FOR OFFICIAL USE

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	KU	RNA
Total Marks		

4040/401

NATIONAL QUALIFICATIONS 2008

WEDNESDAY, 7 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 (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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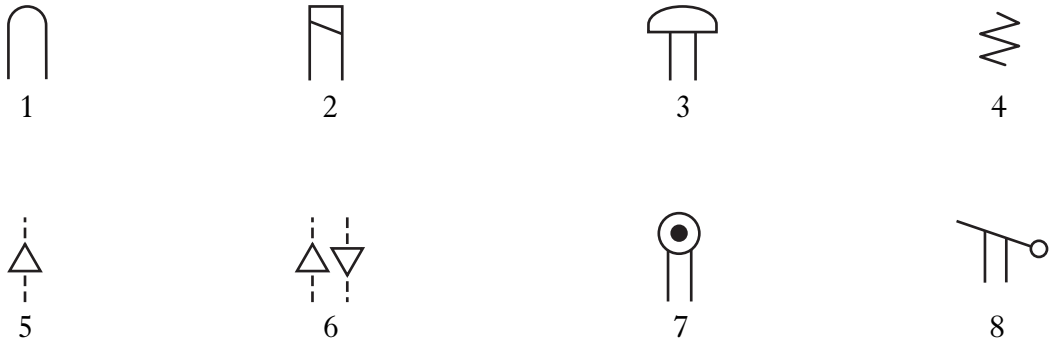
1. (*a*) The following pneumatic actuators have been numbered 1 to 8.

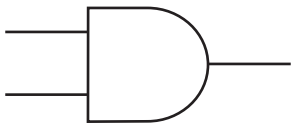


Complete the table below by inserting the symbol number for each actuator. The first one has been completed for you.

Actuator	Symbol Number
Push Button	3
Spring	
Plunger	
Lever	
Solenoid	
Roller	
Pilot	

6
5
4
3
2
1
0

(*b*) State the name of the electronic logic gate shown below.



Gate _____

1
0

(*c*) State the name of the logic gate which is represented by the truth table shown below.

A	B	Z
0	0	0
0	1	1
1	0	1
1	1	1

Gate _____

1
0

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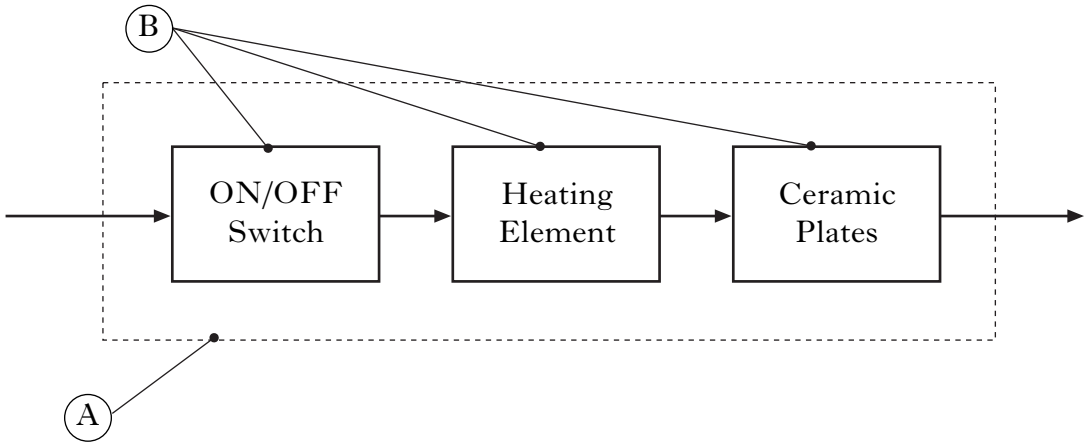
2. Hair straighteners are shown below.

(*a*) Complete the system diagram below for the hair straighteners by adding one main input **energy** and one main output **energy**.

2
1
0

(*b*) The main parts of the hair straighteners are shown below.



(i) (A) separates the system from the outside world.
State the name of this part of the diagram.

_____

1
0

(ii) The whole system can be broken down into several parts labelled above as (B).
State the name given to these parts.

_____

1
0

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3. A microcontroller program is used to operate the door on a train.

The control program for the 'door' sub-procedure is part of a larger program.

The steps in the 'door' sub-procedure are listed below.

- The sequence begins with the door opening.
- The door stays open for 10 seconds.
- The door closes.
- For safety reasons, should a passenger be sensed, the sub-procedure will repeat.

