FOR OFFICIAL USE

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	KU	RNA
Total Marks		

4040/401

NATIONAL QUALIFICATIONS 2007

MONDAY, 30 APRIL
1.00 PM – 2.15 PM

TECHNOLOGICAL STUDIES
STANDARD GRADE
General Level

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Date of birth
Day Month Year

Scottish candidate number

Number of seat

1 Answer all the questions.
2 Read every question carefully before you answer.
3 Write your answers in the spaces provided.
4 Do **not** write in the margins.
5 Do **not** sketch in ink.
6 All dimensions are given in millimetres.
7 **Show all working and units where appropriate.**
8 Reference should be made to the Standard Grade and Intermediate 2 Data Booklet (2006 edition) which is provided.
9 Before leaving the examination room you must give this book to the invigilator. If you do not, you may lose all the marks for this paper.

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1. A CD player is shown below.

(*a*) Complete the diagram below for the CD player by adding one **main** input and one **main** output. One input has been provided for you.

2 1 0

(*b*) **Draw** the Universal System Diagram.

3 2 1 0

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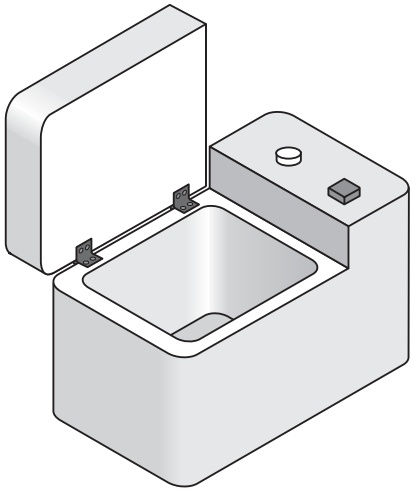
2. A model of a bread making machine is operated by a microcontroller.



The sequence of operations for the breadmaker is shown below:

- the sequence begins when the start switch is pressed and the lid closed;
- the mixer motor runs for 10 seconds then stops;
- the heater switches on for 20 seconds then switches off;
- the sequence is reset.

Input Connection	Pin	Output Connection
	7	
	6	Heater
	5	Mixer motor
	4	
	3	
Lid sensor	2	
Start switch	1	
	0	

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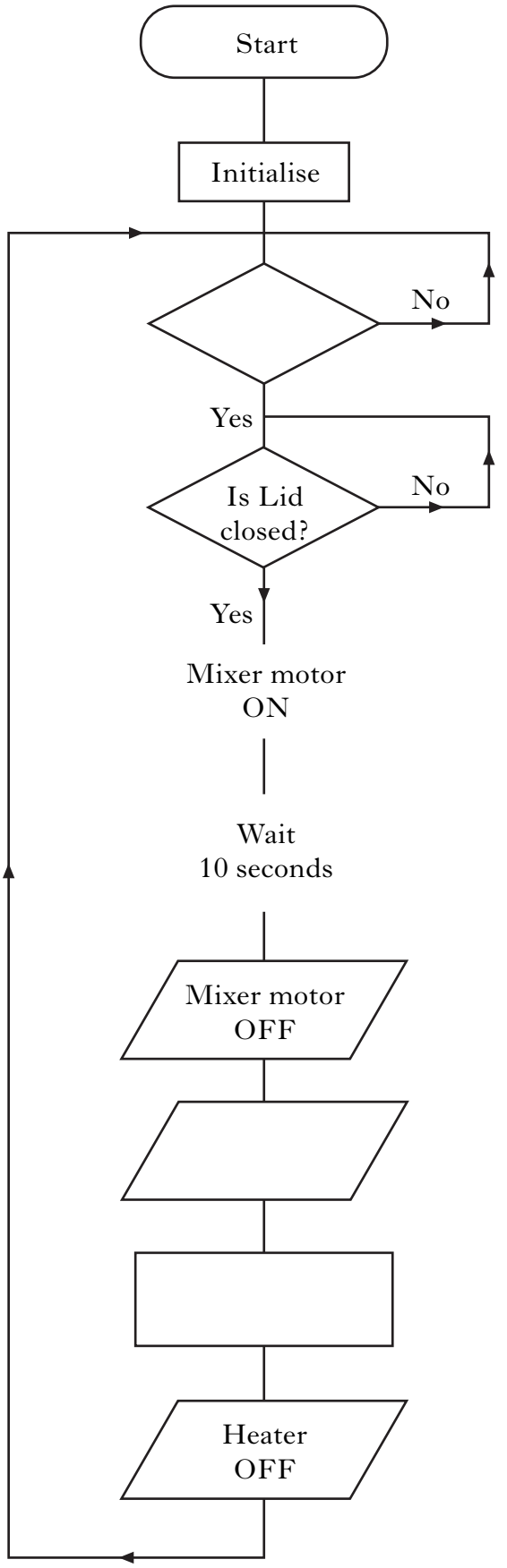
2. (continued)

