2010 Technological Studies

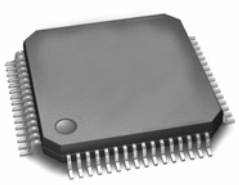
Standard Grade – General

Finalised Marking Instructions

Mark Allocation

Marks	
KU	**RNA**

1. Microcontrollers consist of several sub-systems.



(a) Complete the table by matching the correct sub-system from the list below with its function given in the table.

ALU *Clock* *RAM* *Bus* *ROM*

Microcontroller sub-systems	Function
Clock	Synchronises the system and controls the speed of operation.
ALU	The "brain" of the microcontroller that carries out mathematical functions.
Bus	Used to move information between microcontroller sub-systems.
RAM	Temporary memory used during the running of the program/task.
ROM	Permanent memory where a program can be stored.

5
4
3
2
1
0

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

(i) **ROM**

Full name **Read only memory**

1
0

(ii) **RAM**

Full name **Random access memory**

1
0

(iii) **ALU**

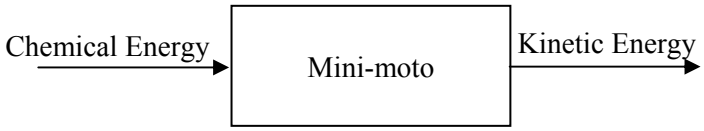
Full name **Arithmetic logic unit**

1
0

	Marks	
	KU	RNA

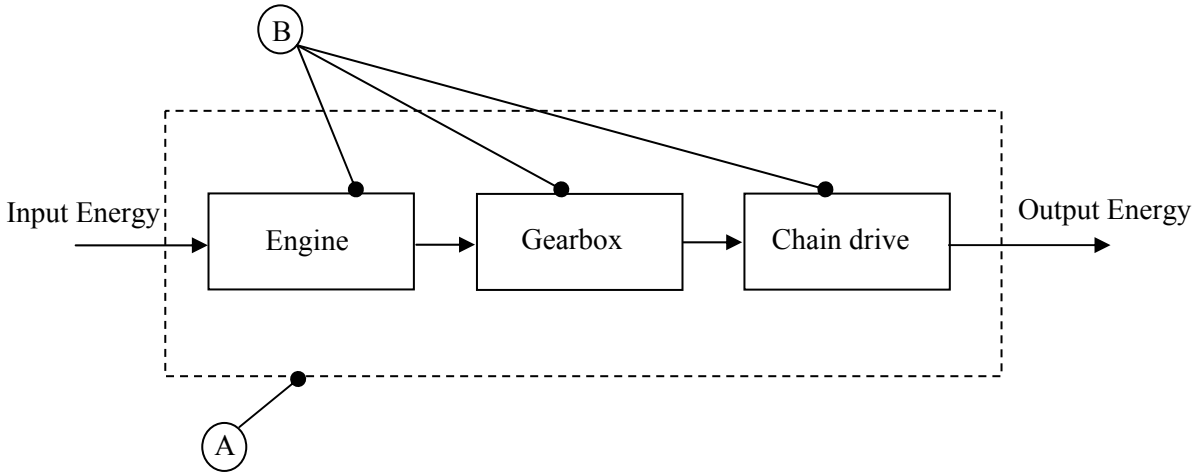
2. A petrol driven mini-moto is shown below.

(a) Complete the system diagram below for the mini-moto by adding the main input **energy** and the main output **energy**.



2
1
0

(b) The main parts of a mini-moto drive system are shown in the diagram below.



(i) (A) separates the system from the outside world.

State the name of this part of the diagram.

(System) Boundary

1
0

(ii) The whole system can be broken down into several parts labelled above as (B).

State the name given to these parts.

Sub-systems

1
0

Marks	
KU	RNA

3. An automatic sliding roof for a sports stadium is operated by a microcontroller.

Part of the control program includes a sub-procedure ‘close’ which will run when frost is detected.

The sequence is as follows:

- the floodlights switch on;
- after a 5 second delay the roof motor switches on;
- when the stadium roof is fully closed a limit switch is activated which stops the motor;
- the sequence ends and returns to the main program.