(*a*) Complete, with reference to the Data Booklet, the flowchart below for the 'door' sub-procedure.

7 6 5 4 3 2 1 0

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3. (continued)

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(*b*) The program requires pins 4, 6 and 7 to be set as outputs and the rest as inputs. With reference to the Data Booklet:

(i) state the PBASIC command for this setup; **2 1 0**

_____

(ii) state the PBASIC command used to produce a 10 second delay. **1 0**

_____

(*c*) State the **full** name and **function** of the following microcontroller terms.

(i) **ROM**

Full name _____ **2 1 0**

Function _____

(ii) **RAM**

Full name _____ **2 1 0**

Function _____

(iii) **ALU**

Full name _____ **2 1 0**

Function _____

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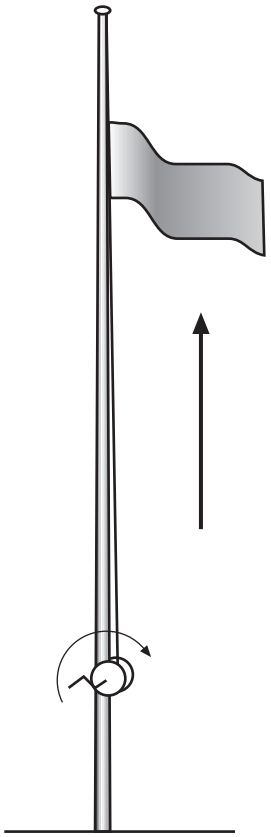
4. A flag is raised each morning.

The mass of the flag is 0·8 kg and it is raised 7·5 m.



(*a*) Calculate the potential energy gained by the flag.
(Show all working and units.)

2 1 0

The force on the rope when raising the flag is 9·3 N.

(*b*) Calculate the work done (input energy) in raising the flag.

2 1 0

(*c*) State the **two** reasons why the input energy is different from the energy gained by the flag.

1 _____

2 _____

2 1 0

(*d*) (i) State **two** examples of **finite** energy sources.

2 1 0

1 _____ 2 _____

(ii) State **two** examples of **renewable** energy sources.

2 1 0

1 _____ 2 _____

4. (continued)

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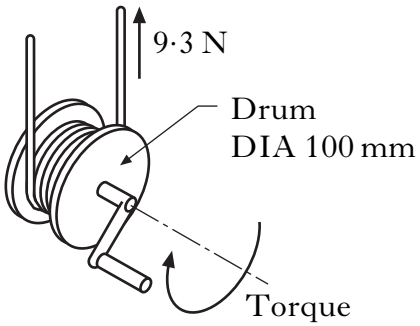
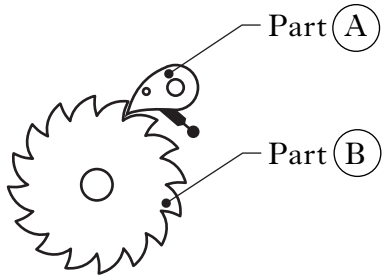
The flag is raised by a small hand winch. The cord passes around a drum of 100 mm diameter.



(*e*) Calculate the torque on the drum due to the tension on the rope of 9·3 N.

2 1 0

To stop the flag lowering under its own weight, the winch is fitted with the mechanism shown below.

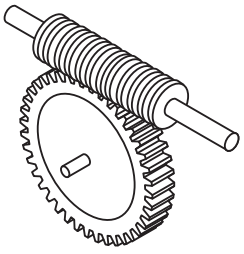


(*f*) State the name of parts (A) and (B).

2 1 0

(A) _____ (B) _____

The sketch below shows another type of mechanism that stops the output from driving the input.



(*g*) State the name of the mechanism shown above.

2 1 0

_____ and _____

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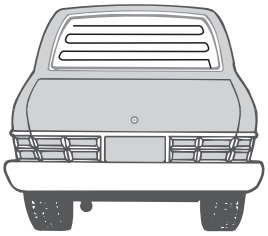
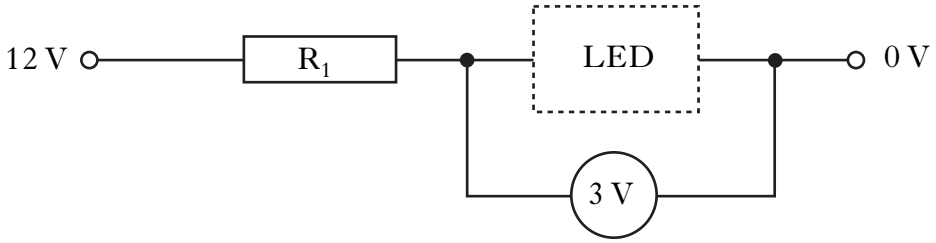
5. A Light Emitting Diode (LED) is used to indicate when the heated rear windscreen of a car is switched on.



