FOR OFFICIAL USE

C

	KU	RNA
Total Marks		

4040/402

NATIONAL QUALIFICATIONS 2009

TUESDAY, 5 MAY
2.35 PM – 4.05 PM

TECHNOLOGICAL STUDIES
STANDARD GRADE
Credit 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.

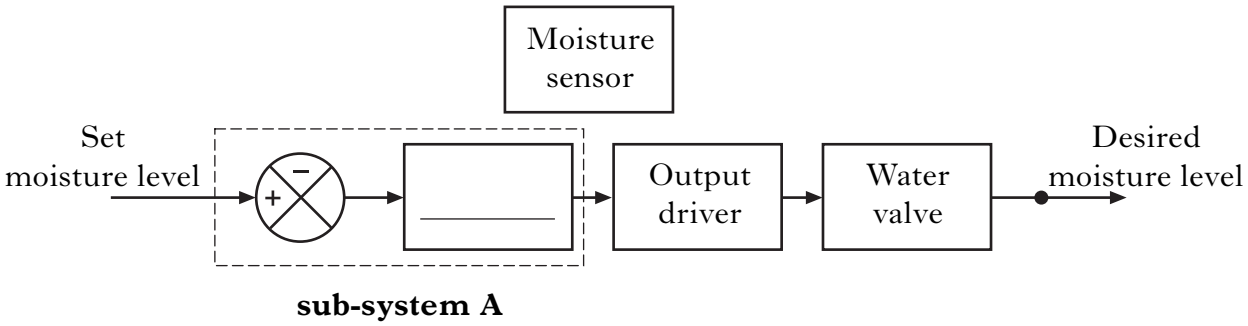
[BLANK PAGE]

DO NOT WRITE IN THIS MARGIN

KU	RNA

1. The moisture level in a greenhouse is controlled automatically.

(*a*) Complete the **control** diagram below.



sub-system A

2 1 0

(*b*) State the type of control produced by this automatic system.

_____

1 0

(*c*) State a suitable electronic device which could be used for the output driver sub-system.

_____

1 0

(*d*) Describe the operation of **sub-system A**.

_____

_____

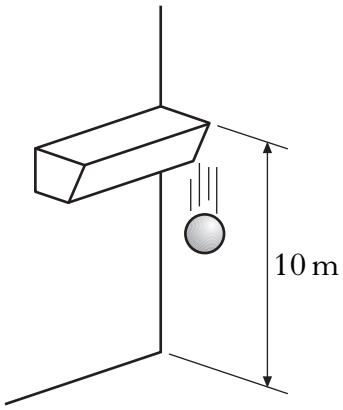
2 1 0

[Turn over

DO NOT WRITE IN THIS MARGIN

KU	RNA

2. A 0·7 kg ball is dropped from a 10 m high balcony.



(*a*) Calculate, **showing all working and units**:

(i) the potential energy of the ball at the balcony;

2 1 0

(ii) the maximum velocity of the ball.
(Assume that all E_p is converted into E_k.)

2 1 0

(*b*) When the ball bounces, it does not reach its original height.
State the two main forms of **energy** which are lost when the ball bounces.

(i) _____ **2 1 0**

(ii) _____

DO NOT WRITE IN THIS MARGIN

KU	RNA

2. (continued)

Renewable energy can be generated from a number of different sources.

(*c*) State **one disadvantage** for each of the following renewable sources.
(**Give a different disadvantage for each source.**)

