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NATIONAL QUALIFICATIONS 2012

PHYSICS
STANDARD GRADE
General Level

MONDAY, 30 APRIL
9.00 AM – 10.30 AM

3220901

3220/29/01

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth
Day   Month   Year   Scottish candidate number

Reference may be made to the Physics Data Booklet.

1   All questions should be answered.

2   The questions may be answered in any order but all answers must be written clearly and legibly in this book.

3   For questions 1–5, write down, in the space provided, the letter corresponding to the answer you think is correct. There is only **one** correct answer.

4   For questions 6–19, write your answer where indicated by the question or in the space provided after the question.

5   If you change your mind about your answer you may score it out and replace it in the space provided at the end of the answer book.

6   If you use the additional space at the end of the answer book for answering any questions, you **must** write the correct question number beside each answer.

7   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.

Use **blue** or **black ink**. Pencil may be used for graphs and diagrams only.

SQA

1. In a radio, the tuner is used to

    A   select one signal from all the signals reaching the radio

    B   make the electrical signal stronger

    C   supply electrical energy to the radio

    D   change electrical energy to sound energy

    E   detect all the signals reaching the radio.

Answer ☐ **1**

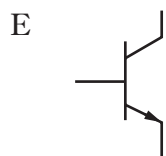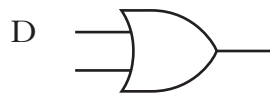**2.** A student looks at the letter R on a piece of paper. The image formed on the student's retina is

    A

    B

    C

    D

    E

Answer ☐ **1**

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3. Which of the following is the circuit symbol for an OR gate?

A

B

C

D

E
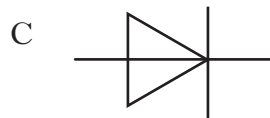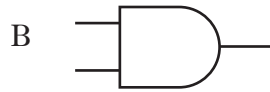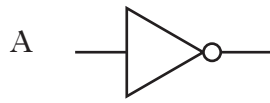
Answer ☐   **1**

4. Which term describes an object which orbits a star?

A   moon

B   planet

C   solar system

D   galaxy

E   universe

Answer ☐   **1**

5. A 5 kilogram mass is hung on a Newton balance and both are allowed to fall freely. What is the reading on the balance while the mass and balance are falling?

A   0 Newtons

B   5 Newtons

C   50 Newtons

D   500 Newtons

E   5000 Newtons

Answer ☐   **1**

6. (*a*) The telephone is one method of communicating by wires. A telephone handset contains an earpiece and a mouthpiece as shown.

earpiece ———
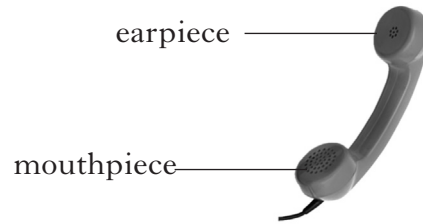
mouthpiece———

(i) State the device used in the mouthpiece.

....

1

(ii) State the energy change in this device.

....

1

(*b*) The mouthpiece of a telephone is connected to an oscilloscope. A student whistles into the mouthpiece four times and the patterns produced on the oscilloscope are shown.

The oscilloscope settings are not altered between each whistle.

A

B

C

D
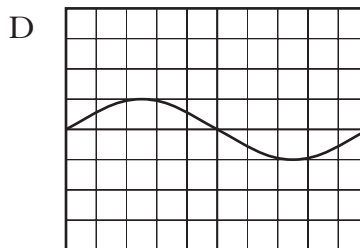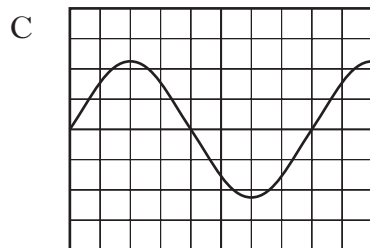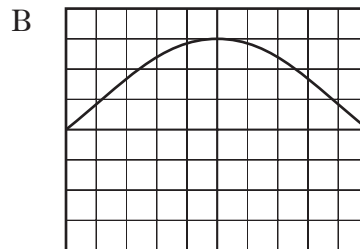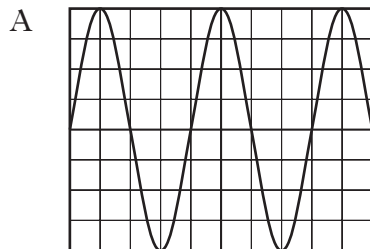
Which pattern is caused by:

(i) the lowest frequency sound;

....