(*a*) Complete the circuit below by inserting correctly the symbol for an LED.

1 0 | **1 0**

With a supply voltage of 12 V the circuit has a current of 5 mA. The voltage across the LED is 3 V.



(*b*) Determine the voltage drop across the resistor R_1.

1 0

(*c*) Calculate the value of resistor R_1.

2 1 0

(*d*) State, with reference to the Data Booklet, the colour code for a 6k7 resistor.

1st Colour	2nd Colour	3rd Colour

3 2 1 0

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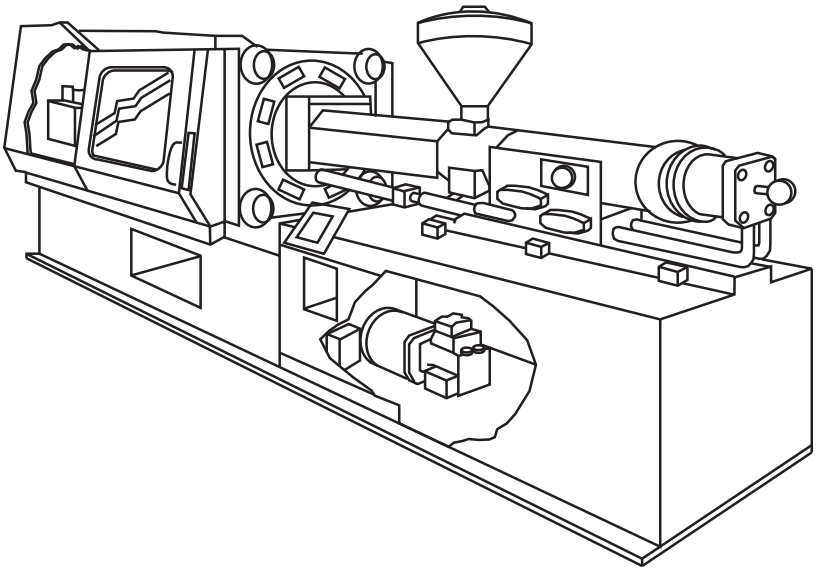
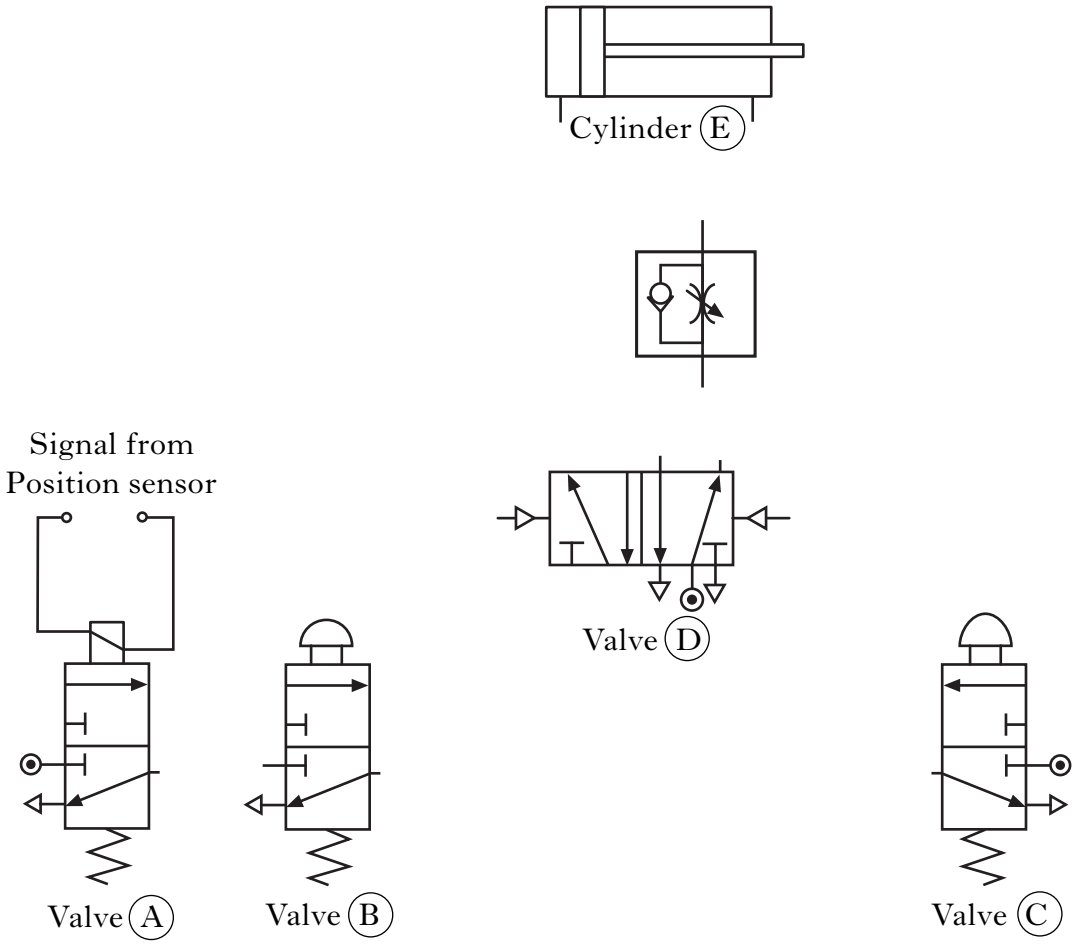
6. A plastic injection moulding machine is operated by a speed controlled pneumatic cylinder.