Tidal _____

_____

Wave _____ **2**

_____ **1**

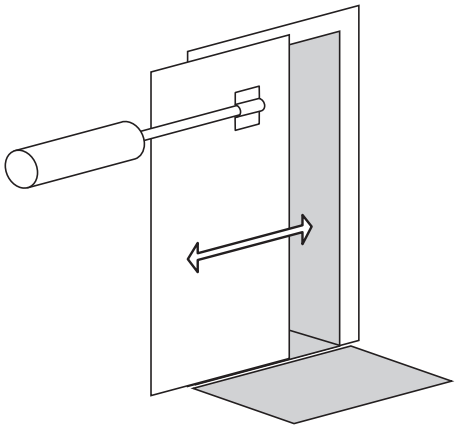
0

[Turn over

DO NOT WRITE IN THIS MARGIN

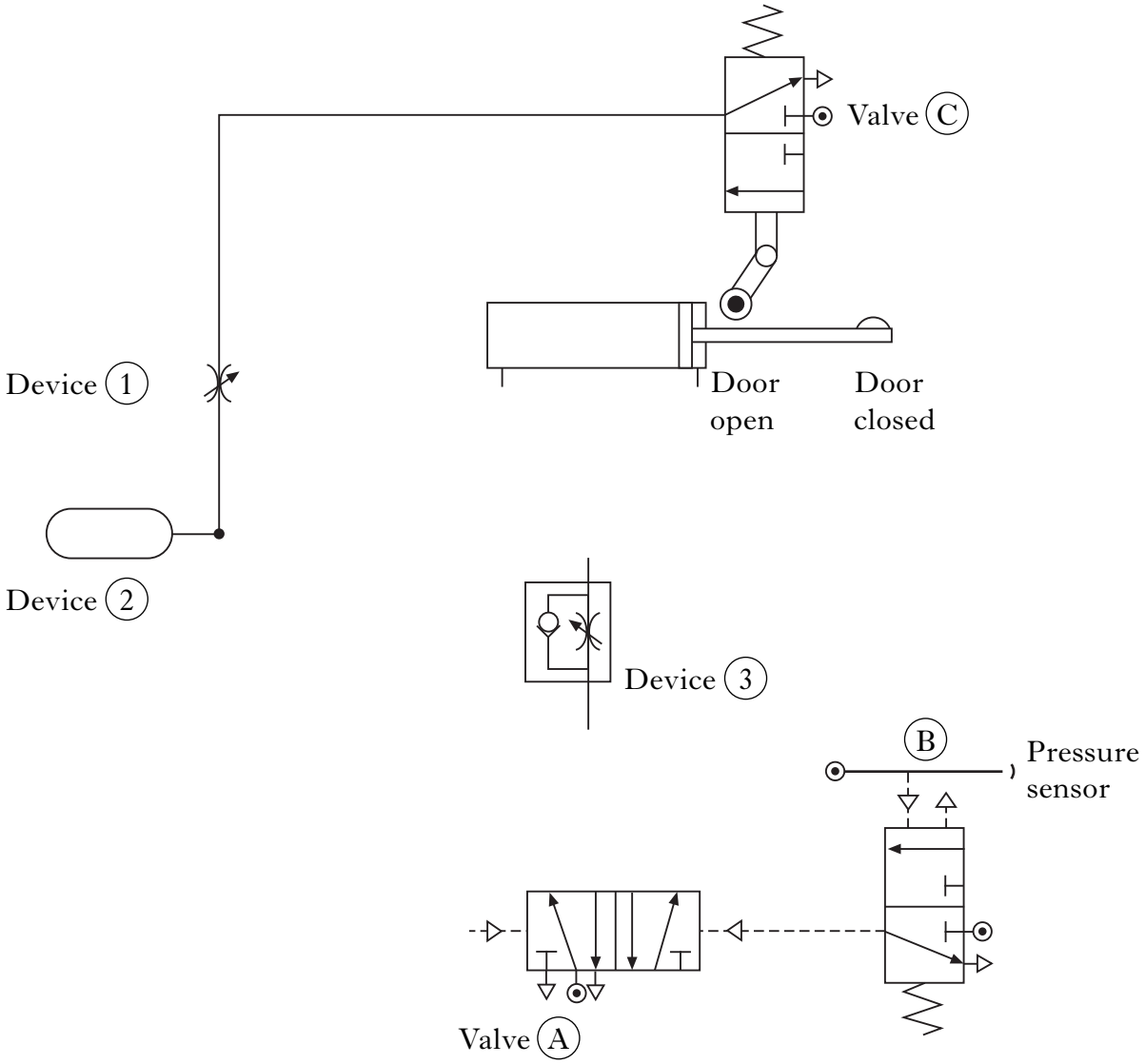
KU	RNA

3. A pneumatic circuit is used to control the operation of an automatic door.



When a person steps on to the pressure sensor, the piston will instroke and open the door. After an 8 second delay, the piston will automatically outstroke and slowly close the door.

