FOR OFFICIAL USE

G

	KU	RNA
Total Marks		

4040/401

NATIONAL QUALIFICATIONS 2009

TUESDAY, 5 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.

DO NOT WRITE IN THIS MARGIN

KU	RNA

1. (*a*) The following electronic symbols have been numbered 1 to 10.

1

2

3

4

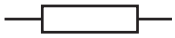
5

6

7

8

9



10

Complete the table below by inserting the symbol number for each item.

The first one has been completed for you.

Item	Symbol Number
Resistor	10
Lamp	
LED	
Motor	
Transistor	
Switch	
LDR	

6
5
4
3
2
1
0

System diagrams can be used to solve electronic problems.

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

3
2
1
0

DO NOT WRITE IN THIS MARGIN

KU	RNA

2. A hand held games console is shown.

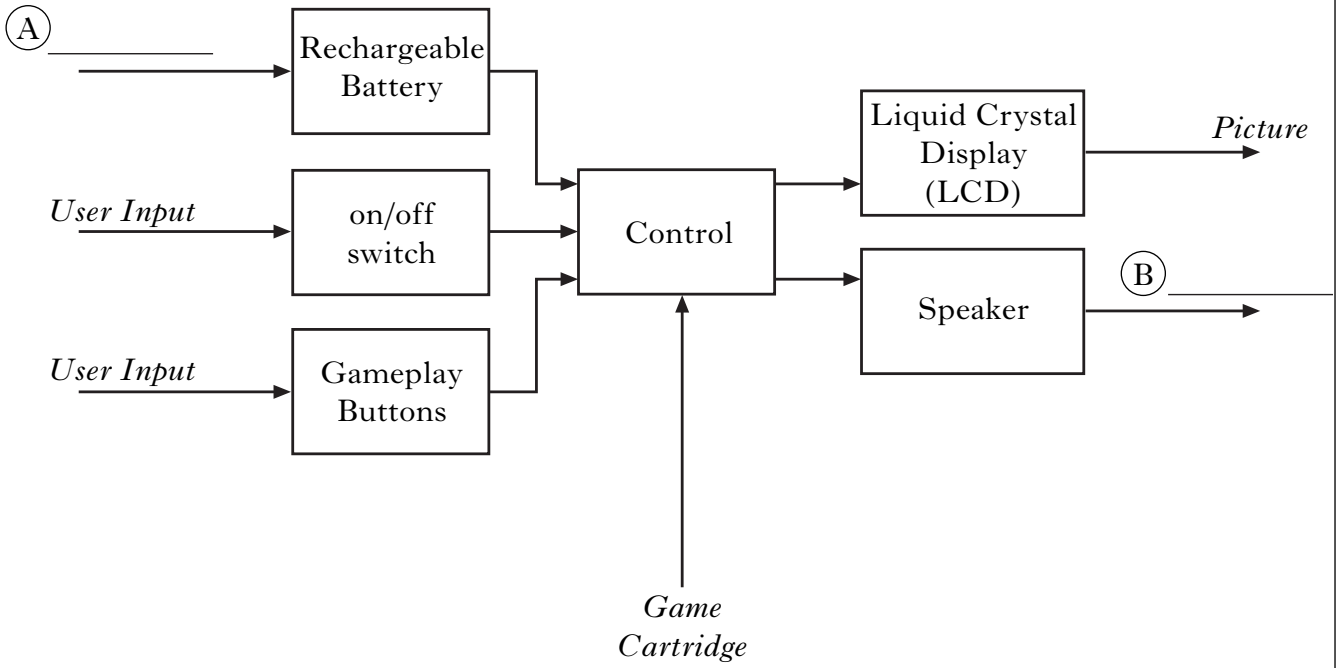
A simplified diagram of the main parts of the games console is shown below.

(*a*) Complete the diagram by adding:

(i) the missing input (A);

(ii) output (B);

(iii) the system boundary.



