FOR OFFICIAL USE

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	KU	RNA
Total Marks		

4040/29/01

NATIONAL QUALIFICATIONS 2013

WEDNESDAY, 8 MAY
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 (2008 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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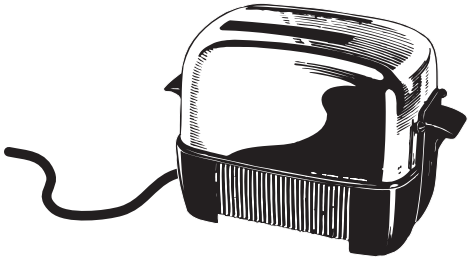
1. The systems approach is often used to help understand engineering problems.

(*a*) Draw the Universal Systems diagram.

3
2
1
0

A toaster is shown below.



(*b*) Draw a **system diagram** for a toaster. Show the **main energy** input and the **main energy** output.

2
1
0

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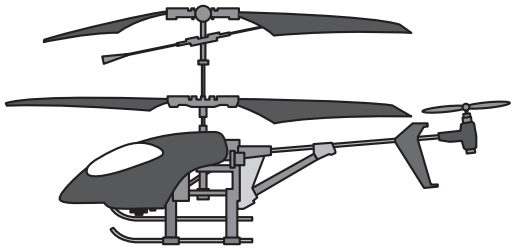
2. Microcontrollers are used in many products. One such example is in a remote controlled helicopter.

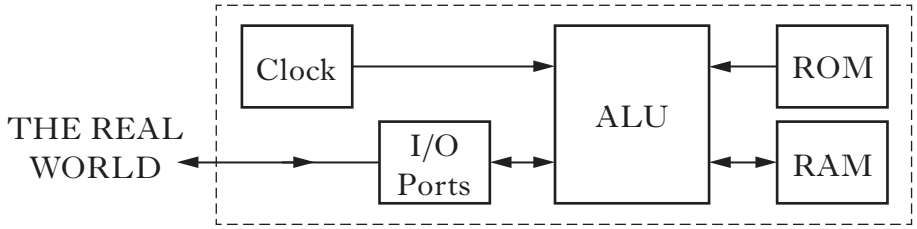


(*a*) Describe two **advantages** of using a microcontroller over a hard-wired electronic circuit.

1 _____ **2**

2 _____ **1 0**

The simplified block diagram below shows a typical microcontroller system.



(*b*) State the **full name** of the following microcontroller sub-systems.

(i) ALU _____ **3**

(ii) ROM _____ **2 1**

(iii) RAM _____ **0**

(*c*) Describe the **function** of the following microcontroller sub-systems.

(i) ALU _____ **2 1**

(ii) RAM _____ **0**

PBASIC control programs are used with a microcontroller.

(*d*) State, with reference to the Data Booklet, the PBASIC command to:

(i) give a 10 second delay _____ **1 0**

(ii) switch on pin 3 _____ **1 0 2 1**

(iii) check pin 0 and if low loop to label 'main' _____ **0**

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3. A student uses electronics boards to test the control of a security lighting system.

The security lighting relay will operate:

automatically when darkness is sensed **and** a timer switch is on

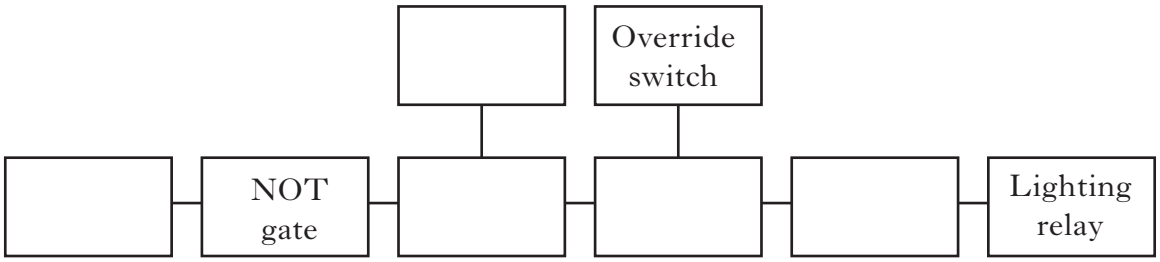
or

manually when an override switch is pressed.

