2013 Technological Studies

Standard Grade – General

Finalised Marking Instructions

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Part One: General Marking Principles for Technological Studies – Standard Grade – General

This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this Paper. These principles must be read in conjunction with the specific Marking Instructions for each question.

(a) Marks for each candidate response must always be assigned in line with these general marking principles and the specific Marking Instructions for the relevant question. If a specific candidate response does not seem to be covered by either the principles or detailed Marking Instructions, and you are uncertain how to assess it, you must seek guidance from your Team Leader/Principal Assessor.

(b) Marking should always be positive ie, marks should be awarded for what is correct and not deducted for errors or omissions.

GENERAL MARKING ADVICE: Technological Studies – Standard Grade – General

The marking schemes are written to assist in determining the "minimal acceptable answer" rather than listing every possible correct and incorrect answer. The following notes are offered to support Markers in making judgements on candidates' evidence, and apply to marking both end of unit assessments and course assessments.

Mark Allocation

Marks	
KU	RNA

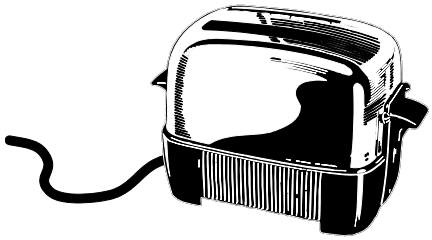
1. The systems approach is often used to help understand engineering problems.

(a) Draw the Universal Systems diagram.

3 2 1 0

1 KU - Input 1 KU - Output 1 KU - Process with box and arrows

A toaster is shown below.



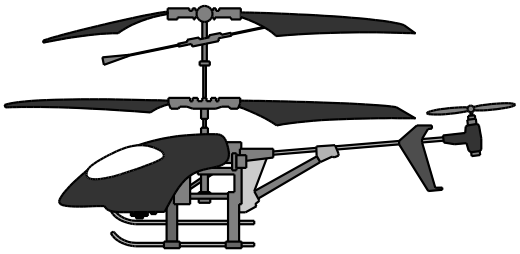
(b) Draw a **system diagram** for a toaster. Show the **main energy** input and the **main energy** output.

2 1 0

1 RNA - Input 1 RNA - Output (both must be energy)

	Marks	
	KU	RNA

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.

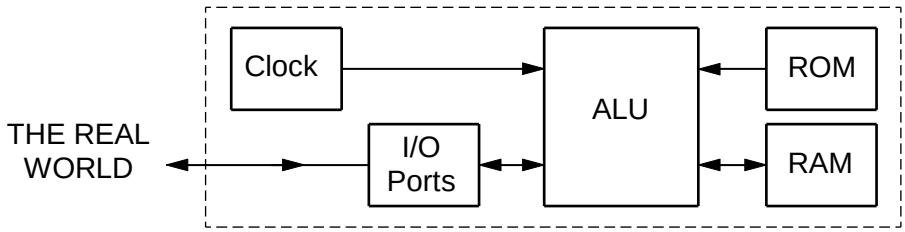
1 **Upgradable/reprogrammable** — **2**

Smaller due to fewer components — **1**

2 **Fewer components – less to go wrong/cheaper** — **0**

1 KU each valid answer (answers must be description)

The simplified block diagram below shows a typical microcontroller system.



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

(i) ALU **Arithmetic Logic Unit** **1 KU** — **3**

(ii) ROM **Read Only Memory** **1 KU** — **2**

(iii) RAM **Random Access Memory** **1 KU** — **1**, **0**

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

(i) ALU **microcontroller brain** **1 KU** — **2**

(ii) RAM **store program's data** **1 KU** — **1**, **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 **pause 10000** — **1**, **0**

(ii) switch on pin 3 **high 3 or let pins = %00001000 or let pins = 8** — **1**, **0**

(iii) check pin 0 and if low loop to label 'main' **1 RNA if pin0 = 0/1RNA then main** — **2**, **1**, **0**