1

(ii) the quietest sound?

....

1

7. A duck lands in a large pond and produces water waves. A 2·5 metre section of the pond is shown.

← 2·5 metres →
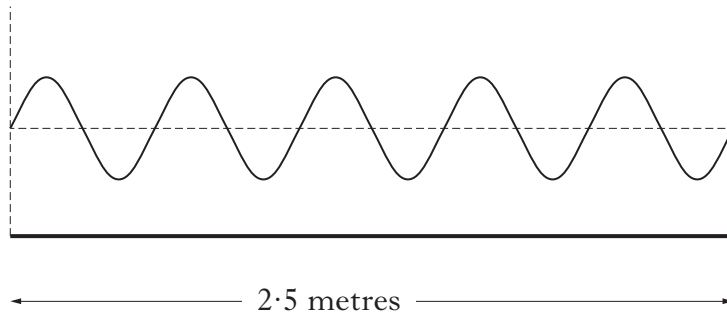
(*a*) Calculate the wavelength of the waves.

Space for working and answer

2

(*b*) The frequency of the waves produced in the pond is 2 hertz.

Calculate the speed of these waves.

Space for working and answer

2

(*c*) Explain why the amplitude is smaller when the waves reach the other side of the pond.

....

1

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8. A halogen heater contains four heater tubes which can be switched on separately or all together. The heater is mains operated.

(*a*) When one heating tube is switched on the current is 1·25 amperes and the voltage across the tube is 230 volts.

Calculate the resistance of the tube.

Space for working and answer

2

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8. (continued)

(*b*) During cold weather the heater is used to heat a large conservatory.

conservatory
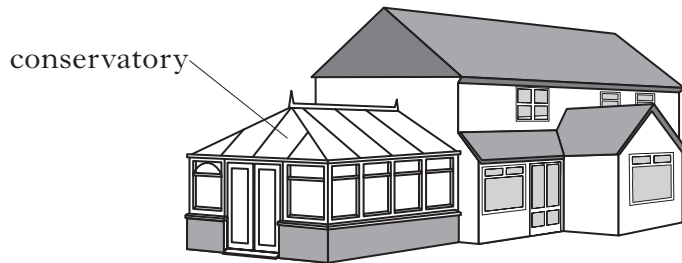
The heater is switched on at its highest setting.

At this setting the heater has a power rating of 1600 watts.

The heater is operated for 8 hours each day for one week.

Calculate the energy in kilowatt-hours used by the heater in this week.

Space for working and answer

2

(*c*) A fault develops in the halogen heater circuit. A technician uses a continuity tester to test the fuse from the plug. The continuity tester contains a lamp and a battery.

Complete the circuit diagram to show the continuity tester connected to the fuse.

Space for diagram

fuse

2

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9. A student compares two different sources of light.

Filament lamp   Discharge tube

(*a*) Where does the energy transformation occur in the filament lamp?

....

1

(*b*) Why is a discharge tube more efficient than a filament lamp?

....

