2012 Technological Studies

Standard Grade – General

Finalised Marking Instructions

	Marks	
	KU	**RNA**

1. A **rotating** scoreboard is shown below.

(a) Complete the system diagram below for the **rotating** scoreboard by adding the main input **energy** and the main output **energy**.

Electrical Energy → Scoreboard → **Kinetic** Energy

① **RNA**   ① **RNA**

2
1
0

The main parts of a rotating scoreboard are shown in the diagram below.

Input energy → Control → Motor → Gearbox → Output energy

(b) State the name of this type of diagram.

Sub-system   ① **KU**

1
0

The diagram shown below is used in the systems approach.

Input → Process → Output

(c) State the name of this type of diagram.

Universal system   ① **KU**

1
0

2. A 75 kg diver is standing on the top diving board 10 metres above a swimming pool.

(a) Calculate the potential energy of the diver when standing on the diving board.

Ep   =   mgh

    =   75 x 9·81 x 10   ① **RNA**

    =   7357·5 J   ① **RNA for answer from given working**

The diver is travelling at 14 m/s when he reaches the water.

(b) Calculate the kinetic energy of the diver at this point.

Ek   =   ½ m v^2

    =   ½ x 75 x 14^2 ① **RNA**

    =   7350 J   ① **RNA for answer from given working**

(c) The pool building is heated by a **solar** powered system with a backup gas boiler.

    (i) State **three** examples of **renewable** energy other than a solar source.

      1   **Wind**

      2   **Wave**   ① **KU x 3**

      3   **Tidal/geo-thermal/biomass/hydro**

    (ii) State **two** methods which would reduce heat loss from a building.

      1   **Insulate walls/windows – double glazing**

      2   **Any other acceptable answer**   ① **KU x 2**

3. A "smart entry" system is modelled using electronic boards.

The turnstile will unlock when a person is sensed **and** a valid ticket is swiped.

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

Pulse generator   AND gate   Solenoid   Buzzer   OR gate
Latch   Light sensor   Transducer driver   Inverter

```
                    ┌──────────┐
                    │  Ticket  │
                    │  sensor  │
                    └────┬─────┘
┌────────┐  ┌──────────┐  │  ┌──────────┐  ┌────────────┐  ┌──────────┐
│ Light  │──│ Inverter │──┴──│ AND gate │──│ Transducer │──│ Solenoid │
│ sensor │  │          │     │          │  │   Driver   │  │          │
└────────┘  └──────────┘     └──────────┘  └────────────┘  └──────────┘
```

① **RNA per answer**

Marks RNA: 5 4 3 2 1 0

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

```
    _____
                    _____  ⌐‾‾‾‾‾‾⌐
    _____        _____  |       )
                               |_____/
```

① **KU**   ① **KU**

Marks KU: 2 1 0

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

Input A	Input B	Z
0	**0**	**0**
0	1	1
1	0	1
1	1	1

① **KU**

① **KU**

① **KU**

Marks KU: 3 2 1 0

3. **(continued)**

The system is to be improved so an audible and visual warning will be given when "fake" tickets are detected.

(c) State the name of the output **board** required to give:

    (i)   an audible warning;

       buzzer (unit)

    (ii) a visual warning.

       lamp/bulb (unit)

(d) Tick (✓) a box to indicate what a **pulse generator** is used for.

    [ ] To give a time delay

    [✓] To switch the output signal on and off repeatedly

    [ ] To give a digital output when the input rises above the set level

    [ ] To drive the output board

(e) The following electronic boards can be grouped to be either input, process or output. Tick (✓) a box indicating the type for each of these electronic boards.

	Input	*Process*	*Output*
Temperature sensor	✓		
Magnetic switch	✓		
Motor Unit			✓
Latch Unit		✓	
OR gate		✓	

