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Total Marks

KU	RNA

4040/29/01

NATIONAL
QUALIFICATIONS
2012

FRIDAY, 4 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
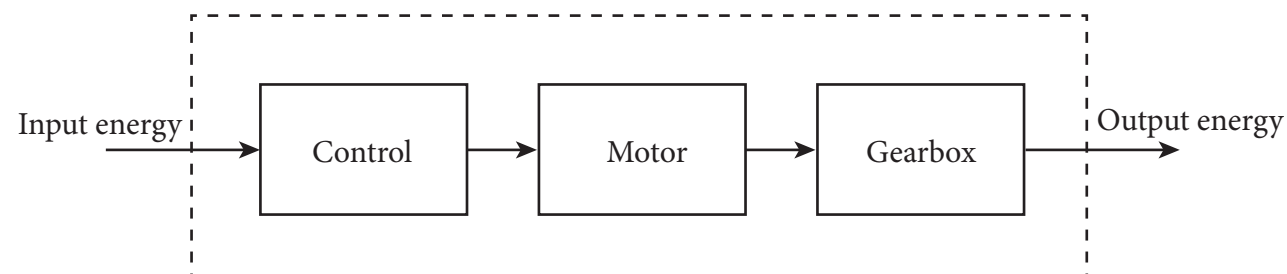
1 Answer all the questions.

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.

SQA
©

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**.

```
_____ Energy    ┌─────────────┐    _____ Energy
                ───────────▶   │  Scoreboard │   ─────────▶
                              └─────────────┘
```

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.

_____

The diagram shown below is used in the systems approach.

```
                    ┌─────────────┐
Input  ───────────▶ │   Process   │ ─────────▶ Output
                    └─────────────┘
```

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

_____

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.

**2
1
0**
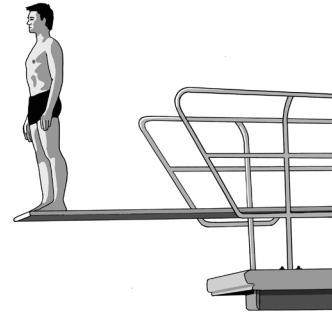
The diver is travelling at 14 m/s when he reaches the water.

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

**2
1
0**

(*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 _____

2 _____

3 _____

**3
2
1
0**

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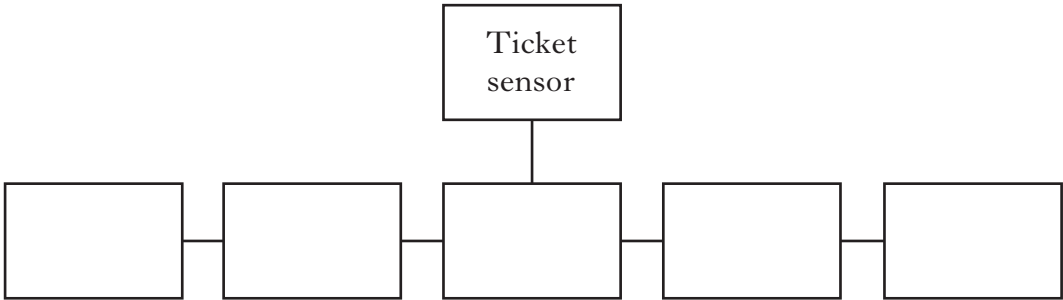
1 _____