(*a*) Complete the block diagram by choosing the correct device from the list below.

Pulse generator *NOT gate* *AND gate* *OR gate* *Latch*

Temperature sensor *Light sensor* *Timer switch* *Transducer driver*



5 4 3 2 1 0

(*b*) (i) Complete the truth table for an **OR** gate.

Input A	Input B	Output Z
0	0	
0	1	
1	0	
1	1	

4 3 2 1 0

(ii) Complete the logic symbol for the following gates.

OR gate **NOT gate** **AND gate**

3 2 1 0

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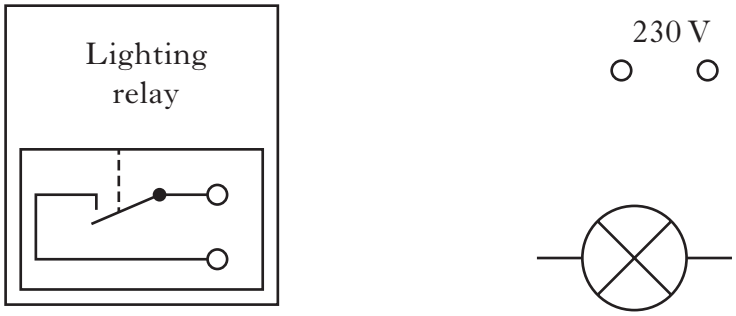
3. (continued)

(*c*) (i) The lighting relay switches an electrical circuit with a security light.

Complete the wiring of the electrical circuit below.



3
2
1
0

(ii) The lighting relay is an example of a SPST switch. State the **full name** of SPST.

1
0

SPST _____

(iii) State why a relay is often used with electronic circuits.

1
0

_____

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4. A crofter uses a wind power system to pump water to a storage tank.

Wind is a renewable source of energy.

(*a*) (i) Complete the table below to show the nature of the given energy sources.

Energy Source	Renewable	Finite
Wind	✓	
Gas		
Solar		
Biomass		

3
2
1
0

(ii) State a **disadvantage** in the use of tidal energy.

_____

1
0

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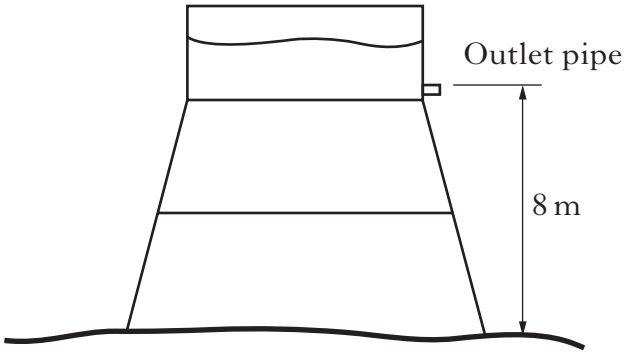
4. (continued)

(*b*) A simplified diagram of the storage tank is shown below.



(i) Calculate the potential energy of 6L (litres) of water at the outlet pipe. (1L of water = 1 kg)

2
1
0

(ii) Calculate the kinetic energy of the 6L of water just as it hits the ground. The velocity of the water is 10 m/s. (1L of water = 1 kg)

2
1
0

(iii) Describe why not all of the water's potential energy is converted into kinetic energy.

_____

1
0

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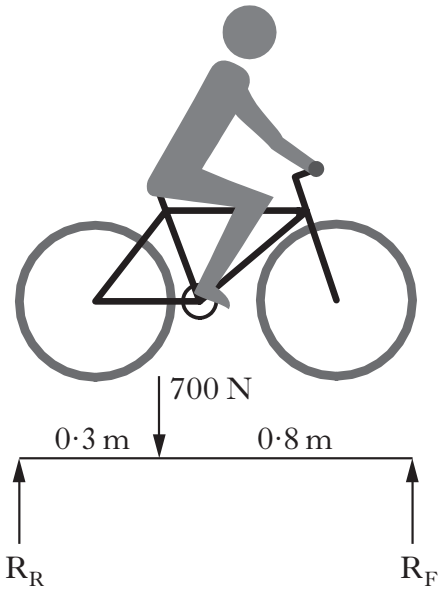
5. A simplified diagram of a bicycle and rider is shown below.