1 0

1 0

1 0

(*b*) The system consists of six parts shown above.

These parts of the system are called _____ **1 0**

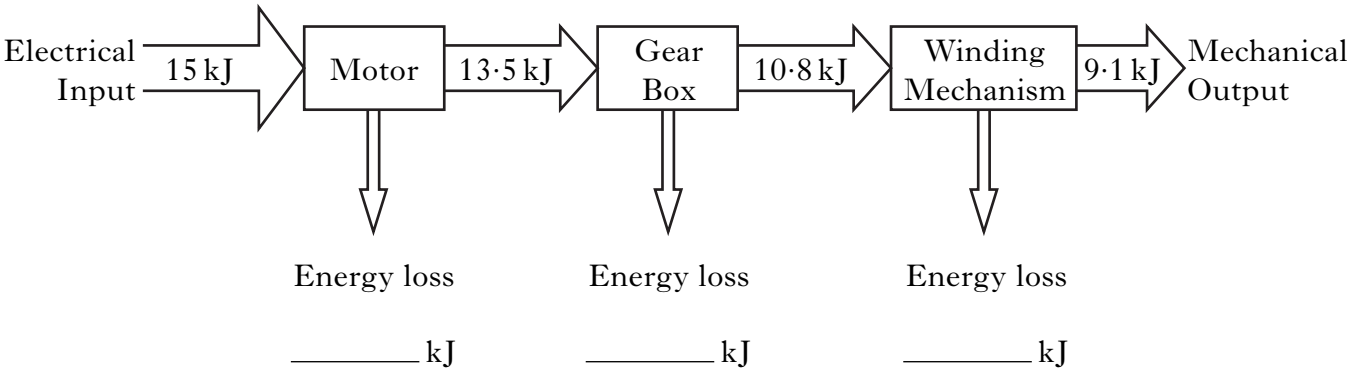
[Turn over

DO NOT WRITE IN THIS MARGIN

KU	RNA

3. An electric motor is used to drive a ski tow.

(*a*) Complete the energy audit below.



3 2 1 0

(*b*) Calculate the **total** energy **loss** in the ski tow.

Total energy loss = _____ kJ

1 0

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

Input energy *Lost energy* *Output energy*

"Because the _____ is always greater than the _____ the efficiency will always be less than 100%."

2 1 0

A local hydro electric power plant provides the energy for the ski tow. Hydro electricity is one example of renewable energy.

(*d*) State **three** other examples of **renewable** energy.

1 _____

2 _____

3 _____

3 2 1 0

DO NOT WRITE IN THIS MARGIN

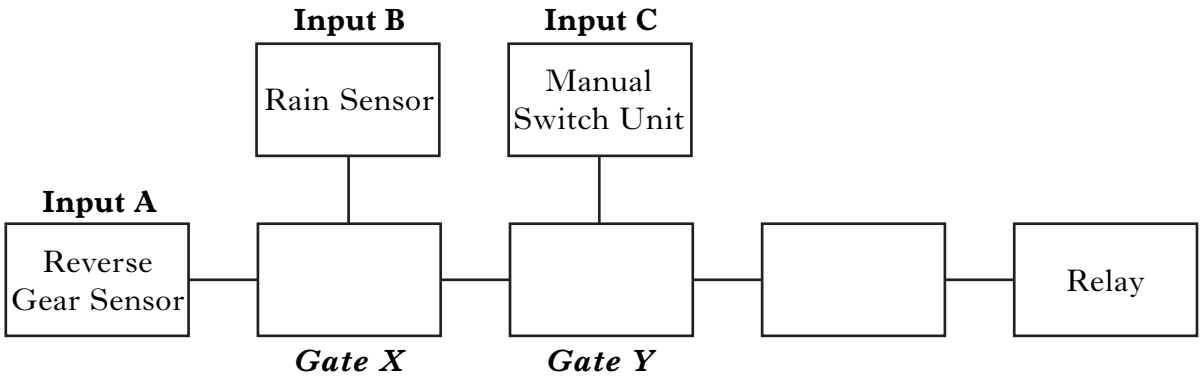
KU	RNA

4. A car rear wiper is controlled using an electronic circuit.

The rear wiper can be activated manually using a switch **or** automatically if the reverse gear is selected **and** rain is detected.