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



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

KU	RNA

3. (continued)

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

(i) Actuator (B) _____ **1 0**

(ii) Device (3) _____ **1 0**

(iii) Valve (C) _____ **3 2 1 0**

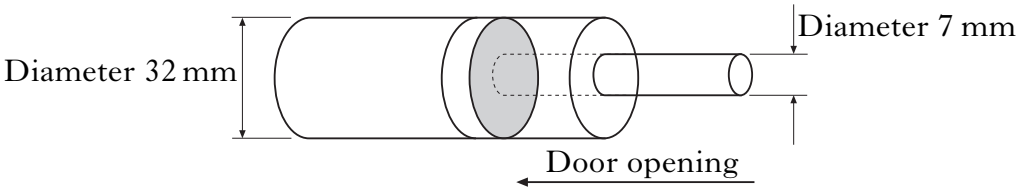
_____

(*c*) Describe, using appropriate terminology, the operation of Device (3).

_____ **2 1 0**

_____

(*d*) Calculate the instroking force when the air pressure is 2·32 N/mm^2.



4 3 2 1 0

(*e*) (i) State the name of Device (2).

_____ **1 0**

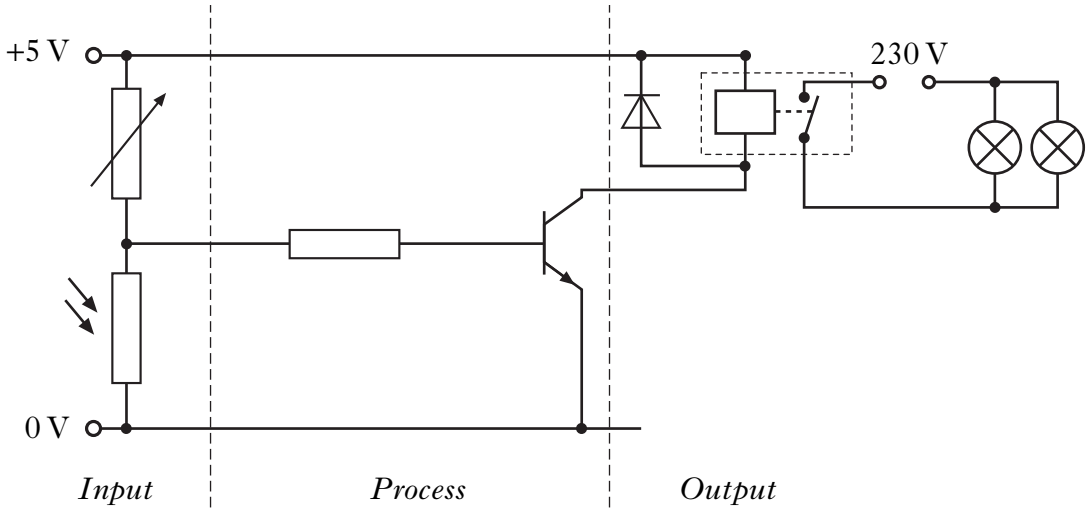
(ii) Describe why Device (2) is rarely used on its own to produce a pneumatic time delay.

_____ **1 0**

DO NOT WRITE IN THIS MARGIN

KU	RNA

4. An automatic lighting system has been developed so that it only switches on when someone is sensed in the room. The circuit diagram is shown below.