(*a*) State the name of the diagram above which shows the forces and distances.

1 0

(*b*) (i) Calculate, by taking moments about R_R, the size of reaction force R_F.

3 2 1 0

(ii) Determine the size of reaction force R_R.

2 1 0

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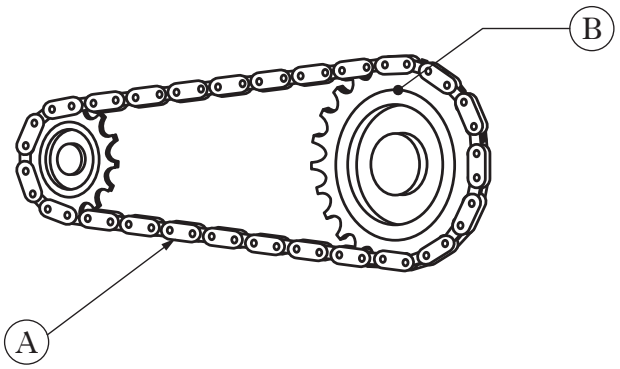
5. (continued)

(*c*) The bicycle drive system is shown below.



(i) State the name of parts (A) and (B) in the drive system. **2 1 0**

(A) _____ (B) _____

(ii) State an advantage of using this type of system instead of a gear drive. **1 0**

_____

To reduce friction the drive system makes use of bearings.

(*d*) State another method of reducing friction in a rotating system. **1 0**

_____

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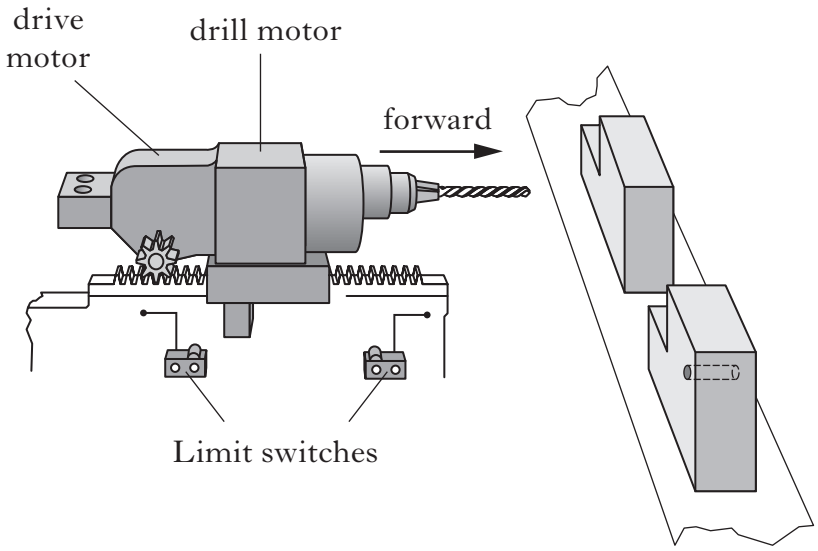
6. An automatic drilling system is operated by a microcontroller.



Part of the control program includes a sub-procedure 'Drill' which will activate when a component is detected on the conveyor belt.

The sequence of operations for the sub-procedure 'Drill' is as follows:

- a drive motor will move forward until the *forward limit* switch is pressed;
- the drive motor will halt for 3 seconds;
- the drive motor will reverse until the *back limit* switch is pressed;
- the drive motor will stop and the sequence will return to the main program.

Input Connection	Pin	Output Connection
	7	Drive Motor forward
	6	Drive Motor backward
	5	
	4	
Back limit switch	3	
Forward limit switch	2	
	1	
	0	

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6. (continued)

Complete the flowchart for the sub-procedure 'Drill', with reference to the sequence of operations and the Data Booklet.

8 7 6 5 4 3 2 1 0

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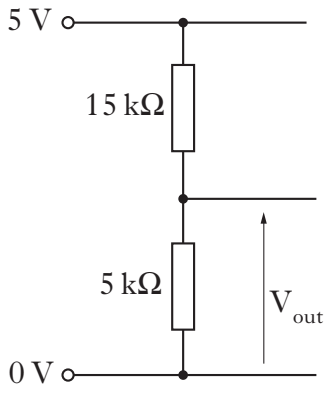
7. A technician is investigating part of an electronic circuit shown below.