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

Pulse generator *AND gate* *OR gate* *Magnetic Switch*
Latch *Temperature sensor* *Transducer driver* *NOT gate*



3 2 1 0

(*b*) (i) Sketch the logic symbol for ***Gate X***.

2 1 0

(ii) Sketch the logic symbol for ***Gate Y***.

2 1 0

DO NOT WRITE IN THIS MARGIN

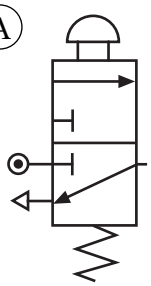
KU	RNA

5. A control gate in a gas pipeline is operated by a pneumatic cylinder.

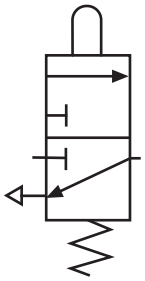
The gate must operate when **both** valves (A) **and** (B) are actuated **or** when valve (C) is pressed.

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

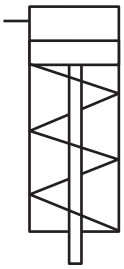
Valve (A)



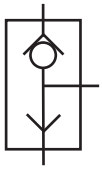
Valve (B)



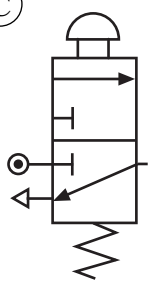
Cylinder (1)



Valve (D)



Valve (C)



4 3 2 1 0

DO NOT WRITE IN THIS MARGIN

KU	RNA

5. (continued)

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

3 2 1 0

(i) Valve (B) _____

1 0

(ii) Valve (D) _____

1 0

(iii) Cylinder (1) _____

1 0

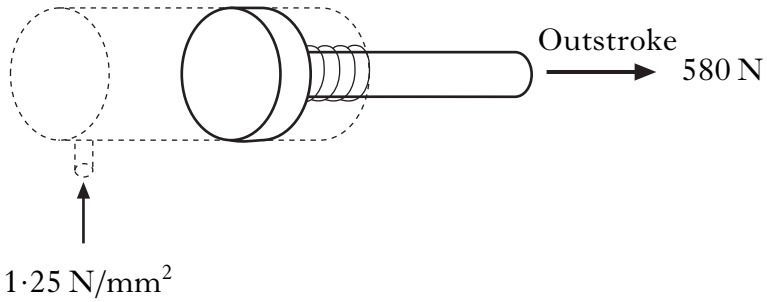
(*c*) State **one** advantage of using compressed air as an energy source.

_____

1 0

(*d*) Calculate the piston area if air is supplied at 1·25 N/mm^2 and the outstroking force of the piston rod is 580 N.

(Ignore the force of the spring.)