1

(*c*) The student sets up the following experiment to investigate the power of a filament lamp.
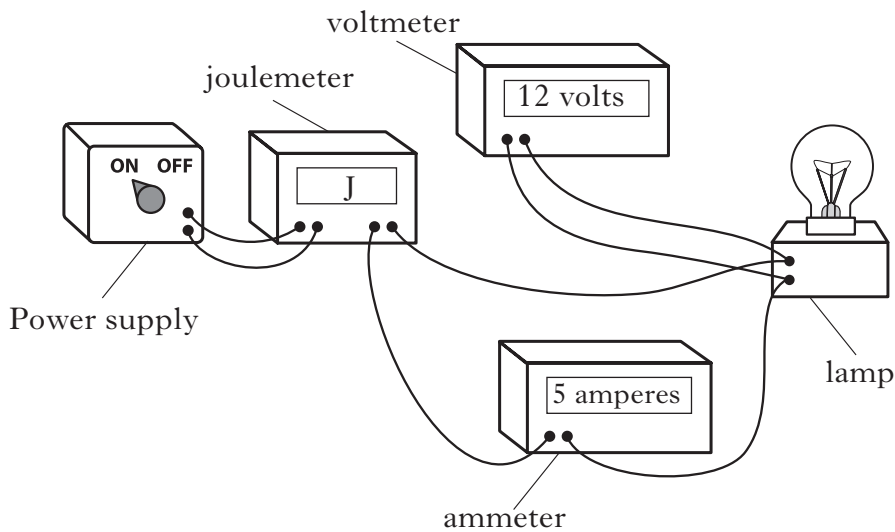
The reading on the voltmeter is 12 volts and the reading on the ammeter is 5 amperes.

Calculate the power dissipated in the lamp.

Space for working and answer

2

322029010 8

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9. (continued)

(*d*) The student examines the following images.

Explain why each situation is dangerous.

(i)

....

1

(ii)

....

1
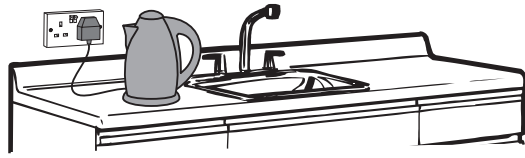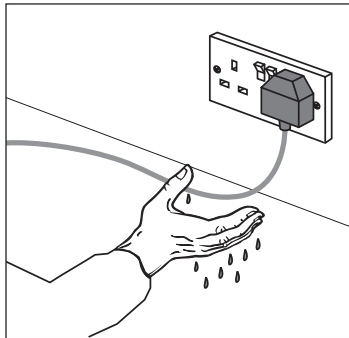
[Turn over

10. (*a*) A simple model of the atom is shown.

Label the diagram to show the **electrons** and **protons** in this model.

Neutron

1
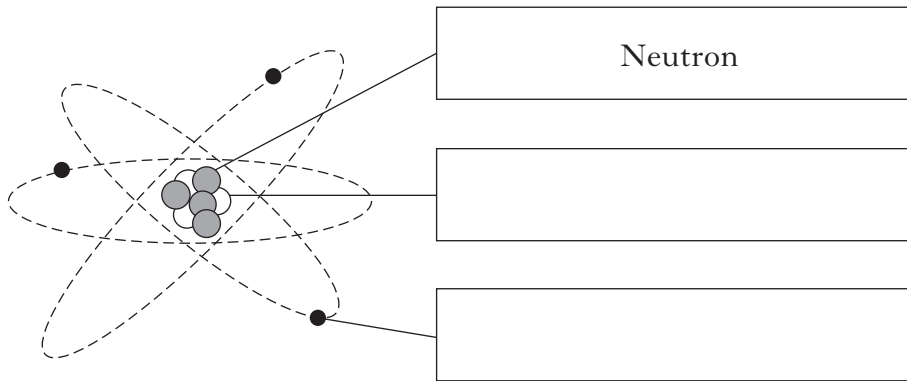
(*b*) A radioactive source emits two types of radiation labelled R and S. The diagram shows how far these radiations will travel through different materials.

Radioactive Source

R

S

Paper   2 mm   2 cm Lead
        Aluminium
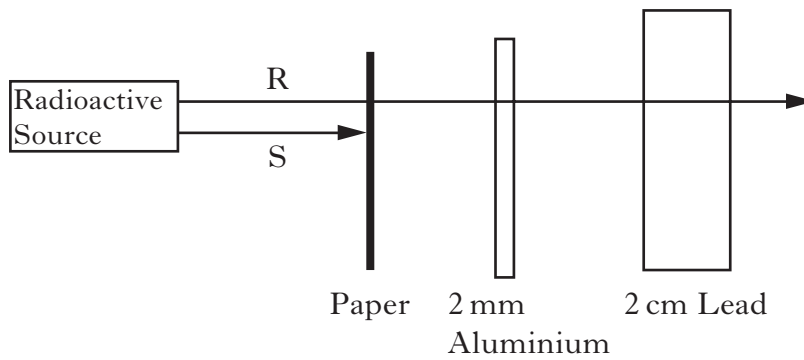
(i) Identify radiation R.