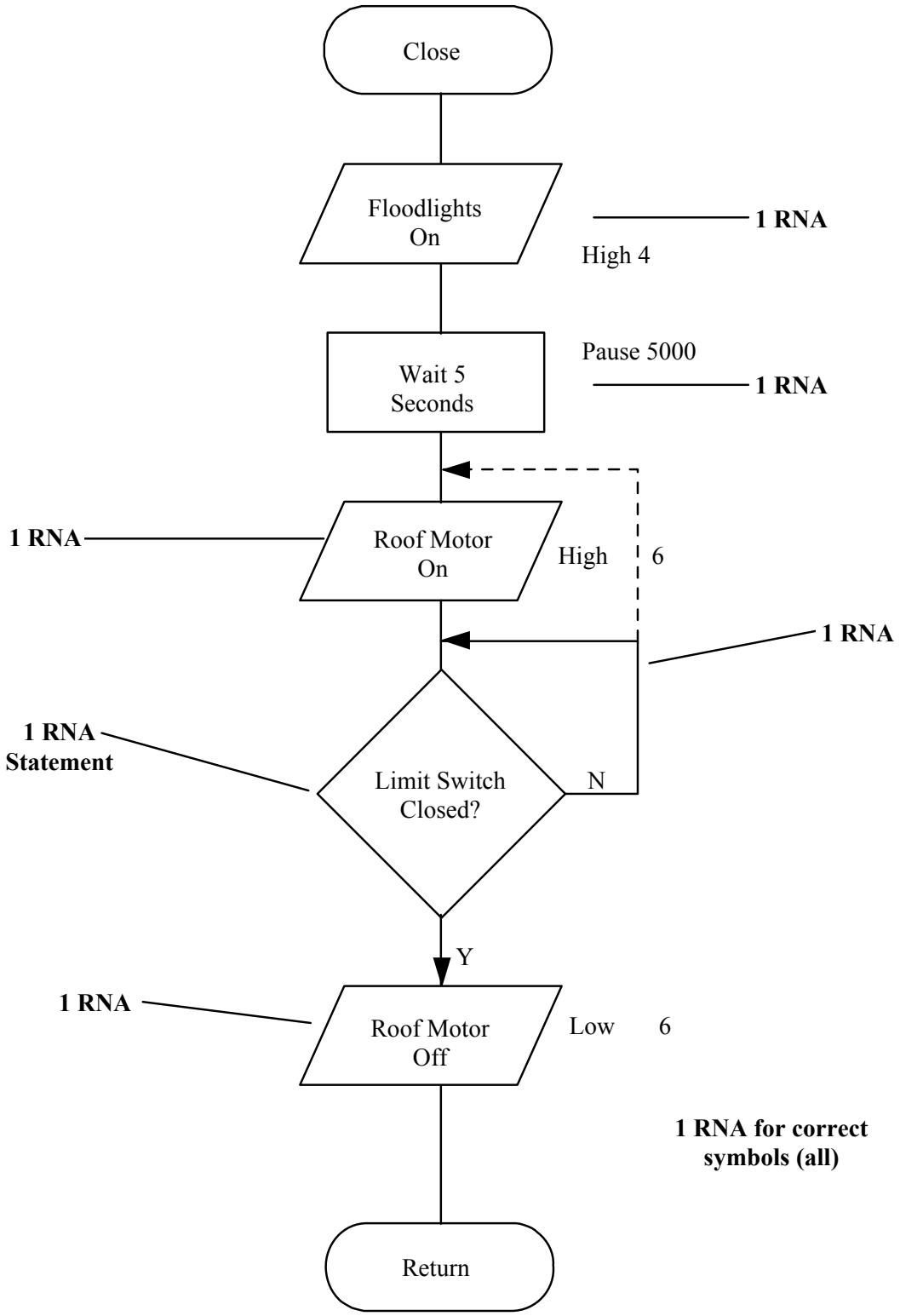
INPUT/OUTPUT CONNECTIONS

Input Connection	Pin	Output Connection
	7	
	6	Roof motor
	5	
	4	Floodlights
	3	
	2	
Limit Switch	1	
	0	

Marks	
KU	RNA

3. (continued)

(a) Complete, with reference to the sequence of operations and Data Booklet, the flowchart for sub-procedures 'close'.