2 1 0

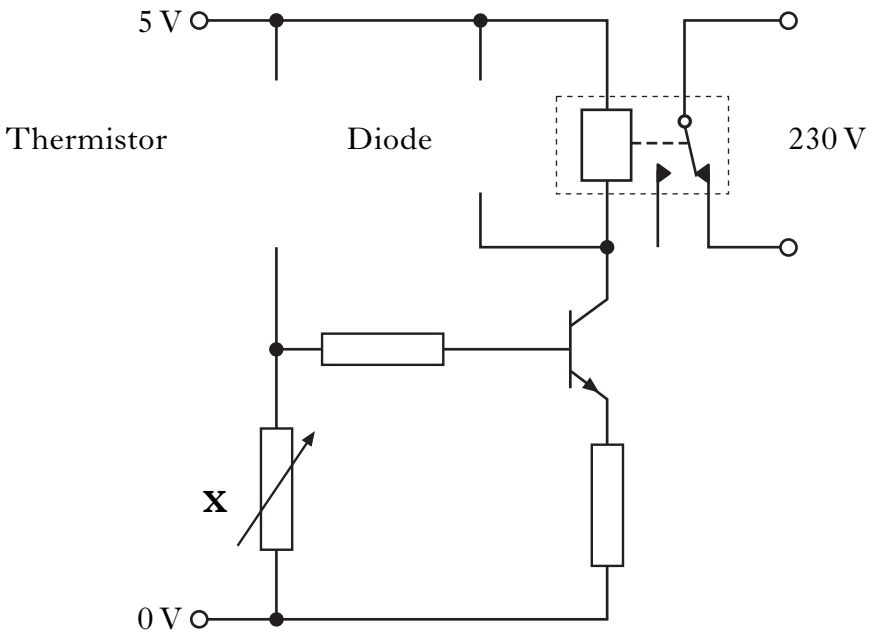
[Turn over

DO NOT WRITE IN THIS MARGIN

KU	RNA

6. A microwave oven is fitted with a safety circuit that will automatically switch off if the outside surface gets too warm.

The incomplete safety circuit is shown below.



(*a*) Draw the symbols for the two components named above to complete the safety circuit. **2** **1** **0**

(*b*) State the name of component **X**. **1** **0**

_____

(*c*) Determine, with reference to the Data Booklet, the temperature **range** of a **type 1** thermistor. **2** **1** **0**

_____ °C to _____ °C.

(*d*) State the saturation voltage of a transistor. **1** **0**

V_{be} _____

DO NOT WRITE IN THIS MARGIN

KU	RNA

(*e*) (i) Calculate the current flowing through the relay if the coil has a resistance of 400 Ω and a voltage drop of 4 V.

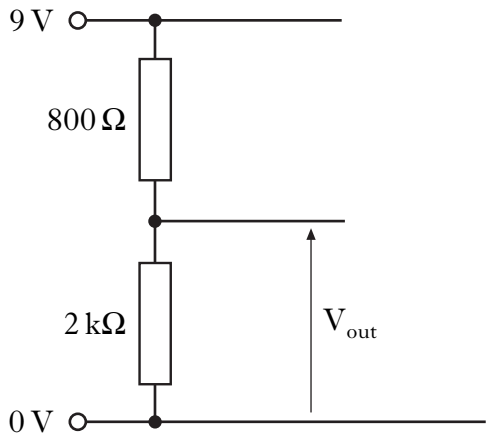
2 1 0

(ii) Calculate the power used by the relay coil.

2 1 0

Resistors are used in many electronic circuits.

(*f*) (i) Calculate the voltage V_{out} in the circuit shown below.



2 1 0

(ii) State the name of the series resistor arrangement shown above.