.... **1**

(ii) Identify radiation S.

.... **1**

(*c*) State **one** detector of nuclear radiation.

.... **1**

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11. Different types of radiation can be used in medicine for both the diagnosis and treatment of a variety of illnesses.

The table shows information on some of the types of radiation used in medicine.

Type of radiation	*Use of radiation*
Infra red	
	Detects broken bones
Gamma	
	Treats skin conditions such as acne

(*a*) Complete the table to show:

   (i) the missing types of radiation;   **1**

   (ii) the missing uses of radiation.   **1**

(*b*) Lasers are also used in medicine for various treatments.

   (i) State **one** use of lasers in medicine.

....   **1**

   (ii) Complete the diagram to show how light is transmitted along an optical fibre.

laser light

2

[Turn over

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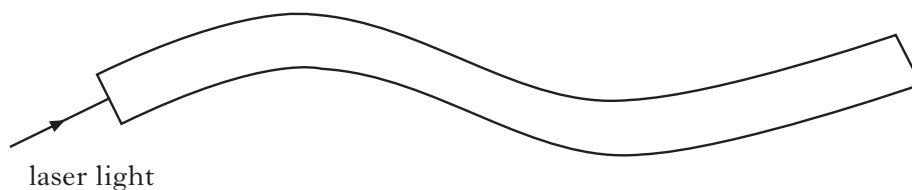
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12. An electronic megaphone is used by police to give instructions to large numbers of people.

A megaphone is a device that amplifies the voice of the person using it.

(*a*) The megaphone consists of an electronic system.

An electronic system can be represented by a block diagram.

The electronic devices used for the first two parts of the electronic system are shown below.

Complete the diagram by adding a suitable output device.

Microphone	→	Amplifier	→	....

1

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12. (continued)

(*b*) The megaphone is being tested.

Two oscilloscopes are used to display the signals from the microphone and from the output device.

For one test, the signal obtained from the output device is shown in Figure 2.

The settings for each oscilloscope are identical.

Complete Figure 1 to show the corresponding signal from the microphone.

Signal from microphone   Signal from output device
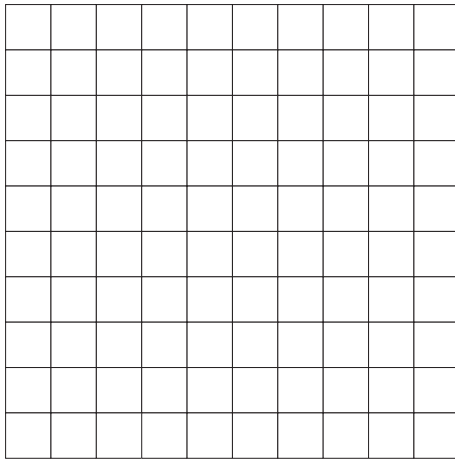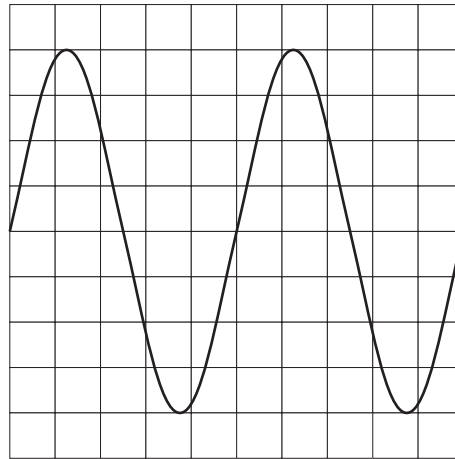
Figure 1   Figure 2   **2**

(*c*) During another test of the megaphone, the voltage measured at the microphone is 0·25 volts. The voltage measured at the output device is 2·25 volts.