                                            ① **KU per answer**

Marks column (c)(i): 1 0
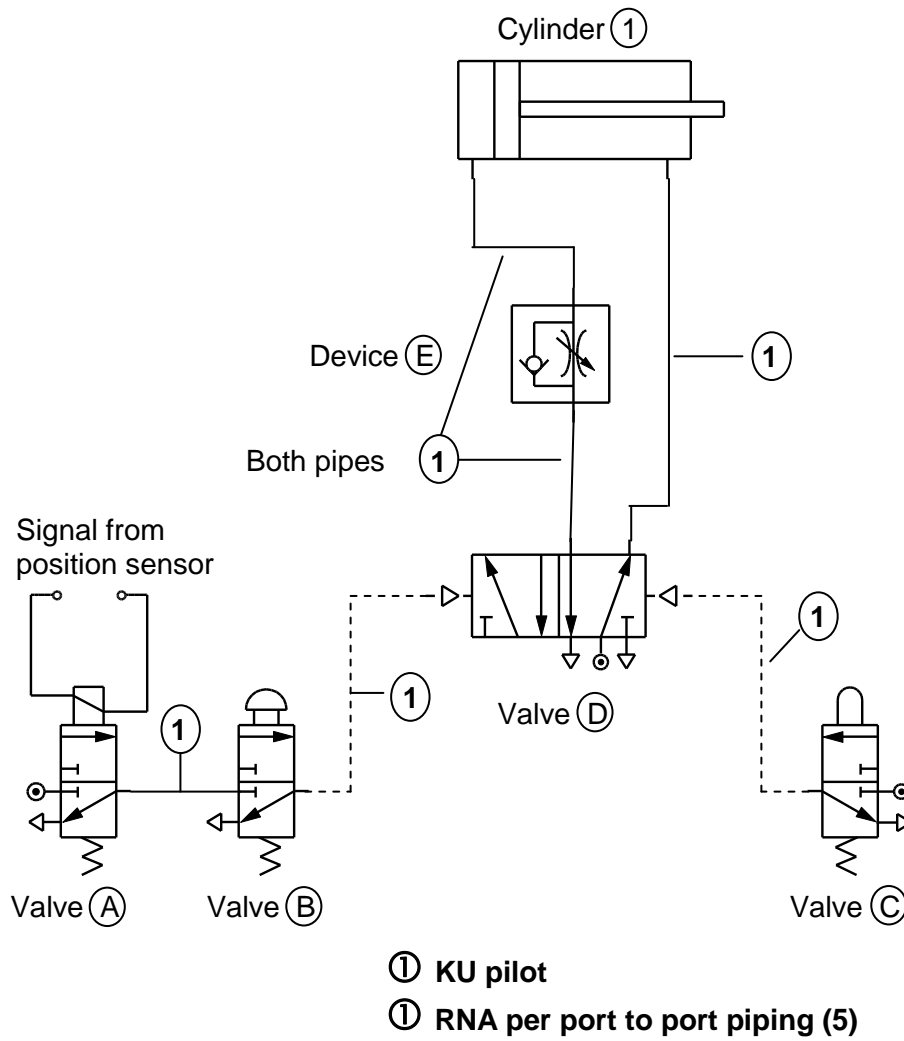Marks column (c)(ii): 1 0
Marks column (d): 1 0
Marks column (e): 5 4 3 2 1 0

4. A BMX starting gate is controlled by a pneumatic circuit.

The piston outstrokes at full speed when valve Ⓐ **and** valve Ⓑ are actuated. The piston instrokes slowly when valve Ⓒ is actuated.

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

Cylinder ①

Device Ⓔ   ①

Both pipes ①

Signal from position sensor

①

①

Valve Ⓓ

①

Valve Ⓐ   Valve Ⓑ   Valve Ⓒ

① **KU pilot**

① **RNA per port to port piping (5)**

4.   (continued)

3
2
1
0

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

(i)   Valve Ⓒ   **Plunger/ 3/2 /spring return**

1
0

(ii)   Cylinder ① **Double acting**

1
0

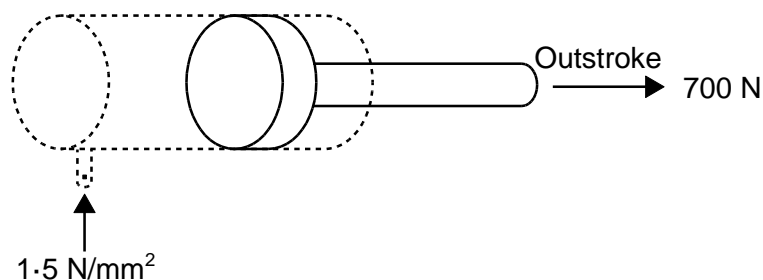(c)   State the name of the pneumatic symbol below.

⊙—   **Main air**

1
0

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

Clean

1
0

Cylinder ① is supplied with an air pressure of 1·5 N/mm^2 and the outstroking piston force is 700 N.
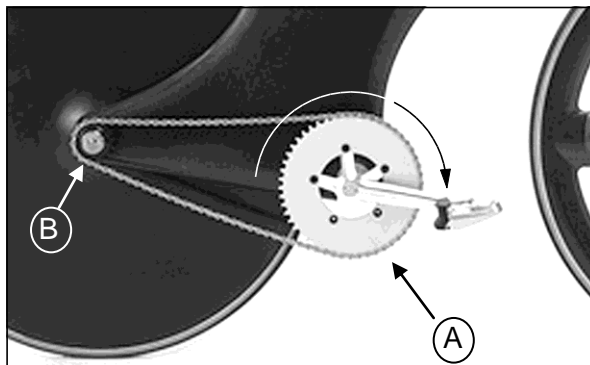
(e)   Calculate the area of the piston.

Outstroke
→ 700 N

1·5 N/mm^2

$$A \quad = \quad \frac{F}{P} \quad = \quad \frac{700\,N}{1\cdot5\,N/mm^2}$$ ① RNA

$$= \quad 466\cdot67\ mm^2$$ ① RNA answer from given working

2
1
0

5. A photographic recorder is used at the finish line in a 100 metre sprint.

Photographic recorder

Part of the electronic circuit is below.