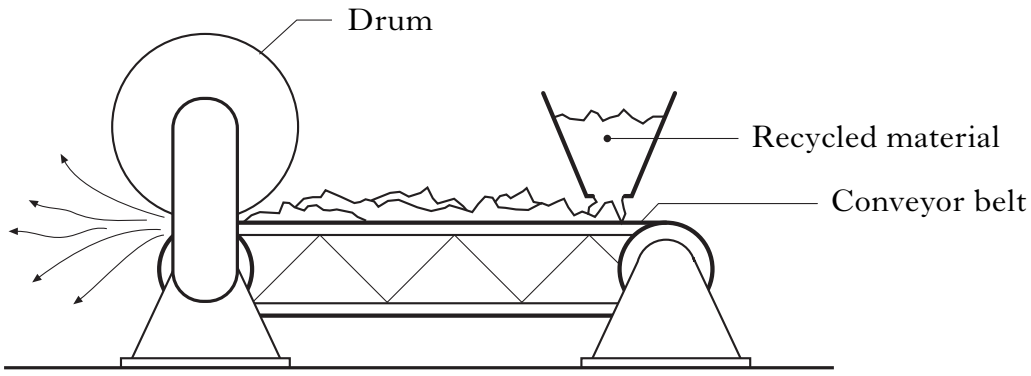
1 0

_____

DO NOT WRITE IN THIS MARGIN

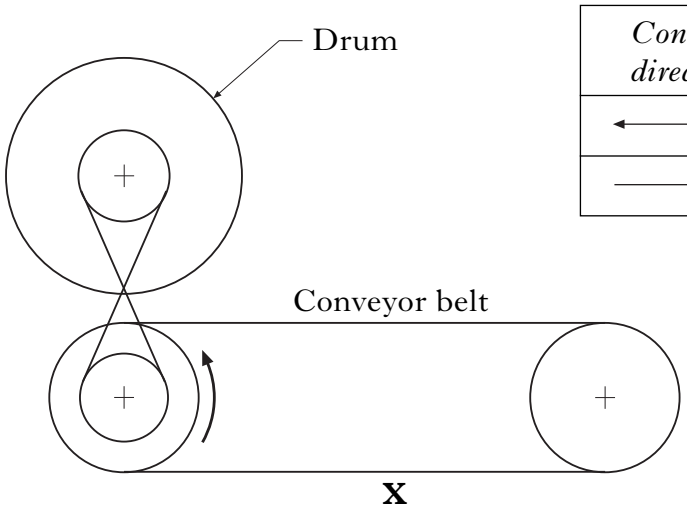
KU	RNA

7. A conveyor belt system is used in a recycling process.



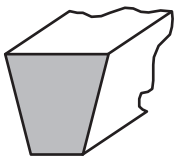
(*a*) Indicate (✓) on the tables below the direction of movement of the conveyor belt and the drum.

Drum direction	

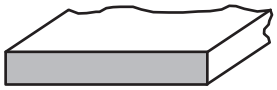


Conveyor belt direction at **X**	
←	
→	

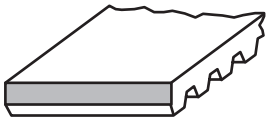
Three different types of belt are shown below.



(1) V belt



(2) Flat belt



(3) Toothed belt

(*b*) State which belt (1, 2 or 3) is used for:

(i) crossed belt drives;

_____

(ii) positive (non-slip) drives.

_____

2
1
0

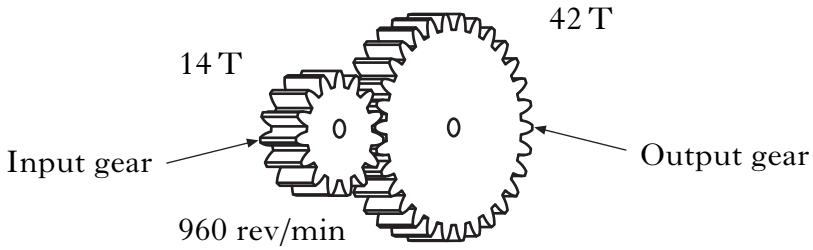
1
0

1
0

DO NOT WRITE IN THIS MARGIN

7. (continued)

An electric motor drives the conveyor belt system through a simple gear train.



(*c*) Calculate the speed of the output gear when the input gear rotates at 960 rev/min.

KU	RNA
	2
	1
	0

[Turn over

DO NOT WRITE IN THIS MARGIN

KU	RNA

8. An automatic bicycle rack for a car is operated by a microcontroller.

The sequence of operations for **lowering** a bicycle is listed below.