The piston speed is slowed on the outstroke. The piston outstrokes when a position sensor operates valve (A) **and** valve (B) is activated. Valve (C) stops the injection process and instrokes the piston.

Complete the piping of the pneumatic circuit below.



	5
	4
	3
	2
1	**1**
0	**0**

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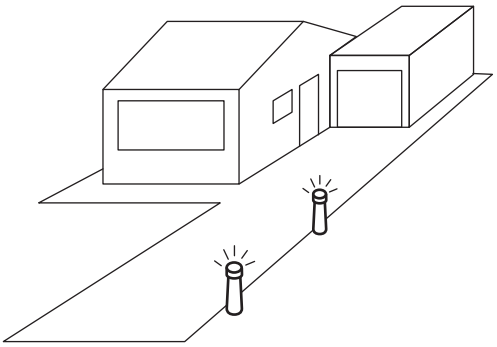
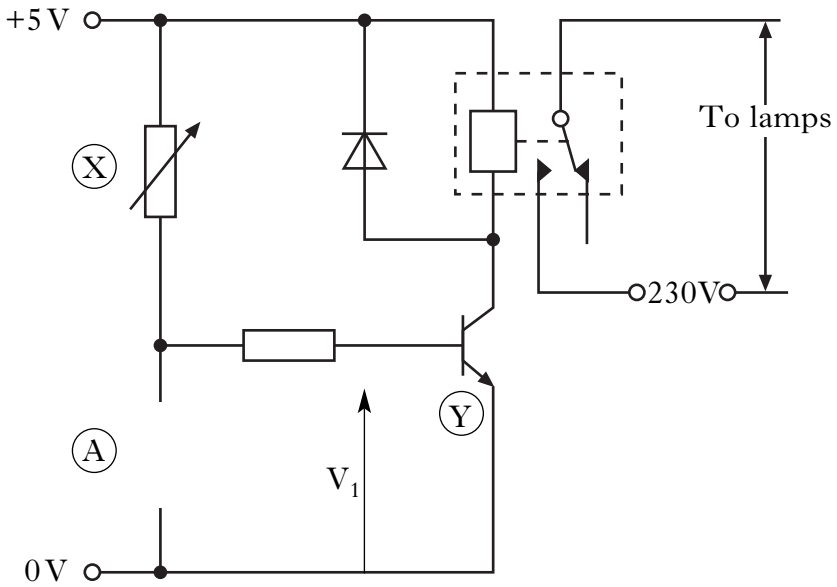
7. A house owner decides to install two lamps on her driveway.



The lamps are connected to a control circuit shown below.



(*a*) (i) Complete the circuit above by drawing the symbol for a Light Dependent Resistor (LDR) at position (A). **1 0**

(ii) State the name of components (X) and (Y). **2 1 0**

(X) _____ (Y) _____

(iii) Determine, with reference to the Data Booklet, the light level of the LDR when the resistance is 10 kΩ.

