance. 1

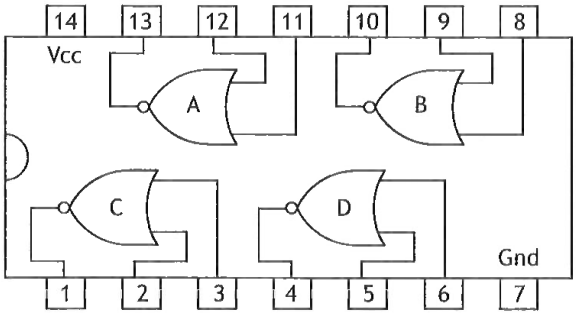
Space for working and answer

~~20Ω~~ $\rightarrow 4 + 16$

$R_1 + R_2 \cdots = 20\Omega$

4. Logic gates are widely used in electronic circuits.

(a) A pinout for a 74 series logic chip is shown below.



(i) Using information from the data sheet, identify the **integrated circuit** (IC) shown. 1

7402 Quad 2 input NOR gate

(ii) Identify an **output** pin on the integrated layout diagram above. 1

Pin 13

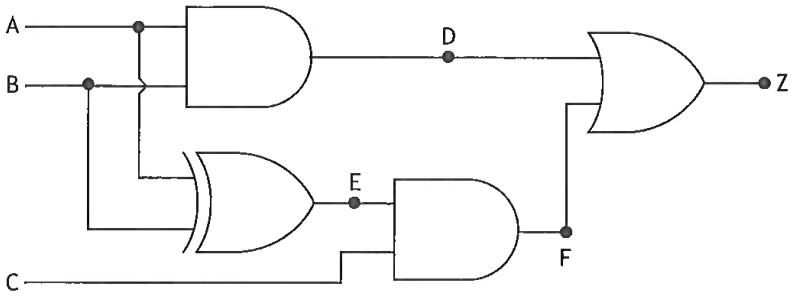
(iii) With reference to logic gate A, on the above pinout diagram, pins 12 and 13 have a logic state of 0.

State the logic state at pin 11. 1

1

4. **(continued)**

(b) Complete the truth table for the logic circuit shown below. 4



A	B	C	D	E	F	Z
0	0	0	0	0	0	0
0	0	1	0	0	0	0
0	1	0	0	1	0	0
0	1	1	0	1	1	1
1	0	0	0	1	0	0
1	0	1	0	1	1	1
1	1	0	1	0	0	1
1	1	1	1	0	0	1

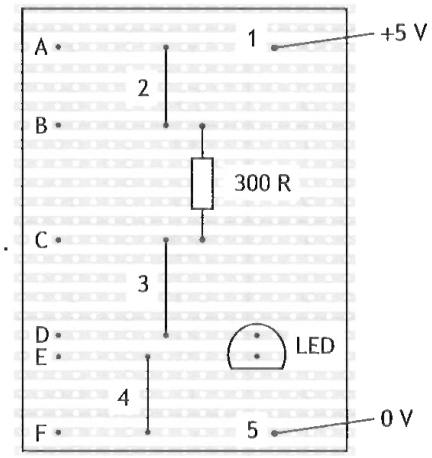
(An additional truth table, if required, can be found on *page 20*.)

5. (a) State an advantage of colour coding wires. 1

to distinguish their different purposes & Placements incase of tanglement or a lot of wires

(b) A student plans a stripboard layout of an LED in series with a resistor.

The layout, shown below, includes wires and test points. The wires are labelled one to five. The test points are marked A to F.



(i) The layout includes wires of different insulation colours: red, blue and black.

Identify the wire number that should have blue insulation. 1

3

5. (b) (continued)

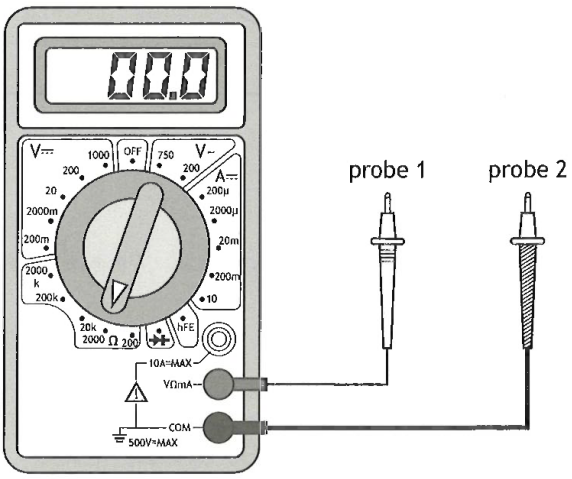
(ii) Explain the purpose of the resistor in the circuit. 1

So the LED doesn't go over it's threshold

(iii) The student now constructs the circuit from part (b).