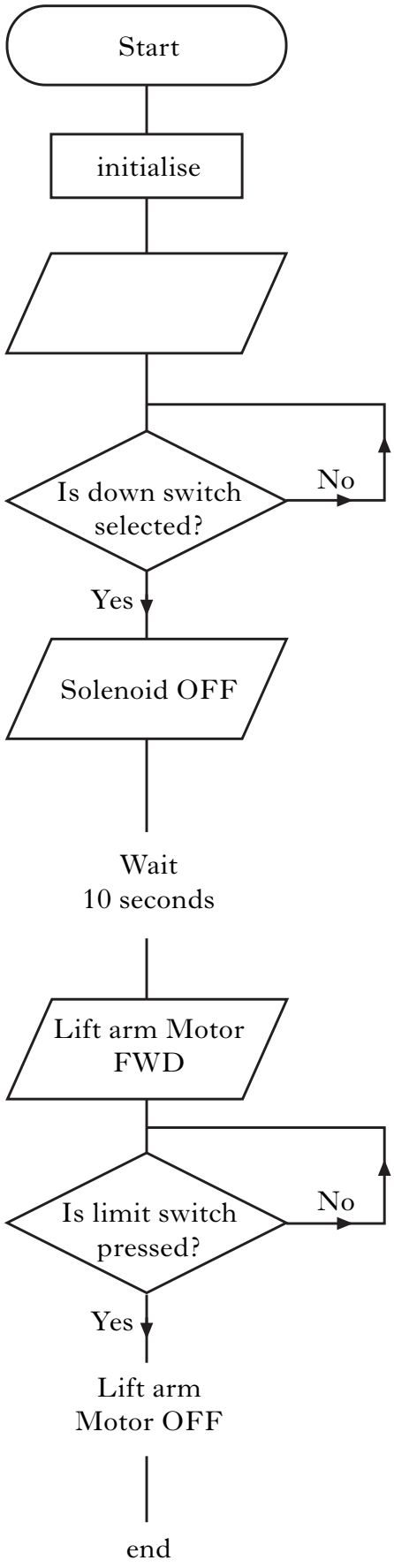
- The sequence begins with the lift arm motor off and locking solenoid on.
- When the 'down' switch is pressed the locking solenoid switches off then 10 seconds later the lift arm motor rotates forward.
- When the lift arm is in the fully lowered position a limit switch is activated which stops the motor.
- The sequence ends.

Input Connection	Pin	Output Connection
	7	
	6	
	5	
	4	
	3	Lift Arm Motor FORWARD
	2	Locking Solenoid
Limit Switch	1	
Down Switch	0	

DO NOT WRITE IN THIS MARGIN

8. (continued)

(*a*) Complete, with reference to the sequence of operations and Data Booklet, the flowchart by adding the correct symbols and instructions.



KU	RNA
	5
	4
	3
	2
	1
	0

DO NOT WRITE IN THIS MARGIN

8. (continued)

KU	RNA

(*b*) Complete, with reference to the microcontroller connections, Data Booklet and flowchart, the PBASIC program.

```
init:       _____________________     'set pins 0 and 1 as inputs, rest outputs
            let pins = 0              'switch all pins off

main:       let pins = %00000100      'solenoid ON and motor OFF
            if pin0 = 1 then label_1  'test pin0
            goto main                 ' _____________________

label_1:    _____________________     'solenoid OFF
            pause 10000               '10 second delay
            high 3                    'motor forward

label_2:    _____________________     'test pin 1
            goto label_2

label_3:    low 3                     ' _____________________
            end                       'end program
```

5 4 3 2 1 0

(*c*) State **two** advantages of using a microcontroller instead of a hardwired electronic circuit.

1 _____ **2 1 0**

2 _____ **2 1 0**

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

(i) **ROM**

Full name _____ **2 1 0**

Function _____ **2 1 0**

(ii) **RAM**

Full name _____ **2 1 0**

Function _____ **2 1 0**

(iii) **ALU**

Full name _____ **2 1 0**

Function _____ **2 1 0**

DO NOT WRITE IN THIS MARGIN

KU	RNA
1 0	

8. (continued)

(*e*) State the function of the clock in a microcontroller.

_____

[*END OF QUESTION PAPER*]

[BLANK PAGE]