(*a*) Describe, using appropriate terminology, the operation of the:

(i) Input sub-system _____

_____

_____

_____ **2 1 0**

(ii) Process sub-system _____

_____

_____

_____ **2 1 0**

(iii) Output sub-system _____

_____

_____

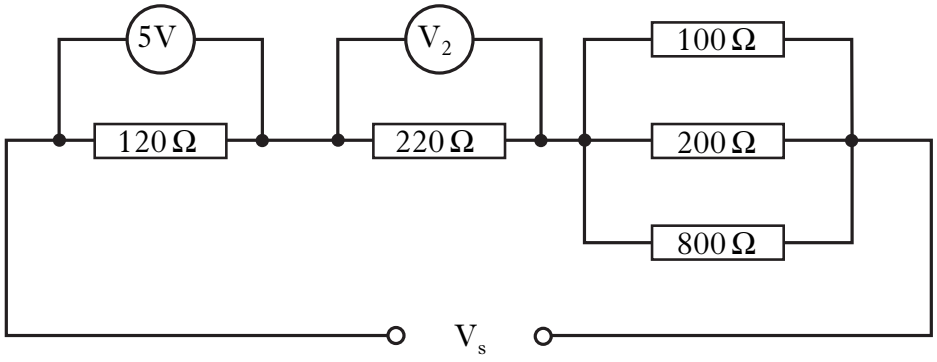
_____ **2 1 0**

DO NOT WRITE IN THIS MARGIN

KU	RNA

4. (continued)

Another part of the lighting system uses the following circuit.



(*b*) Calculate:

(i) the current through the 120 Ω resistor;

2 1 0

(ii) the voltage V_2;

2 1 0

(iii) the total resistance of the three parallel resistors;

3 2 1 0

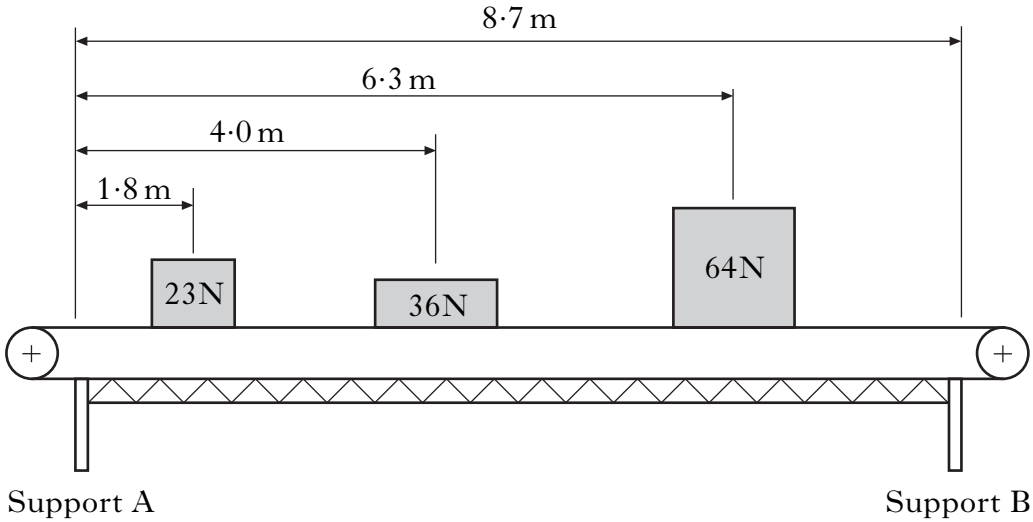
(iv) the supply voltage V_s.

3 2 1 0

DO NOT WRITE IN THIS MARGIN

KU	RNA

5. A conveyor belt is used to move packages in a warehouse. When the conveyor belt stopped, packages were in the position shown.



(*a*) Draw the free body diagram for the system.

2
1
0

(*b*) (i) Calculate, by taking moments about support A, the reaction at support B.

3
2
1
0

(ii) Determine the reaction at support A.

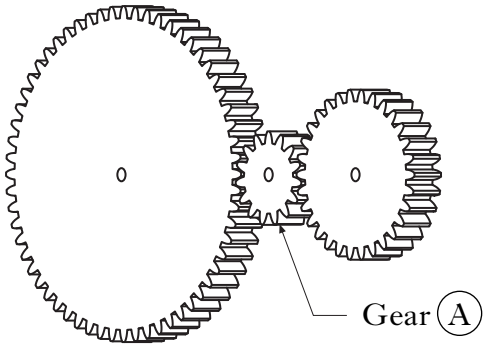
2
1
0

DO NOT WRITE IN THIS MARGIN

KU	RNA

5. (continued)

The conveyor belt is driven by a gear drive, part of which is shown below.