Before connecting the stripboard to the supply, the student tests for continuity using a multimeter.

The multimeter used is shown below and will sound a 'beep' to indicate continuity.

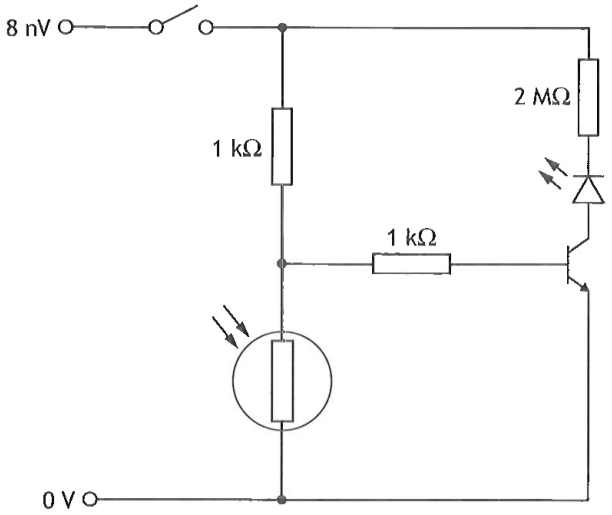


Describe how the above multimeter can be used to test for continuity between the LED and 0 V rail line on the student's stripboard. 3

Place probe 1 on the wire end that connects to the LED on wire 4

Place probe 2 on either the other wire end on wire 4, or on the 0V wire

6. A student simulated the circuit shown.



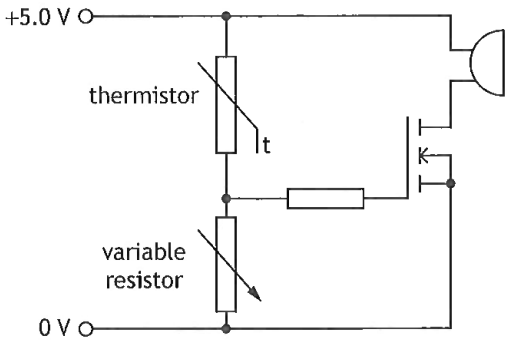
Identify three errors in this simulation. **3**

Error 1:
There is no LED units or readings

Error 2:
The Supply voltage is way too small of a unit to be used

Error 3:
The LED is facing the wrong way

7. An alarm circuit has a buzzer that sounds when the temperature is too high.
The circuit diagram for the buzzer system is shown below.



(a) At a certain temperature, the thermistor has a resistance of 1000 Ω.
The variable resistor is set at a resistance of 1500 Ω.
Calculate the voltage across the variable resistor. 3

Space for working and answer

$V_2 = \frac{R_2}{R_1 + R_2} \times V_S$

$R_1 = 1000\,\Omega$
$R_2 = 1500\,\Omega$
$V_S = 5\,V$

$V_2 = \frac{1500}{1000+1500} \times 5$

$V_2 = 3V$

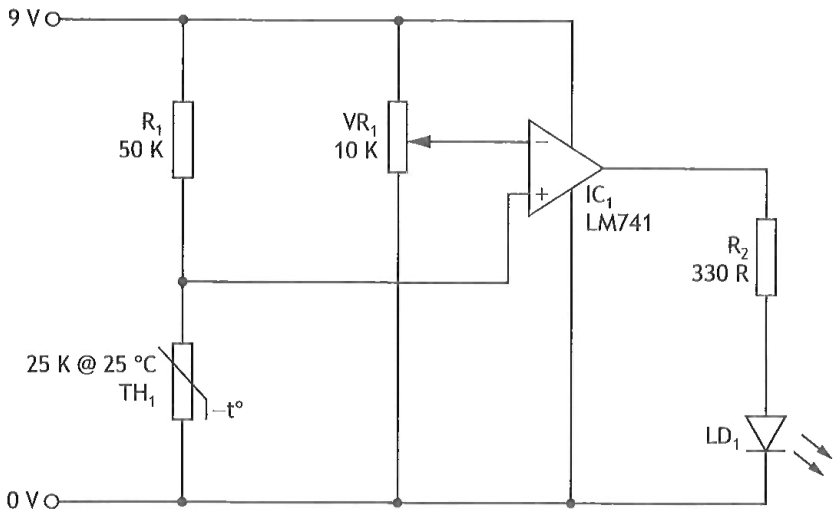
(b) Explain how the circuit operates to sound the buzzer. 3