7 6 5 4 3 2 1 0

	Marks	
	KU	RNA

3. (continued)

The flowchart is used to develop a PBASIC program.

(b) With reference to the Data Booklet state the PBASIC command:

(i) for pin 4, and 6 to be set up as an output and the remaining 6 pins set up as inputs;

let DIRS = %01010000 on 80 (1) (1)

1 RNA for Binary number
1 RNA for PBASIC

2
1
0

(ii) to produce a 5 second delay.

pause 5000

1
0

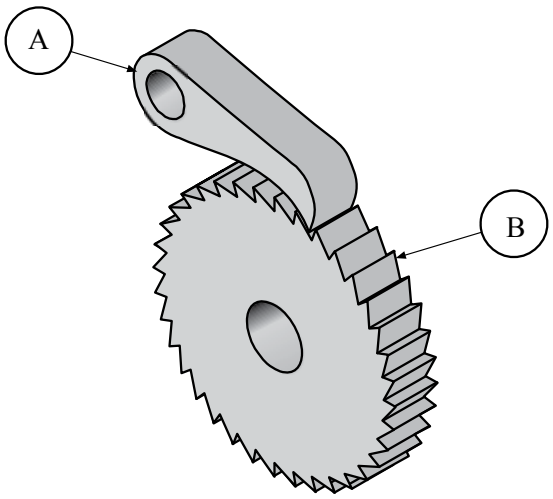
(c) State **two** advantages of using a microcontroller instead of a hard wired electronic system.

1 **More flexible/features/accurate/smaller with less parts**

2 **Re-programmable/easier assembly/cheaper because less parts**

2
1
0

The device shown in the sketch below is part of the stadium roof mechanism.



(d) State the name of parts (A) and (B)

(A) **Pawl** (B) **Ratchet**

1 KU incorrect order

2
1
0

	Marks	
	KU	RNA

4. A bicycle light is modelled using electronic boards.

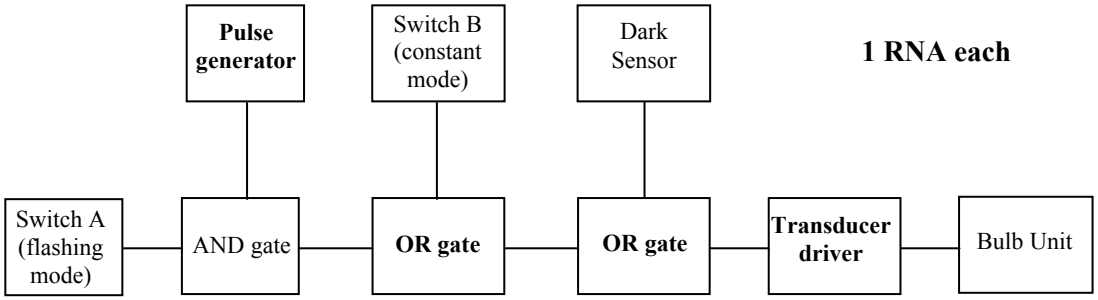
The light can be activated manually by either switch A (flashing mode) **or** by switch B (constant mode). It will also switch on automatically when darkness is sensed.

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

Pulse generator *AND gate* *OR gate* *Magnetic Switch*

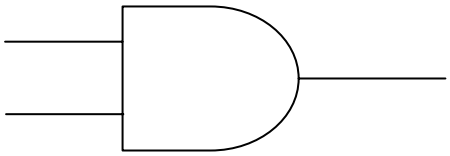
Latch *Temperature sensor* *Transducer driver* *NOT gate*

1 RNA each



		4
		3
		2
		1
		0

(*b*) (i) Sketch the logic symbol for an AND gate.