(*a*) (i) State the name of this type of circuit with the series resistor arrangement.

1 0

_____

(ii) Calculate the value of the voltage V_{out}.

2 1 0

(iii) Complete, with reference to the Data Booklet, the table below to show the colour coding for the two resistors.

Resistor Value	Colour band 1	Colour band 2	Colour band 3
5 kΩ			
15 kΩ			

2 1 0

There are many types of resistor.

(*b*) Complete the symbol for the following resistor types.

Variable resistor Thermistor LDR

3 2 1 0

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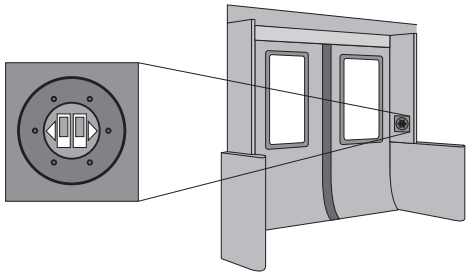
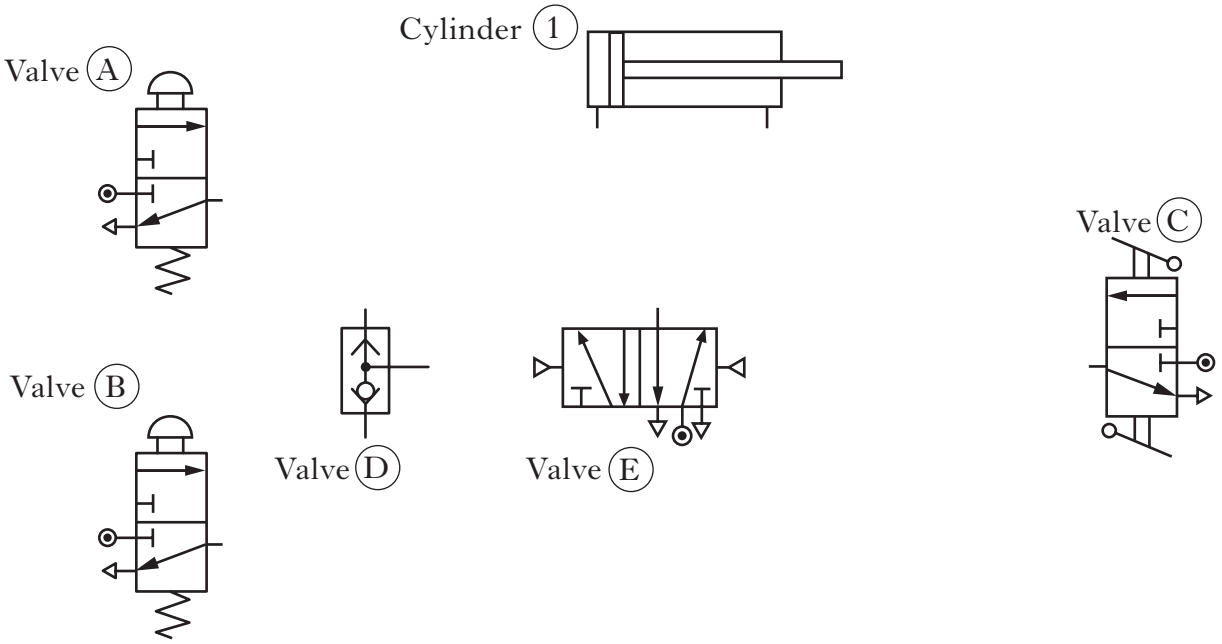
8. A tram door is operated by a pneumatic circuit.



The doors will open when a passenger presses valve (A) **or** valve (B) . The doors will close when the driver actuates valve (C).

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



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	4
	3
	2
1	**1**
0	**0**

(*b*) State the **full name** of the following pneumatic devices.

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3	
2	
1	

(i) Valve (C) _____ **0**

(ii) Valve (D) _____ **1** **0**

For safety the door is to be slowed as the piston outstrokes.

(*c*) (i) State the name of the pneumatic device that is used to slow speed in **one direction** only.

KU	RNA
1	
0	

_____

(ii) Sketch the symbol for this pneumatic device.

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2	
1	
0	

[*END OF QUESTION PAPER*]

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