Calculate the voltage gain of the amplifier.

Space for working and answer

2

13. An electronic circuit, used to give a warning, is shown below.
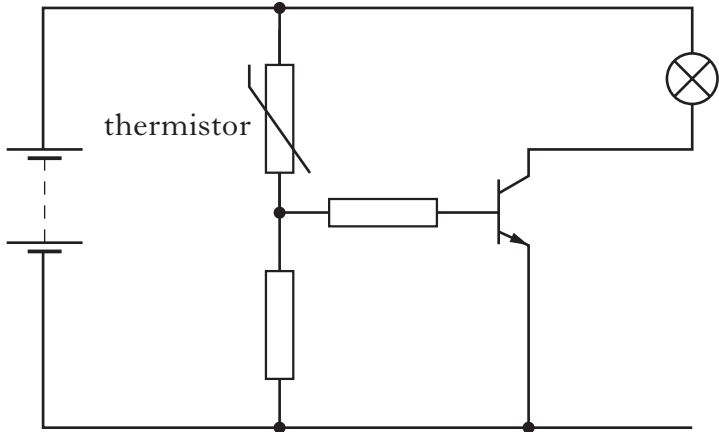
(*a*) (i) What causes the resistance of a thermistor to change?

....

(ii) State the function of the transistor in this circuit.

....

(iii) How does the circuit indicate this warning?

....

(iv) Suggest where this circuit could be used to give a warning.

....

(*b*) Some electronic devices are listed below.

7 segment display   **LED**   **Relay**   **Switch**

Motor   **Solar Cell**   **LDR**   **Solenoid**

From the list, state **two** digital output devices.

....

....

*3 2 2 0 2 9 0 1 1 4 *

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14. A car of mass 1500 kilograms accelerates from rest to a speed of 18 metres per second in 6 seconds.

   (*a*) Calculate the acceleration of the car.

Space for working and answer

2

   (*b*) The car now travels at a constant speed of 18 metres per second for a time of 5 minutes.

       Calculate the distance travelled in this time.

Space for working and answer

2

   (*c*) The driver performs an emergency stop.

       Explain in terms of forces how the seatbelt protects the driver.

....

....

2

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15. In an experiment, a student times how long it takes to run up a flight of stairs in a school.
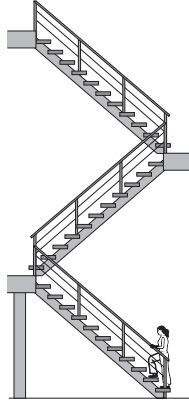
The student obtains the following data.

Mass of student	55 kilograms
Height of stairs	10 metres
Time to climb stairs	11 seconds

(*a*) Calculate the potential energy gained by the student at the top of the stairs.

Space for working and answer

2

(*b*) Calculate the power developed by the student during the climb.

Space for working and answer

2

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15.   (continued)

(*c*)   At the top of the stairs, the student drops two identical sheets of paper down the stairwell.

One sheet is crumpled into a ball.

Both sheets are dropped from the same height at the same time.

Explain which sheet of paper will hit the ground first.

....

....

2

[Turn over

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16. A family wishes to reduce the heat energy being lost from their house.

Heat energy can be lost from the house in three different ways: conduction, convection and radiation.

The family obtains an information booklet that gives advice on some methods to reduce heat loss from the house.

(*a*)	Fit draught-proofing strips to windows and doors.
(*b*)	Fit double glazing.
(*c*)	Increase the amount of loft insulation.
(*d*)	Fill the outside cavity walls with foam.
(*e*)	Reduce the height of all rooms with high ceilings.
(*f*)	Place aluminium foil behind the radiators.

(*a*) Select **one** method from the list that would:

    (i) reduce heat lost by conduction;

    .... **1**

    (ii) reduce heat lost by convection.

    .... **1**

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16. (continued)

(*b*) Three identical houses at different locations have a heating system that keeps the inside temperature at 19 degrees celsius.

The table gives the average outside temperature at each location.