1 KU for shape
1 KU for input/output lines

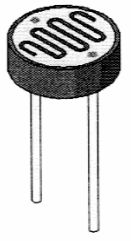
2	
1	
0	

(ii) Complete the truth table for an AND gate.

Input A	Input B	Z	
0	**0**	**0**	**1 KU row**
0	1	0	
1	**0**	**0**	**1 KU row**
1	**1**	**1**	**1 KU row**

3	
2	
1	
0	

(c) State the name of the electronic component shown opposite.



LDR (Light Dependant Resistor)

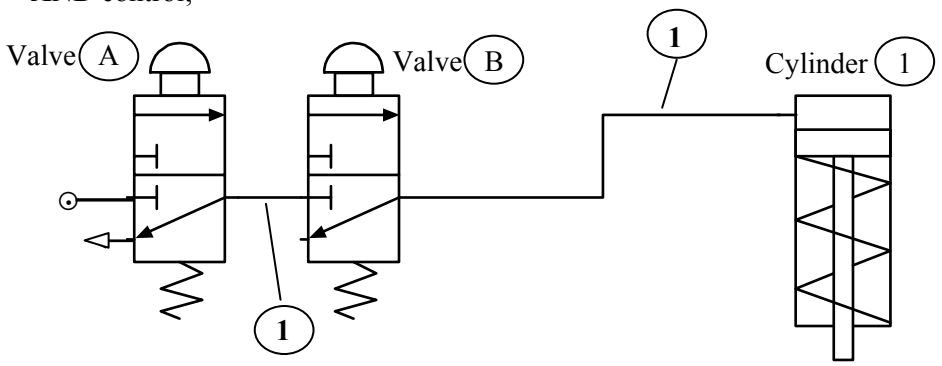
1	
0	

(d) State the function of a Latch Unit.

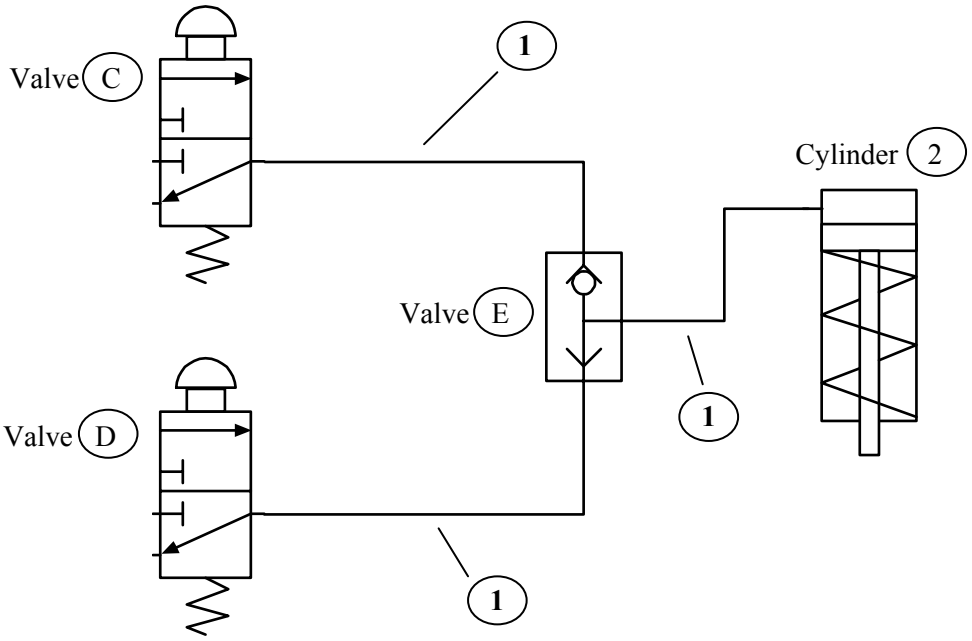
The latch will keep the output on.