As the temperature ~~os~~ increases, the resistance decreases. Causing the PTM switch to activate making more current flow into the buzzer, making it louder.

(c) State the purpose of the variable resistor in this circuit. 1

to be able to change the resistance, & make the buzzer make either louder, or quieter sounds.

8. A student builds the circuit shown.



Using the information from the two suppliers' catalogues shown on the opposite page, complete the costings sheet below to produce the **lowest** cost for the circuit. **5**

Supplier	Component	Product code	Cost (p)
JIMSON	LM741CN	TC 133	56
SWIFT	8 way DIL	SK-0080	10
SWIFT	LED 5 mm std	SC-0155	4
JIMSON	330 R	CR 656	1.2
JIMSON	50 K	CR 654	2.5
SWIFT	10 K potentiometer	PT-0744	55
JIMSON	thermistor	TH 116	22

(An additional costings sheet, if required, can be found on *page 20*.)

8. (continued)

Supplier — SWIFT				
	Component	**Description**	**Product code**	**Cost**
Integrated circuits	LM741CN	op-amp	IC-0258	75 p
	UA741CP	op-amp	IC-0267	41 p
	OP070CP	op-amp	IC-0234	110 p
	8 way DIL	IC socket	SK-0080	10 p
Semi-conductors	LED	5 mm std red	SC-0155	4 p
	LED	10 mm std red	SC-0177	10 p
Thermistor	thermistor	5 K @ 25 °C	BB-0545	65 p
	thermistor	10 K @ 25 °C	BB-0556	50 p
	thermistor	25 K @ 25 °C	BB-0568	28 p
Resistors	50 K	0.25 W carbon film 5%	FR-0855	2.8 p
	4K7	0.25 W carbon film 5%	FR-0856	2 p
	330 R	0.25 W carbon film 5%	FR-0857	1.5 p
Potentiometer	25 K	0.5 W trimmer	PT-0765	95 p
	10 K	0.5 W trimmer	PT-0744	55 p
	1 M	0.5 W trimmer	PT-0732	35 p

Supplier — JIMSON				
	Component	**Description**	**Product code**	**Cost**
Integrated circuits	LM741CN	op-amp	TC 133	56 p
	UA741CP	op-amp	TC 134	36 p
	OP070CP	op-amp	TC 135	105 p
	8 way DIL	IC socket	SK 090	30 p
Semi-conductors	LED	5 mm std red	LD 345	12 p
	LED	10 mm std red	LD 346	25 p
Thermistor	thermistor	5 K @ 25 °C	TH 114	32 p
	thermistor	10 K @ 25 °C	TH 115	45 p
	thermistor	25 K @ 25 °C	TH 116	22 p
Resistors	50 K	0.25 W carbon film 5%	CR 654	2.5 p
	4K7	0.25 W carbon film 5%	CR 655	1.7 p
	330 R	0.25 W carbon film 5%	CR 656	1.2 p
Potentiometer	25 K	0.5 W trimmer	VT 250	92 p
	10 K	0.5 W trimmer	VT 251	65 p
	1 M	0.5 W trimmer	VT 252	40 p

9. An engineer designs a system to control the temperature of the water in a tropical fish tank.

The system requires an electric heater to turn on when the temperature of the water becomes too cold.