(*a*) Complete the flowchart by adding the correct symbols and instructions. You should refer to the sequence and Data Booklet when answering this question.



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	5 4 3 2 1 0

2. (continued)

KU	RNA

(*b*) With reference to the microcontroller connections and flowchart, complete the PBASIC program.

```
init:     let dirs = %11110000          _____________________
          let pins = 0                  'switch all pins off
main:     if pin 1 = 0 then main        'test pin 1
label:    _____________________         'test pin 2
          high 5                        'switch on mixer motor
          pause 10000                   '10 second delay
          _____________________         'switch off mixer motor, switch on heater
          _____________________         '20 second delay
          low 6                         'switch off heater
          _____________________         'reset program
```

5 4 3 2 1 0

(*c*) State the name of the microcontroller parts for each of the following functions.

(i) Function *Permanent memory where a program or data is stored*

Full name _____

(ii) Function *Temporary working memory of the micocontroller* **2 1 0**

Full name _____

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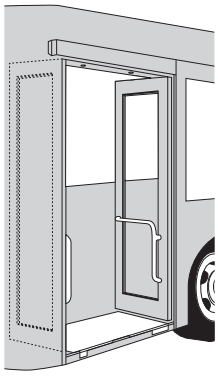
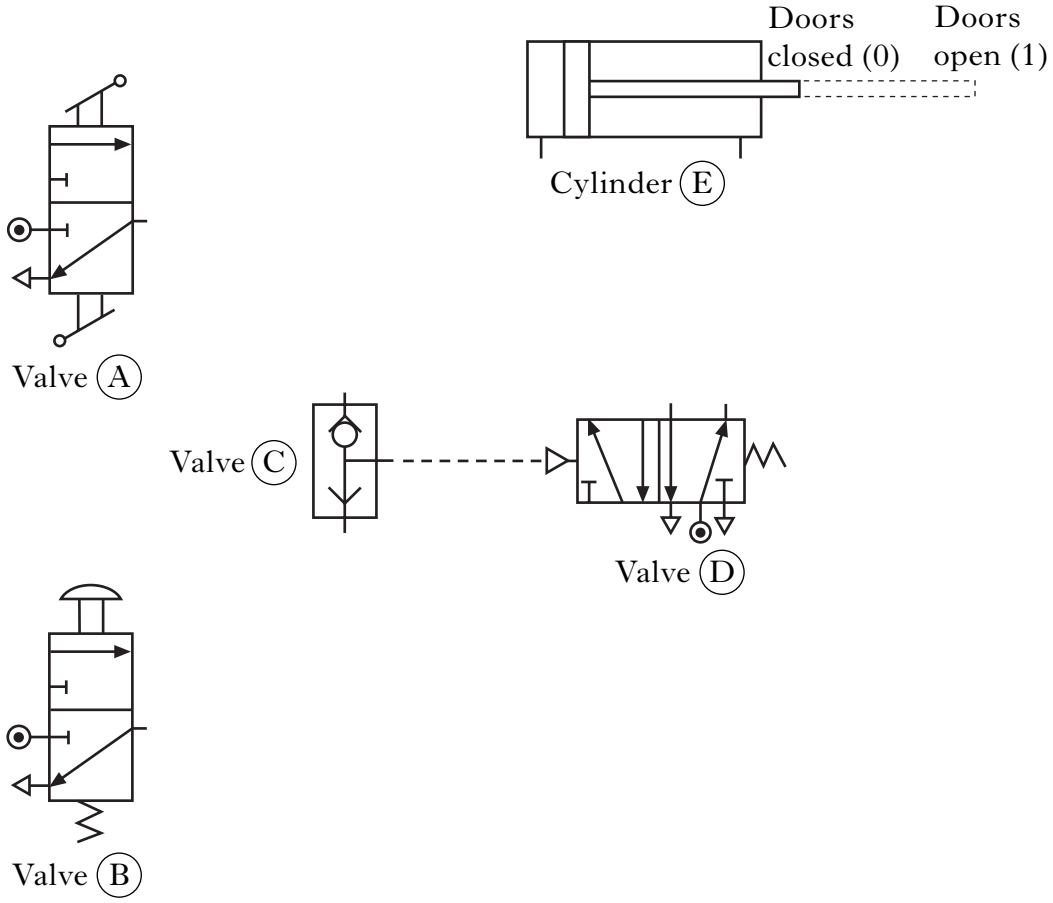
3. The door of a bus is operated by a pneumatic system.