200 Ω

70 Ω   180 Ω

(a) (i) Calculate the resistance of the **series** branch.

70 + 180   ① **RNA**

= 250 Ω   ① **RNA from working**

(ii) Calculate the **total** circuit resistance.

$$R_T = \frac{R_1 \times R_2}{R_2 + R_2} \qquad \frac{250 \times 200}{250 + 200}$$ ① **RNA (allow FTE)**

= 111 Ω   ① **RNA from working**

(b) Calculate the current flowing through the 200 Ω resistor when the voltage across it is 5 volts.

V = IR

$$I = \frac{V}{R} \qquad \frac{5V}{200}$$ ① **RNA**

= 25 mA   ① **RNA from working**

5. (continued)

(c) Complete, with reference to the Data Booklet, the table below by inserting the missing colour bands for the given resistor values.

Resistor Value	Colour band 1	Colour band 2	Colour band 3	
70 Ω	**Violet**	**Black**	**Black**	① RNA
180 Ω	**Brown**	**Grey**	**Brown**	① RNA
3·4 kΩ	**Orange**	**Yellow**	**Red**	① RNA

The following components are also used in the circuit.

(d) State the name of the electronic symbols shown below.

1 **LDR**   2 **LED**

3
2
1
0

2
1
0

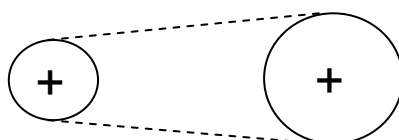|	Marks	
	KU	**RNA**

6. A single speed velodrome bike is shown below.

(a) (i) State the name given to the drive mechanism.

Chain Drive or Chain & Sprocket

<div style="text-align: right">1
0</div>

(ii) Draw the symbol for this drive mechanism.

Allow FTE from answer in (a) (i)

<div style="text-align: right">1
0</div>

(b) Part Ⓐ has 52 teeth and part Ⓑ has 13 teeth. If the input speed of Ⓐ is 80 rev/min:

(i) calculate the output speed of part Ⓑ;

① **RNA** ——— $\frac{52T}{13T} \times 80$ ——— ① **RNA**

= **320 rev/min** ① **RNA answer from working**

<div style="text-align: right">3
2
1
0</div>

(ii) describe a change which could be made to the **mechanism** to increase the output speed.

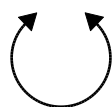**Smaller Ⓑ or larger Ⓐ**

<div style="text-align: right">1
0</div>

6. **(continued)**

The drive mechanism in the velodrome bike is used to transmit rotary motion.

(c) State the name of the following motion symbols.

⟶	**Linear**	① **KU**
⟷	**Reciprocating**	① **KU**
↻	**Oscillating**	① **KU**

7. An inclined conveyor system on the Olympic canoe downhill circuit is operated by a microcontroller.

The control program will activate in the following sequence:

- When the system is switched on the conveyor belt starts and a barrier opens;
- When a canoeist is sensed on the conveyor the barrier closes;
- After a delay of 15 seconds the conveyor belt stops;
- Sequence repeats until switched off.

Input Connection	Pin	Output Connection
	7	
	6	
	5	Barrier
	4	Conveyor belt
	3	
	2	
Canoe sensor	1	
Main ON/OFF switch	0	

7.   (continued)

(a)   Complete, with reference to the sequence and the Data Booklet, the flowchart for the inclined conveyor system.

① **RNA for ALL correct symbols**   ① **RNA for main feedback loop**

Start   Alternative   Start

Switch on?   Is pin0 high?

NO   ① **RNA Comments AND Loops**   NO

YES   YES

Conv on Barr Open   ① **RNA**   high 4 high 5

Canoe sensed?   Is pin1 high?

NO   ① **RNA Comments AND Loops**   NO

YES   YES

Close Barrier   ① **RNA**   low 5

15 sec delay   ① **RNA**   Pause 15000

Conveyor Off   ① **RNA**   low 4

8
7
6
5
4
3
2
1
0

7. **(continued)**

Microcontrollers are used in many everyday devices.

(b) State the **full name** of the following microcontroller terms.

  (i)   ROM   Read Only Memory   ① KU

  (ii) RAM   Random Access Memory ① KU

(c) State the **function** of the bus.

  Transfer data   ① KU

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

  1   Reduced size – fewer components

  2   Reprogrammable
       Fewer components – cheaper/less to go wrong

A flowchart can be used to develop a PBASIC program.

(e) State, with reference to the Data Booklet state the PBASIC command to set up pin 4, 5, 6 and 7 as **outputs** and the remaining four pins as **inputs**.

  let dirs = %1111 0000

  ① RNA   ① RNA
  pbasic   binary

Marks column values:
- (b)(i): KU 10
- (b)(ii): KU 10
- (c): KU 10
- (d): KU 210
- (e): RNA 210

[END OF MARKING INSTRUCTIONS]