1	
0	

	Marks	
	KU	RNA
5. Pneumatic circuits can be used to perform logical operations.		
(a) Draw the symbols for exhaust and mains air on Valve (A) below.	**2**	**2**
	1	**1**
1 KU for correct symbol (exhaust) and 1 KU for correct symbol (mains air)	**0**	**0**
1 RNA for correct position each		
(b) Complete the piping of the pneumatic circuits below to give:		
(i) **AND** control;		



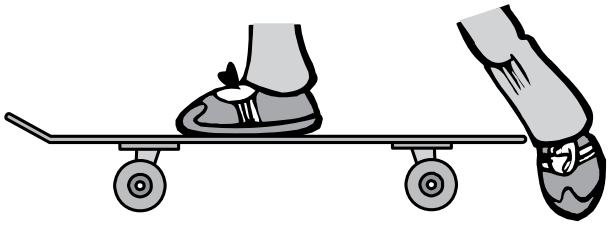
		2
		1
		0
(ii) **OR** control.		



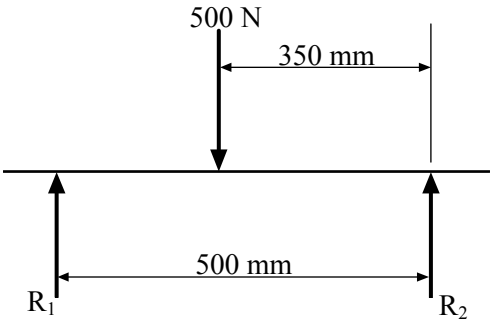
		3
		2
		1
		0
(c) State the **full name** of the following pneumatic components.	**3**	
	2	
	1	
(i) Valve (D) **3/2, spring return, push button**	**0**	
	1	
(ii) Valve (E) **Shuttle**	**0**	

	Marks	
	KU	RNA

6. A skateboarder is shown below.



The diagram below shows the forces and distances on the skateboard.



(a) State the name given to the type of diagram shown above.

Free body (diagram) — **1 0**

(b) (i) Calculate, by taking moments about R_2, the size of the reaction force R_1.

$\Sigma CWM = \Sigma ACWM$

$(R_1 \times 500) = (500 \times 350)$ — **1 RNA for substituion**

$R_1 = \frac{500 \times 350}{500}$ — **1 RNA for transposition** — **3 2**

$R_1 = 350$ N — **1 RNA for correct answer from given working** — **1 0**

(ii) Calculate the reaction force R_2.

Σ upward = Σ downward

$350 + R_2 = 500$ — **1 RNA for substituion – FTE**

$R_2 = 500 - 350$ — **2**

1 RNA for correct answer from given working — **1 0**

$R_2 = 150$ N

Bearings are used in the wheels of a skateboard to reduce friction.

(c) State **one** other method which can be used to reduce friction.

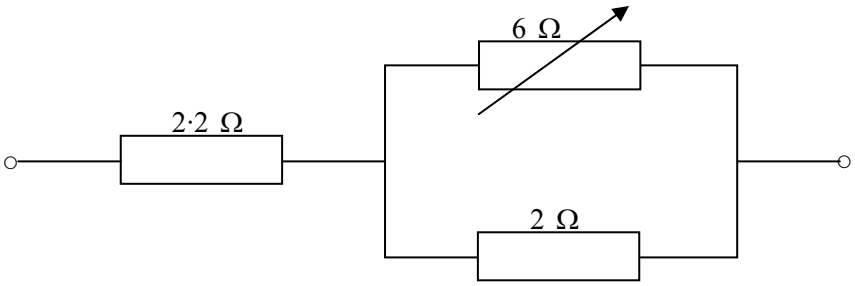
Lubrication — **1 0**

	Marks	
	KU	RNA

7. A hire shop in a popular Spanish resort rents out electric scooters.

The scooters use rechargeable batteries.

(a) Part of a resistor arrangement for the battery charger is shown.



(i) Calculate the resistance of the **parallel** branch shown above.

$$R_T = \frac{R_1 \times R_2}{R_1 + R_2}$$

$$= \frac{6 \times 2}{6 + 2}$$

$$= \frac{12}{8} = 1{\cdot}5\ \Omega$$

1 RNA for substitution
1 RNA for correct answer from given working

	2
	1
	0

(ii) Calculate the **total** circuit resistance for the arrangement shown above.