The door will open when Valve (A) or Valve (B) is actuated.

(*a*) Complete the piping of the pneumatic circuit below.



(*b*) Complete the table below to show the OR control for the door position.

Valve (A)	**Valve (B)**	**Door position (open or closed)**
0	0	
0	1	
1	0	
1	1	open

3 2 1 0

3 2 1 0

3. (continued)

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The air supply between Valve (C) and Valve (D) is shown by a dashed line.

(*c*) State the name given to this type of air supply.

_____ **1 0**

(*d*) State the name of the pneumatic symbols.

(i)  _____ **1 0**

(ii)  _____ **1 0**

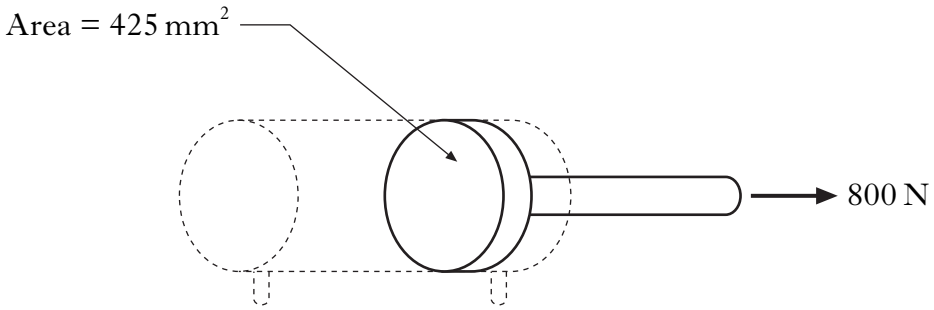
(*e*) State the **full name** of Valve (D). **3 2 1 0**

_____

(*f*) State the name given to the **position** of the **piston** when the door is closed. **1 0**

_____

(*g*) Calculate the air pressure to move the piston with a force of 800 N in the direction shown when the piston has an area of 425 mm^2.



2 1 0

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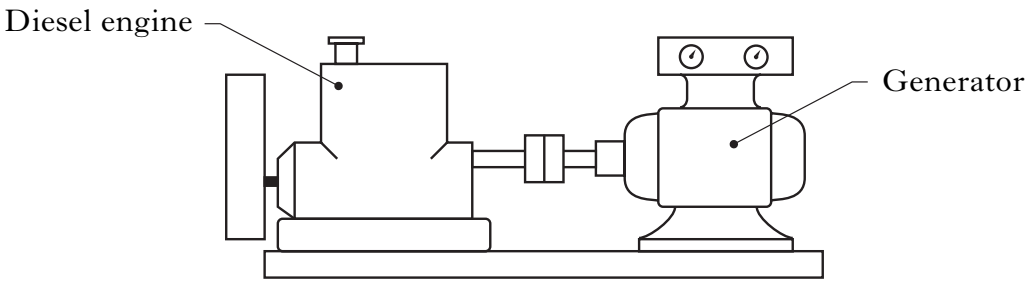
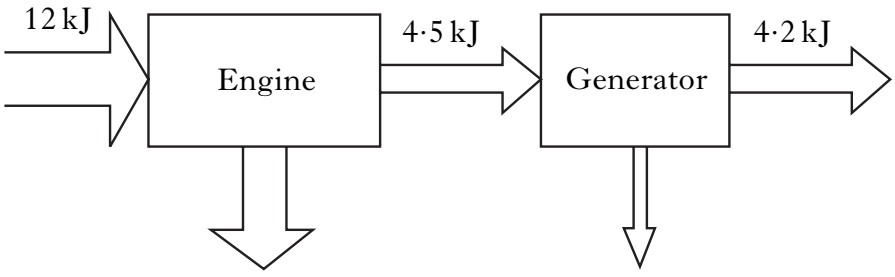
4. A diesel engine is used to drive a generator.