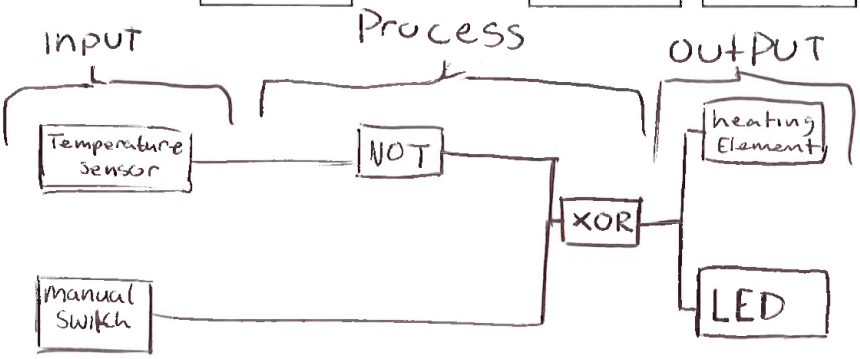
An LED should switch on when the heater is on.

There is also a manual switch to turn the whole system on and off.

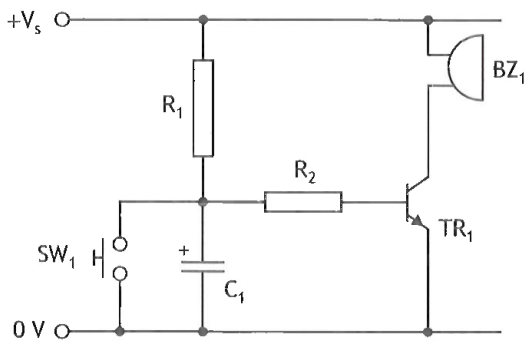
Selecting from the elements given, draw a block diagram of an electronic solution for this system.

On your diagram, clearly indicate the input, process and output sections of your solution. 6

heating element (requires a logic 1 to turn on)	NOT gate	temperature sensor (logic 0 when cold)	NOR gate	manual switch (logic 1 when closed)
AND gate	alarm (requires a logic 1 to turn on)	XOR gate	LED (requires a logic 1 to turn on)	light sensor (requires a logic 1 to turn on)

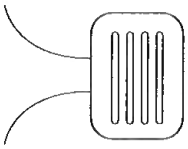


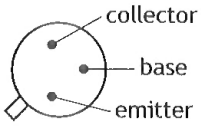
10. A time delay circuit is shown below.



Component data
R_1 — carbon film 10 kΩ 0.25 W
R_2 — carbon film 1 kΩ 0.25 W
C_1 — 2200 mF **electrolytic** capacitor
SW_1 — push-to-make switch
TR_1 — BC108 npn bipolar
BZ_1 — buzzer 6 V dc
TR_1 pin connections

buzzer with connecting wires





electrolytic capacitor



push-to-make switch



On the opposite page, a layout diagram includes the power rails and components TR_1 and R_2.

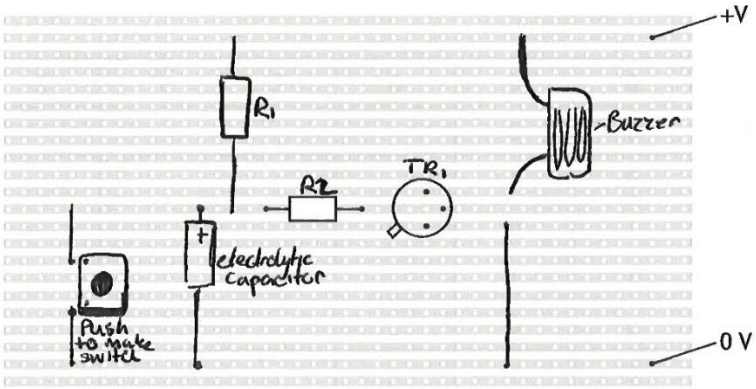
Complete the layout diagram with the remaining components.

Each component must be identified by a label.

Mark on the layout diagram, with an X, where a track has been cut. **5**

10. (continued)

layout diagram



(An additional layout diagram, if required, can be found on *page 21*.)

[END OF QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS

Additional truth table for question 4 (b)

A	B	C	D	E	F	Z
0	0	0				
0	0	1				
0	1	0				
0	1	1				
1	0	0				
1	0	1				
1	1	0				
1	1	1				

Additional costings sheet for question 8

Supplier	Component	Product code	Cost (p)
JIMSON	LM741CN	TC 133	56
SWIFT	8 way DIL	SK-0080	10
	LED 5 mm std		
	330 R		
	50 K		
	10 K potentiometer		
	thermistor		

ADDITIONAL SPACE FOR ANSWERS

Additional diagram for question 10

layout diagram