_____ **1 0**

Component (Y) is fully switched when $V_1 = 0{\cdot}7$ V.

(*b*) State the name of this condition.

_____ **1 0**

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7. (continued)

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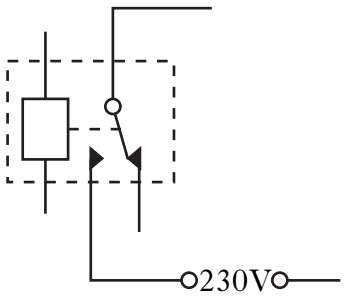
(*c*) Using the symbol ⊗ to represent a lamp, complete the diagram below to show the two lamps connected in **parallel** to the relay.



2 1 0

Each lamp has a rating of 230 V, 200 W.

(*d*) Calculate the current used by each lamp.

2 1 0

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8. A pupil is using systems electronic boards to simulate a security light. The pupil would like the lamp to flash on and off automatically until reset.

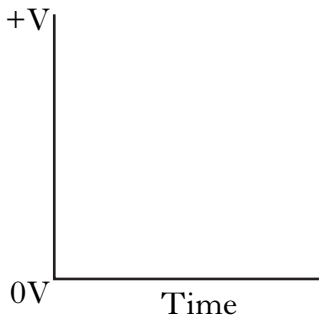
(*a*) State the name of an input board that could be used to automatically switch the lamp ON and OFF repeatedly.

_____ **1 0**

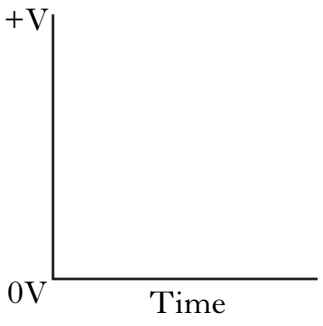
(*b*) State the name of the process board that will keep the lamp flashing until reset.

_____ **1 0**

(*c*) Show, using a sketch on the graphs below, the difference between analogue and digital signals.



Analogue



Digital

2 1 0

(*d*) The following electronic sub-systems can be considered to have either analogue or digital output signals. Tick (✓) to indicate the correct signal type.

	Analogue	*Digital*
Temperature sensor	☐	☐
Magnetic switch	☐	☐
Moisture sensor	☐	☐
Push switch	☐	☐
Light sensor	☐	☐

5 4 3 2 1 0

(*e*) Describe the **function** of a comparator process board.

_____ **1 0**

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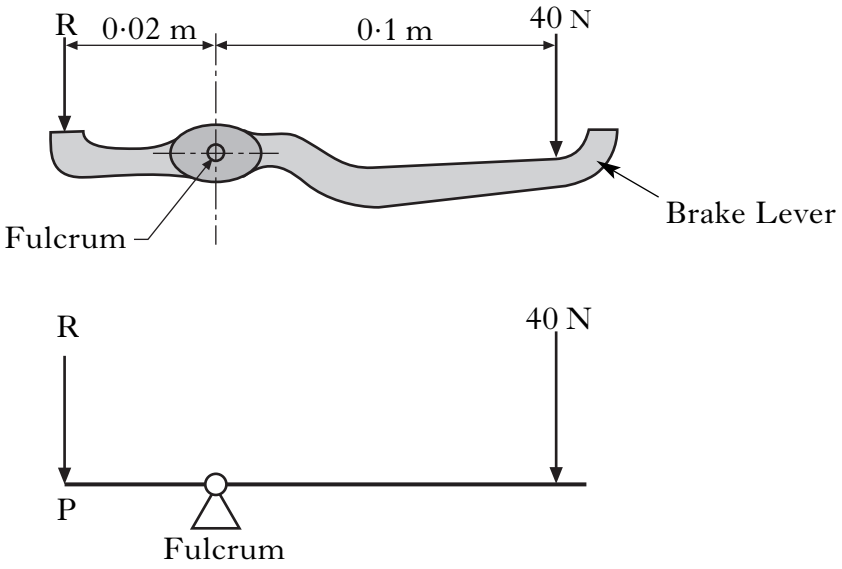
9. Detail of a brake lever for hydraulic brakes on a mountain bike is shown below.



Calculate, by taking moments about the Fulcrum, the force R from the hydraulic brake piston.

3

2

1

0

[*END OF QUESTION PAPER*]

ACKNOWLEDGEMENTS

Question 9—Picture of hydraulic brakes. Reproduced by kind permission of Shimano.

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