(*a*) Complete the diagram below by inserting the **main** input and output **energy**.

2 1 0

(*b*) Calculate and complete the energy audit below.



_____kJ _____ kJ

2 1 0

(*c*) Complete the following sentence by using the list of phrases given.

greater than *less than* *equal to*

"The efficiency of all machines will be _____100% because the input energy is always _____ the output energy.

1 0

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4. (continued)

Oil is a non-renewable fuel source.

(*d*) State **two** other examples of non-renewable fuel.

Fuel source 1 _____ **2 1 0**

Fuel source 2 _____ **2 1 0**

The engine is cooled by water.

(*e*) Calculate the heat energy gained by 3 kg of water as it passes through the engine if its temperature rises from 20 °C to 80 °C.

Specific Heat Capacity (C_W) for water = 4190 J/kg K

3 2 1 0

The generator provides emergency lighting.

(*f*) State **two** ways you can conserve energy in lighting systems.

1 _____ **2 1 0**

2 _____ **2 1 0**

[Turn over

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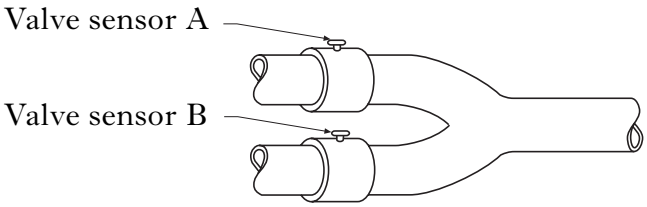
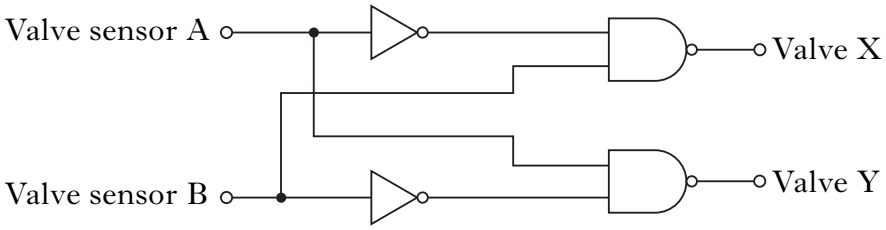
5. An oil refinery process requires that just a single valve, X or Y, is open at any given time.



Part of the logic circuit is shown below.



(*a*) Using the Data Booklet, state the **full name** of the ICs required to construct the logic circuit.