$R_T = R_1 + R_2$ **FTE**

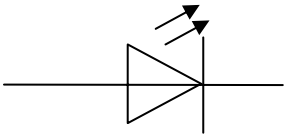
$= 2{\cdot}2 + 1{\cdot}5$ **1 RNA for substitution**

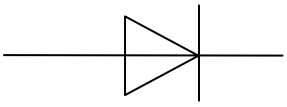
$= 3{\cdot}7\ \Omega$ **1 RNA for correct answer from given working**

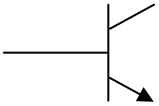
	2
	1
	0

Other electronic components are used in the battery charger.

(b) State the name of the electronic components shown below.







1 **LED** 2 **Diode** 3 **Transistor**

3	
2	
1	
0	

	Marks	
	KU	RNA

7. (continued)

The current flowing through the 2·2 Ω resistor is 0·6 amps.

(c) (i) Calculate the voltage across the 2·2 Ω resistor.

V	=	IR		**2**
V	=	0·6 × 2·2	**1 RNA for substitution**	**1**
	=	1·32 V	**1 RNA for correct answer from given working**	**0**

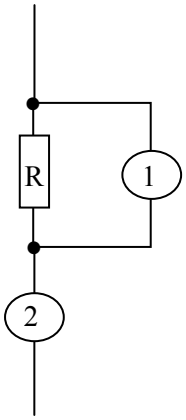
(ii) Calculate the power used by the 2·2 Ω resistor.

P	=	VI	**FTE from *(c)* (i)**	**2**
P	=	1·32 × 0·6	**1 RNA for substitution**	**1**
	=	0·792	**1 RNA for correct answer from given working**	**0**

(iii) Draw the symbol for an ammeter.

1
0

(d) (i) Select (✓) the correct position of a voltmeter to measure the voltage across the resistor R.



✓ Position 1

☐ Position 2

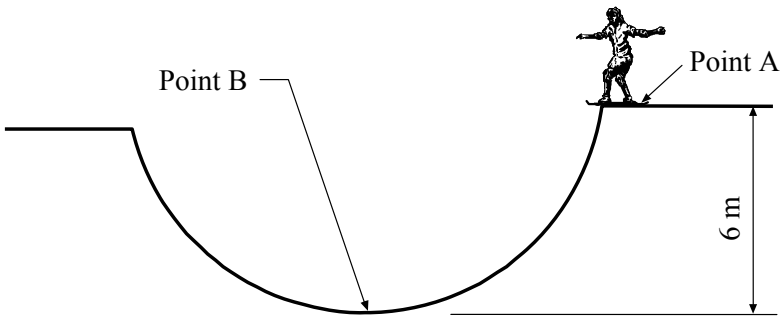
1
0

(ii) Draw the symbol for a voltmeter.

1
0

	Marks	
	KU	RNA

8. A snowboarder of mass 65 kg is standing at point A on a half pipe.



(a) Calculate the potential energy of the snowboarder at point A.

PE	=	mgh		**2**
	=	65 × 9·81 × 6	**1 RNA for substitution**	**1**
	=	3825·9 J	**1 RNA for correct answer from given working**	**0**

The snowboarder is travelling at 10 m/s when he reaches point B.

(b) Calculate the kinetic energy of the snowboarder at point B.

KE	=	½ mv^2		**2**
	=	0·5 × 65 × 10^2	**1 RNA for substitution**	**1**
	=	3250 J	**1 RNA for correct answer from given working**	**0**

(c) Complete the table below to indicate (✓) whether each listed energy source is renewable or non-renewable.

Energy source	Energy type	
	Renewable	*Non-renewable*
Wind	✓	
Coal		✓
Gas		✓
Bio-mass	✓	
Wave	✓	

1 KU each

5
4
3
2
1
0

[END OF MARKING INSTRUCTIONS]