	Marks	
	KU	RNA

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

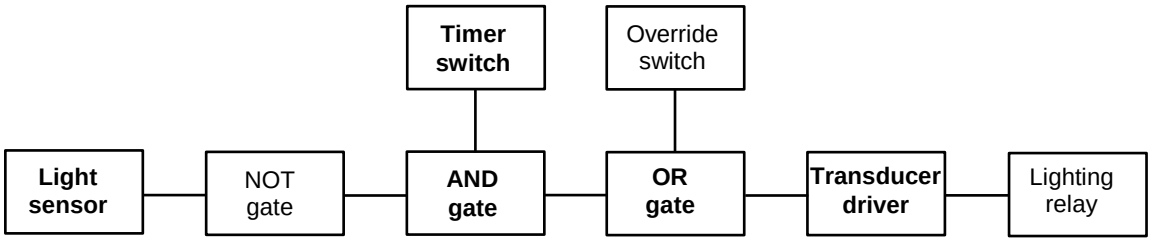
The security lighting relay will operate:

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 RNA

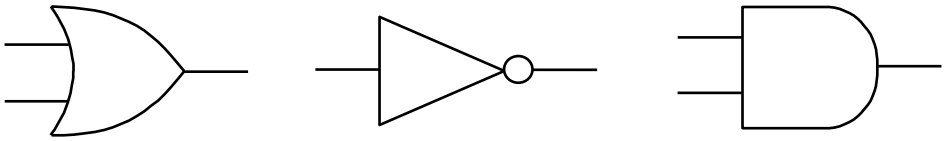
5 4 3 2 1 0

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

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

4 3 2 1 0

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



OR gate 1 KU **NOT gate 1 KU** **AND gate 1 KU**

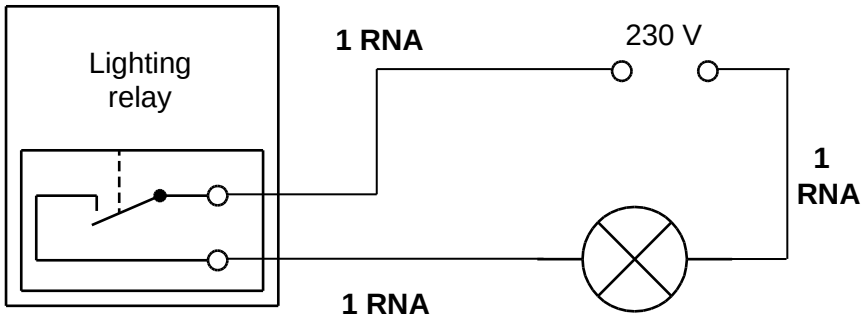
3 2 1 0

	Marks	
	KU	RNA

3. (continued)

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

Complete the wiring on 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.

SPST **Single Pole Single Throw**

1	
0	

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

To allow the low voltage/current electronic circuit to operate a high voltage/current electrical circuit

1	
0	

	Marks	
	KU	RNA

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 KU

3
2
1
0

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

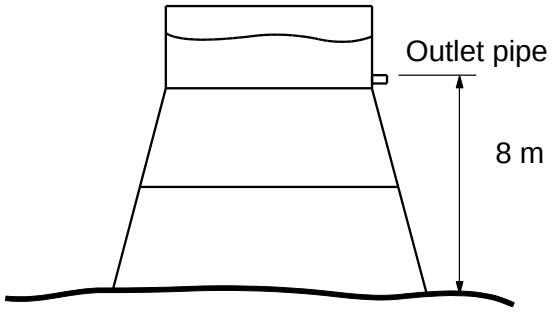
Only suitable at certain locations/damage to environment etc
Distance from population – power lines etc
Maintenance issues

1
0

	Marks	
	KU	RNA

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)

E_p = m g h		**2**
E_p = 6 × 9·81 × 8	**1 RNA substitution**	**1**
E_p = 470·88J	**1 RNA answer from working**	**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)

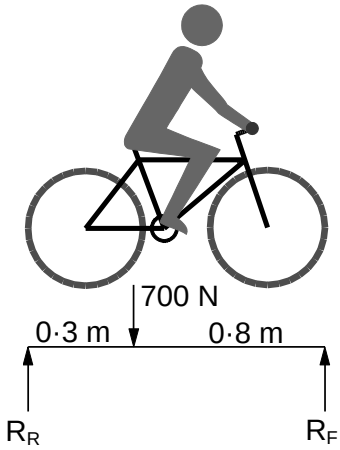
E_K = ½ m v^2		**2**
E_K = ½ × 6 × 10^2	**1 RNA substitution**	**1**
E_K = 300J	**1 RNA answer from working**	**0**

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

	1
Energy lost to heat/sound 1 RNA or due to air resistance etc 1 RNA	**0**

	Marks	
	KU	RNA

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.