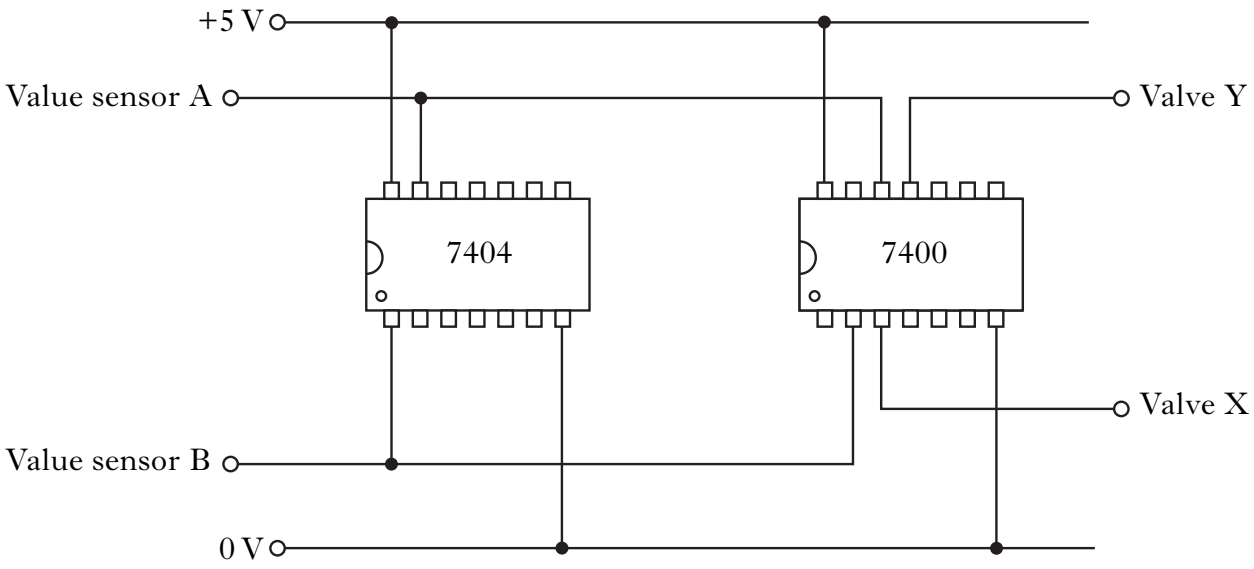
IC 1 Reference number – 7404

Full name _____ **1 0**

IC 2 Reference number – 7400

Full name _____ **1 0**

(*b*) Complete the wiring diagram below for the logic circuit.



2 1 0

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5. (continued)

(*c*) A truth table for a logic gate is shown below.

C	**D**	**Z**
0	0	**1**
0	1	**0**
1	0	**0**
1	1	**0**

(i) State the name of the logic gate that the truth table represents.

_____ **1**

0

(ii) Sketch the logic symbol for this gate.

2

1

0

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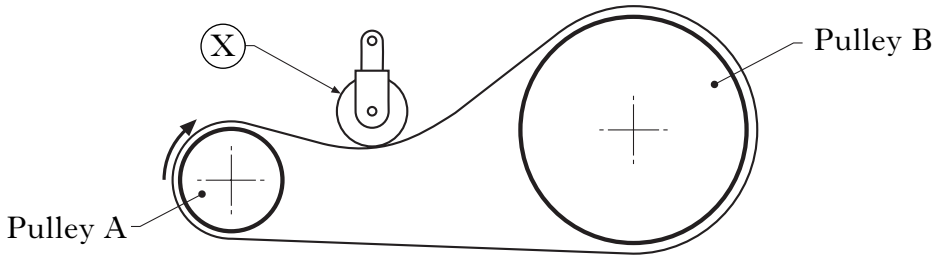
6. An air compressor on a heavy goods vehicle is driven by a belt.



(*a*) State the name of device (X) in the sketch above.

_____ **1 0**

Pulleys can rotate either **clockwise** or **anti-clockwise**.

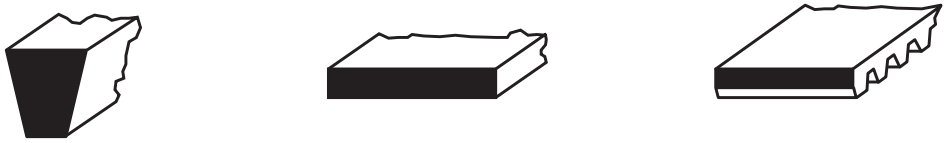
Pulley A rotates clockwise, as shown in the diagram above.

(*b*) State the direction of rotation of device (X) .

_____ **1 0**

Three different types of belts are shown below.

(*c*) State the name of each belt.



(i) _____ (ii) _____ (iii) _____ **3 2 1 0**

Friction is the resistance of one surface to move over another.

(*d*) State **two** methods of **reducing** friction.

1 _____ **2 1 0**

2 _____

6. (continued)

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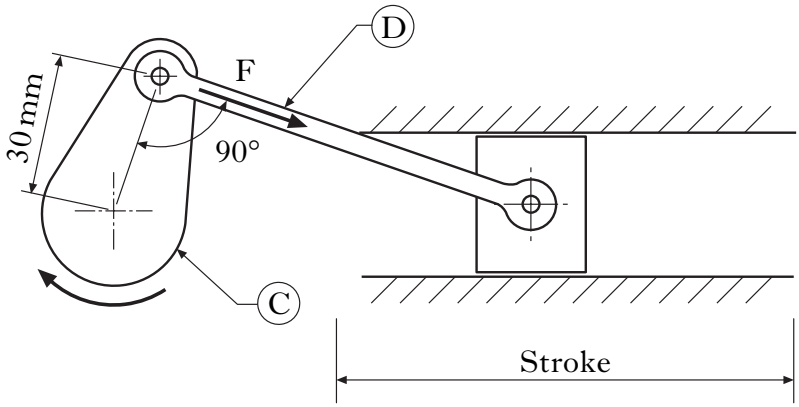
The mechanism shown below is used in the compressor.