2 _____

**2
1
0**

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  │
                        └────┬─────┘
┌──────┐  ┌──────┐  ┌───────┴──┐  ┌──────┐  ┌──────┐
│      │──│      │──│          │──│      │──│      │
└──────┘  └──────┘  └──────────┘  └──────┘  └──────┘
```

5
4
3
2
1
0

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

2
1
0

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

Input A	Input B	Z
0	1	1

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;

_____

(ii) a visual warning.

_____

(*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	☐	☐	☐

[Turn over

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 Ⓔ

Signal from
position sensor

Valve Ⓓ

Valve Ⓐ   Valve Ⓑ   Valve Ⓒ

4.   **(continued)**

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

(i)   Valve ⓒ _____

(ii)   Cylinder ① _____

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

⊙— _____

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

_____

Cylinder ① is supplied with an air pressure of $1.5 \, \text{N/mm}^2$ and the outstroking piston force is 700 N.
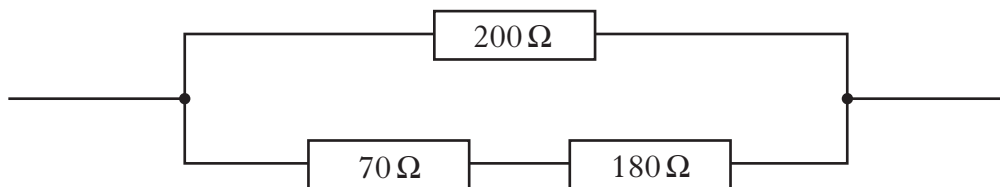
(*e*)   Calculate the area of the piston.

Outstroke
→ 700 N

$1.5 \, \text{N/mm}^2$
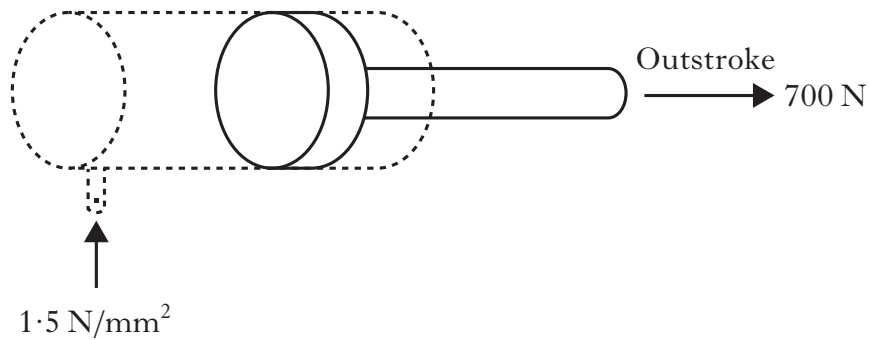
[Turn over

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

Photographic recorder
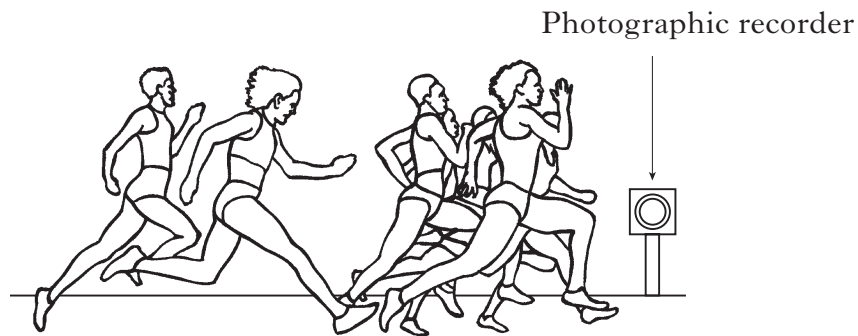
Part of the electronic circuit is shown below.

```
            ┌──────────[ 200 Ω ]──────────┐
   ─────────●                             ●─────────
            └──[ 70 Ω ]───[ 180 Ω ]───────┘
```

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

2
1
0

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

2
1
0

(*b*)   Calculate the current flowing through the $200\,\Omega$ resistor when the voltage across it is 5 volts.

2
1
0

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			
180 Ω			
3·4 kΩ			

The following components are also used in the circuit.

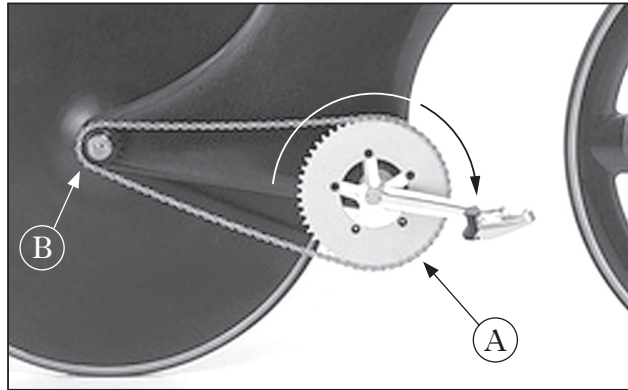(*d*) State the name of the electronic symbols shown below.

1 —————————————————— 2 ——————————————————
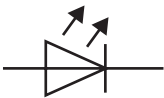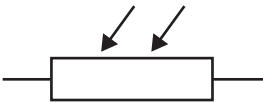
[**Turn over**

6. A single speed velodrome bike is shown below.

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

_____

     (ii)   Draw the symbol for this drive mechanism.

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

    (i)   calculate the output speed of part (B);

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

_____

6. **(continued)**

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

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

→

_____

←→

_____

↻

_____

[Turn over

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.

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 _____

   (ii)   RAM _____

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

_____

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

   1 _____

   2 _____

A flowchart can be used to develop a PBASIC program.

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

_____

[*END OF QUESTION PAPER*]

ACKNOWLEDGEMENTS

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