Free Body — **1 0**

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

Σ*CWM* = ΣACWM

0·3 m × 700 N = 1·1 m × R_F **1 RNA substitution**

$R_F = \frac{0 \cdot 3 \times 700}{1 \cdot 1}$ **1 RNA transposition** — **3 2 1 0**

R_F = 190·9 N **1 RNA answer from working**

(ii) Determine the size of the reaction force R_R.

$\Sigma F_{up} = \Sigma F_{down}$

190·9 N + R_R = 700 N

R_R = 700 N − 190·9 N

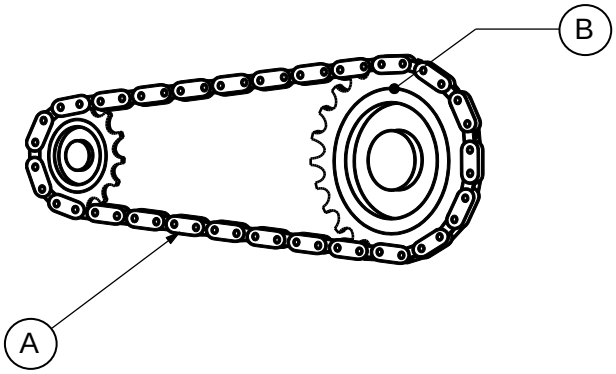
R_R = 700 N − 190·9 N **1 RNA substitution (allow FTE)** — **2 1 0**

R_R = 509·1 N **1 RNA answer from working**

	Marks	
	KU	RNA

5. (continued)

(c) The bicycle drive system is shown below.



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

(A) **Chain** **1** **KU** (B) **Sprockett** **1** **0**

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

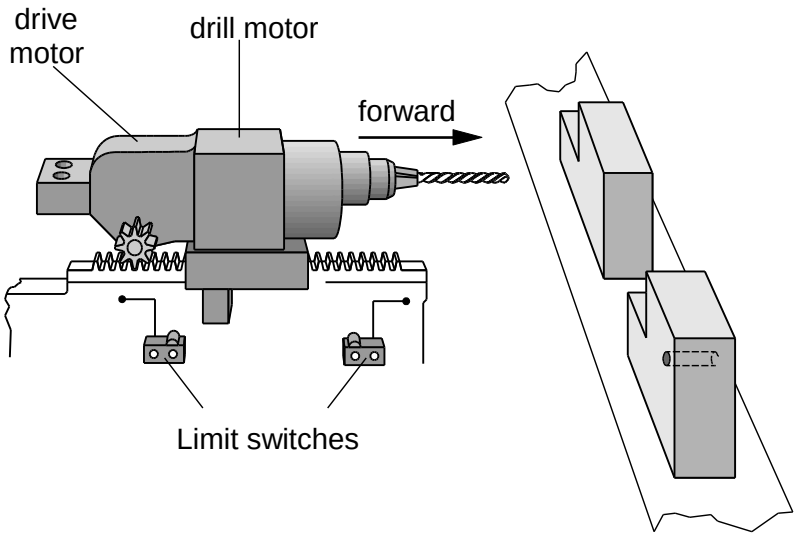
Transmit motion over longer distances/turn in same direction **0**

To reduce friction the drive system makes use of bearings.