(*e*) State the names of parts (C) and (D).

2 1 0

(C) _____ (D) _____

(*f*) Determine the length of **stroke** for the above mechanism.

1 0

_____

Part (C) has a radius of 30 mm and, as it rotates, the force **F** in part (D) is 250 N in the position shown.

(*g*) Calculate the torque.

2 1 0

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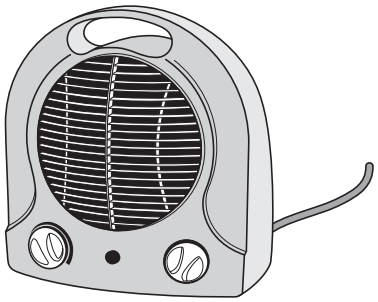
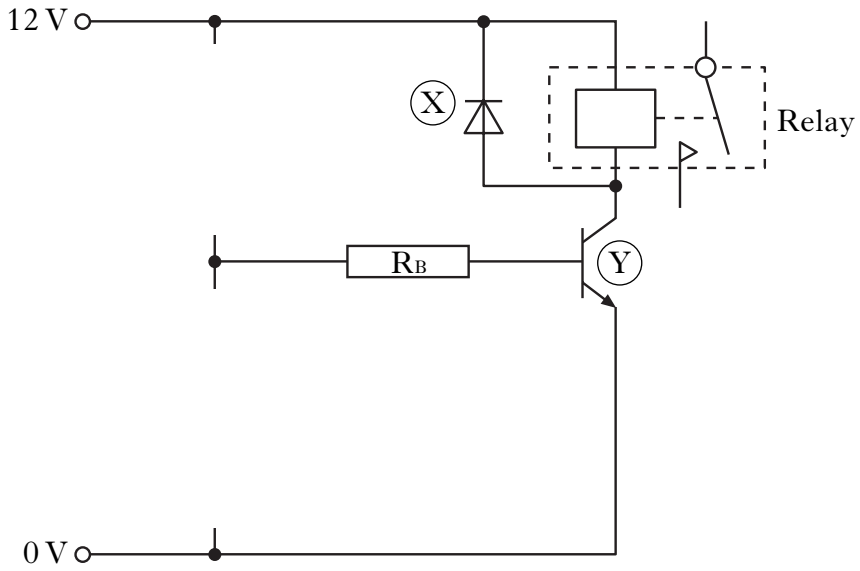
7. A heater has variable temperature control.



An incomplete electronic circuit for the heater control is shown.



(*a*) (i) Complete the circuit above by inserting the symbol for a variable resistor and a thermistor to form a **cold sensor**.

2 1 0

(ii) State the name of the components (X) and (Y).

Component (X) _____

Component (Y) _____

2 1 0

(*b*) Determine, with reference to the Data Booklet, the resistance of the thermistor type 3 at 0 °C.

_____

1 0

1 0

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7. (continued)

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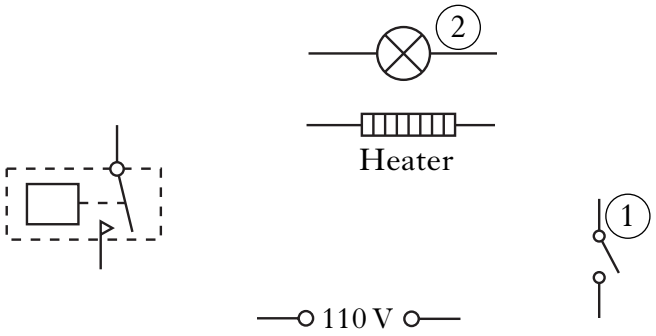
(*c*) The relay is part of a 110 V electrical circuit which is made up of component (1) and the heater connected in series. Component (2) is connected in parallel with the heater.

(i) Complete the wiring of this electrical circuit.



4 3 2 1 0

(ii) State the name of components (1) and (2).

Component (1) _____ **2 1 0**

Component (2) _____

(iii) State why a relay is required to switch on the heater circuit.

_____

_____ **1 0**

(*d*) The heater is rated at 3·3 kW operating at 110 V. Calculate:

(i) the heater current;

2 1 0

(ii) the resistance of the heater.

2 1 0

[*END OF QUESTION PAPER*]

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