(*c*) State **one** advantage of using a gear drive over a belt drive.

_____ **1 0**

(*d*) (i) State the name of Gear (A).

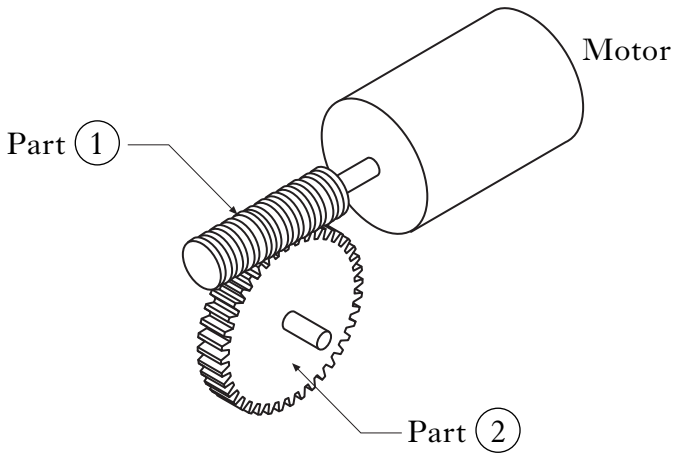
_____ **1 0**

(ii) Describe the effect Gear (A) has on the output speed **and** direction of the mechanism.

_____ **2 1 0**

_____

Another part of the system makes use of the mechanism shown below.



(*e*) State the name of the two parts of the mechanism shown above.

Part (1) _____ **2 1 0**

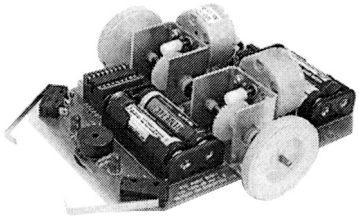
Part (2) _____

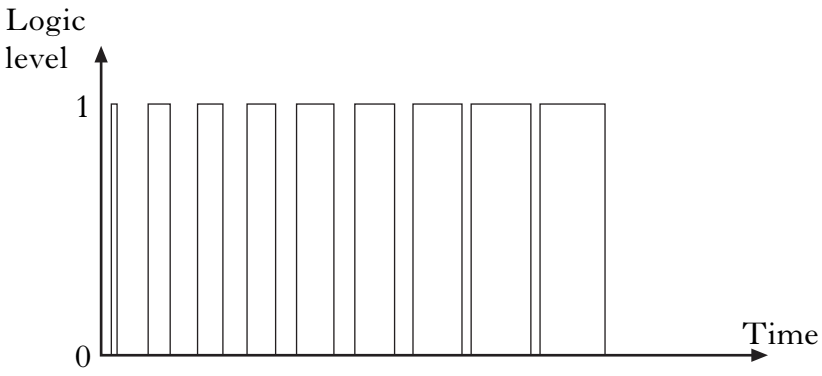
DO NOT WRITE IN THIS MARGIN

KU	RNA

6. A student is programming a microcontroller to start and slowly accelerate a motorised buggy.

A graph showing the control required is given below.





(*a*) State the name given to the programming technique **where a motor is rapidly switched on and off**.

_____ **1 0**

(*b*) For the programming technique you named in (*a*):

(i) state the name given to the **time** when the motor is **switched on**;

_____ **1 0**

(ii) state the name given to the **time** when the motor is **switched off**.

_____ **1 0**

The student's initialisation and the PBASIC sub-procedure "speed", used to slowly accelerate the buggy, is shown below.