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

Lubricate – 'Slippier' material used. **0**

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:

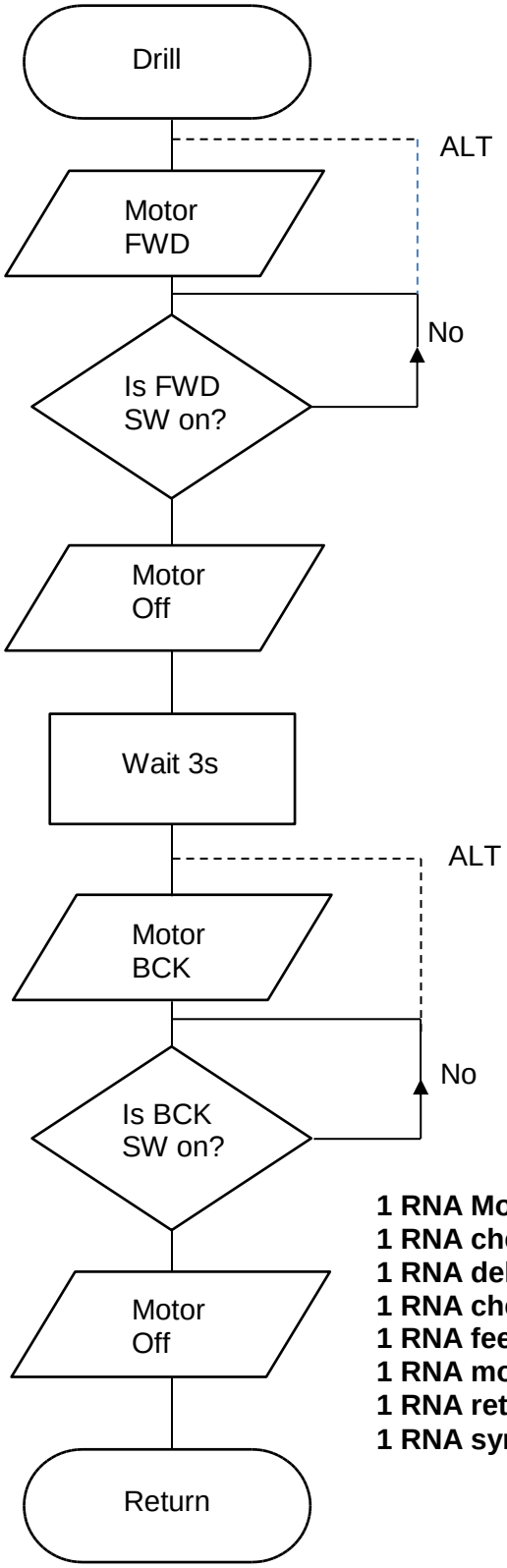
- a drive motor will move forward until the *forward limit* switch is pressed;
- the drive motor will halt for 3 seconds;
- the drive motor will reverse until the *back limit* switch is pressed;
- the drive motor will stop and the sequence will return to the main program.

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	

	Marks	
	KU	RNA

6. (continued)

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

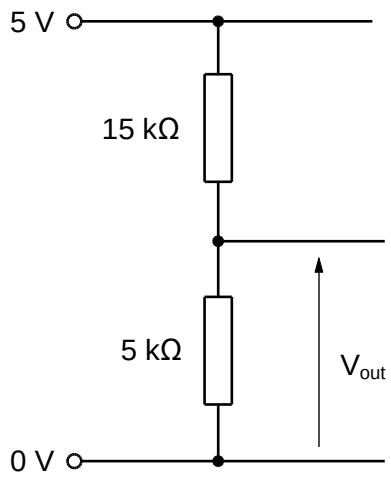


1 RNA Motor directions (× 2)
1 RNA check Fwd sw
1 RNA delay
1 RNA check bck sw
1 RNA feedback loops (× 2)
1 RNA motor off (× 2)
1 RNA return
1 RNA symbols (all)

8 7 6 5 4 3 2 1 0

	Marks	
	KU	RNA

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.

Voltage (potential) divider — **1 0**

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

$$V_1 = \frac{R_1}{R_T} \times V_S$$

$$V_1 = \frac{5k}{20k} \times 5\,V$$ **1 RNA substitution**

V_1 = 1·25 V **1 RNA from working** — **2 1 0**

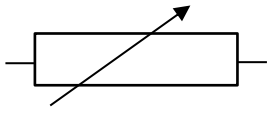
(iii) Complete, with reference to the Data Booklet, the table below to show the colour coding for the two resistors.