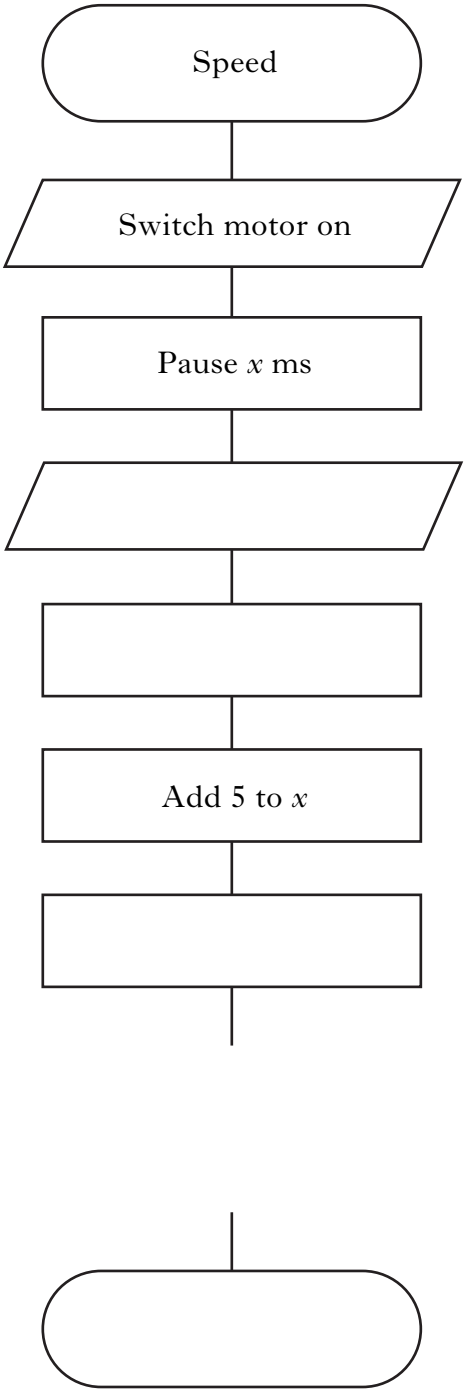
```
init:   symbol x = b0          'rename memory location b0 as x
        symbol y = b1          'rename memory location b1 as y
        symbol motor = 7       'rename pin 7 as "motor"
        let x = 0              'starting value of x is 0
        let y = 50             'starting value of y is 50

speed:  for b2 = 1 to 10       'start for ... next loop
            high motor         'motor on
            pause x            'pause x ms
            low motor          'motor off
            pause y            'pause y ms
            let x = x + 5      'add 5 to x
            let y = y – 5      'subtract 5 from y
        next b2                'complete for ... next loop

        return                 'return to main program
```

DO NOT WRITE IN THIS MARGIN

KU	RNA

6. (continued)

(*c*) Complete, with reference to the PBASIC "**speed**" sub-procedure and the Data Booklet, the flowchart below.