Resistor Value	Colour band 1	Colour band 2	Colour band 3
5 kΩ	**green**	**black**	**red**
15 kΩ	**brown**	**green**	**orange**

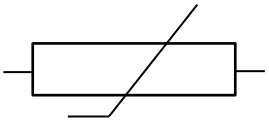
1 RNA row — **2 1 0**

There are many types of resistor.

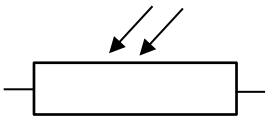
(b) Complete the symbol for the following resistor types.



Variable resistor



Thermistor

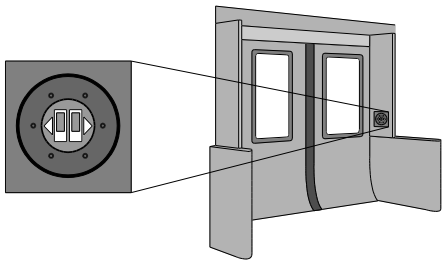


LDR

3 2 1 0

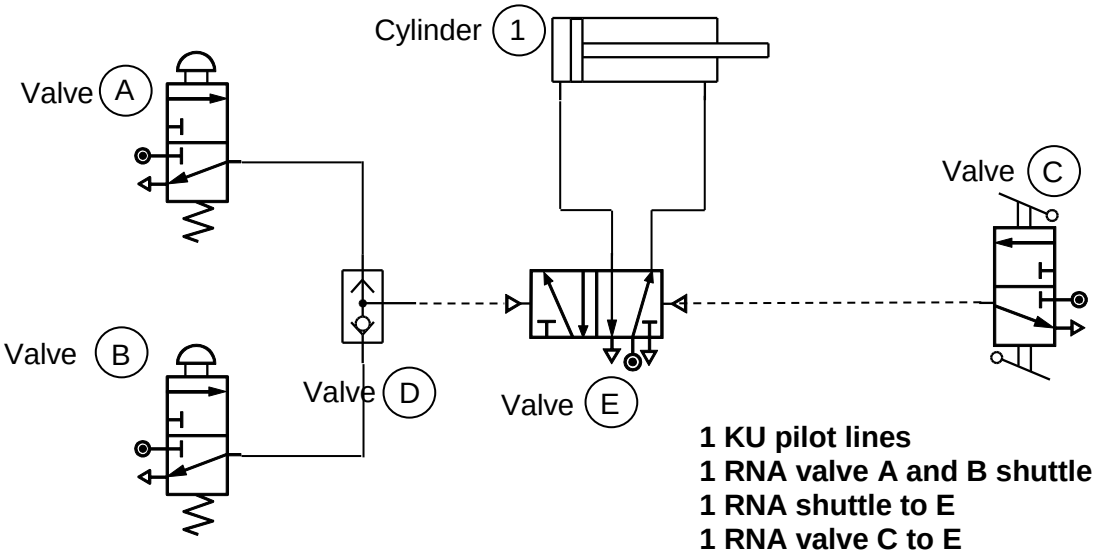
	Marks	
	KU	RNA

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.



	KU	RNA
1 KU pilot lines		**4**
1 RNA valve A and B shuttle		**3**
1 RNA shuttle to E		**2**
1 RNA valve C to E	**1**	**1**
1 RNA valve E to cylinder	**0**	**0**

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

	KU	RNA
	3	
	2	
	1	

(i) Valve (C) **Lever/Lever 3/2** **1 KU/ name (3)** — **0**

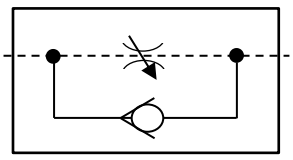
(ii) Valve (D) **Shuttle** — **1** **0**

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.

Uni-directional restrictor — **1** **0**

(ii) Sketch the symbol for this pneumatic device.



	KU	RNA
1 KU restrictor		
1 KU by-pass	**2**	
(1 KU PTE MAX)	**1**	
	0	

[END OF MARKING INSTRUCTIONS]