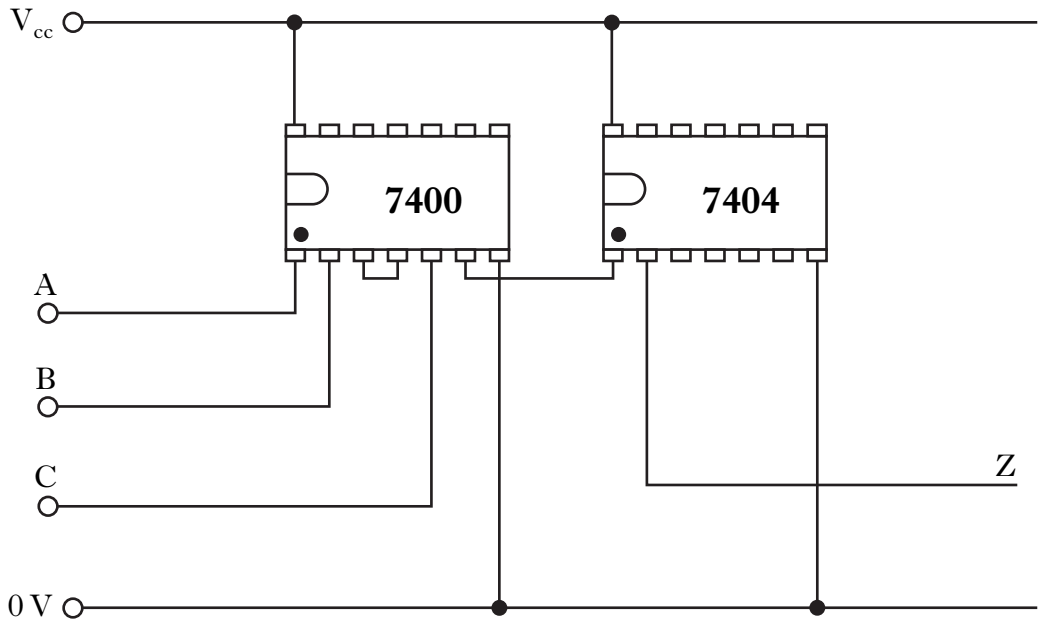
6 5 4 3 2 1 0

[Turn over

DO NOT WRITE IN THIS MARGIN

KU	RNA

7. A set of DJ turntables has a number of indicator lights. Part of the circuitry for the control of these lights is shown below.



(*a*) State, with reference to the Data Booklet, the **full name** of the ICs required to build the circuit.

IC Number **7400**

Full Name _____

IC Number **7404** **2**

Full Name _____ **1 0**

(*b*) Draw the logic diagram for the wiring circuit shown above.

3 2 1 0

DO NOT WRITE IN THIS MARGIN

KU	RNA

7. (continued)

(*c*) (i) State the name of the family which these ICs belong to.

1 0

_____

(ii) State a suitable supply voltage (V_{cc}) for this family of ICs.

1 0

_____

(iii) State the name of another family of ICs.

1 0

_____

(iv) State one **advantage** of using this family of ICs over the type named in (iii).

1 0

_____

(v) State one **disadvantage** of using this family of ICs over the type named in (iii).

1 0

_____

(*d*) State the purpose of the dot on an IC.

1 0

_____

An LED is used to show a high output from the circuit.

(*e*) (i) State the full name of an LED.

1 0

_____

(ii) Draw the symbol for an LED below.

1 0

A resistor is normally used in series with an LED.

(*f*) State the purpose of this resistor.

1 0

_____

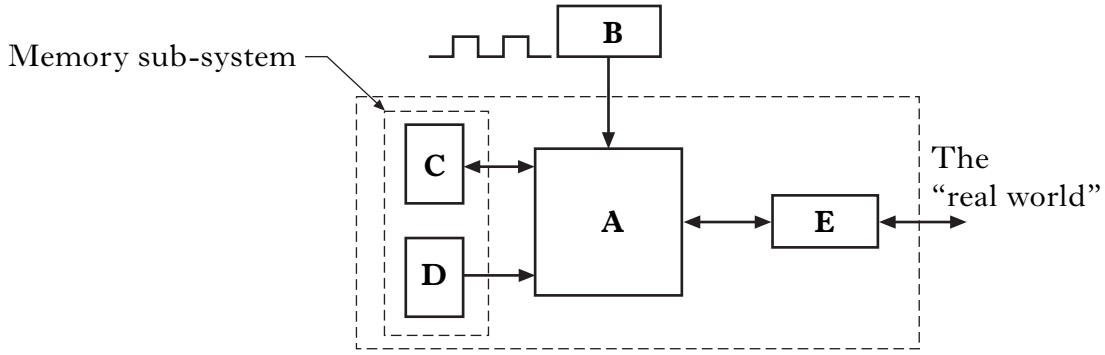
[Turn over for Question 8 on *Page sixteen*

DO NOT WRITE IN THIS MARGIN

KU	RNA

8. Microcontrollers are used in a variety of modern systems.

A simplified block diagram showing a microcontroller is given.



(*a*) State the name of the parts (**A** to **E**) shown on the diagram above.

A _____

B _____

C _____

D _____

E _____

5
4
3
2
1
0

(*b*) State the full name and function of the EEPROM sub-system used with a microcontroller.

Full name _____

_____

Function _____

_____

2
1
0

[*END OF QUESTION PAPER*]