House location	Average outside temperature in degrees celsius
Forfar	7
Braemar	4
London	11

(i) Which house location will have the greatest heat loss?

....

1

(ii) Give a reason for your answer.

....

1

(*c*) Three students carry out an experiment to investigate heat loss by radiation. They use three metal cubes which are different colours. The same volume of water at 80 degrees celsius is poured into each cube. The temperature of each cube is measured at regular intervals using an infrared thermometer as shown.

infrared thermometer

white

black

silver
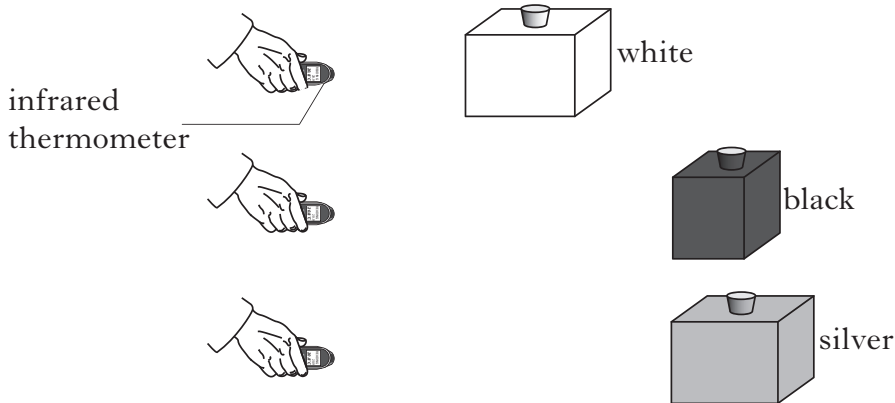
State **two** reasons why this is not a fair test.

....

....

2

17. Electricity can be generated from different energy sources.

(*a*) Examples of energy sources are:

**gas   wind   oil   solar   wave   hydro   coal**

These energy sources can be classified as renewable or non-renewable.

Complete the table below to show which of these examples are renewable and which are non-renewable.

Renewable	*Non-renewable*

2

(*b*) A coal-fired power station burns coal in order to generate electricity. A simplified diagram of a coal-fired power station is shown.

Coal in → Boiler → Steam → Turbine → Drive Shaft → Generator → National Grid
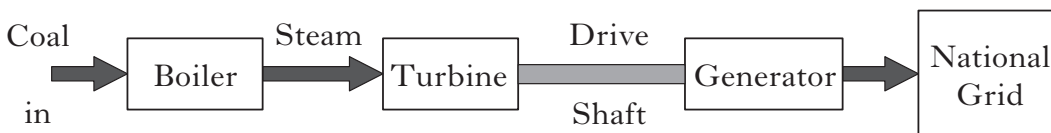
State the energy transformation in the boiler.

....

1

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17. (continued)

(*c*) Drax power station is a coal-fired power station that can generate a power of 3960 megawatts.

Cruachan power station is a pumped hydro-electric scheme that can generate a power of 440 megawatts.

(i) How many pumped hydro-electric schemes would be required to generate the same power as Drax power station?

> *Space for working and answer*

1

(ii) The pumped storage scheme uses water at the rate of 200 kilograms per second. The scheme can run continuously for 22 hours.

Calculate the mass of water that would pass through the scheme in this time.

> *Space for working and answer*

1

[Turn over

322029012 1

18. Visible light is part of a family of waves known as the electromagnetic spectrum.

(*a*) What is the speed of waves in the electromagnetic spectrum?

....

1

(*b*) A student notices that when white light passes through a glass of lemonade it is split into different colours.

The student decides to reproduce this effect in a laboratory using the following equipment.

(i) State the name of the glass block that the student uses to split the light into different colours.

....

1

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18. (**b**)   **(continued)**

(ii)   When white light enters the glass block its speed and direction are changed.

What name is given to this effect?

....   **1**

(iii)   The colours appear on the screen in order of wavelength. The shortest wavelength appears at Z.

State which of the colours green, blue or red would be seen at positions **X**, **Y** and **Z** on the screen.

X ....

Y ....

Z **2**
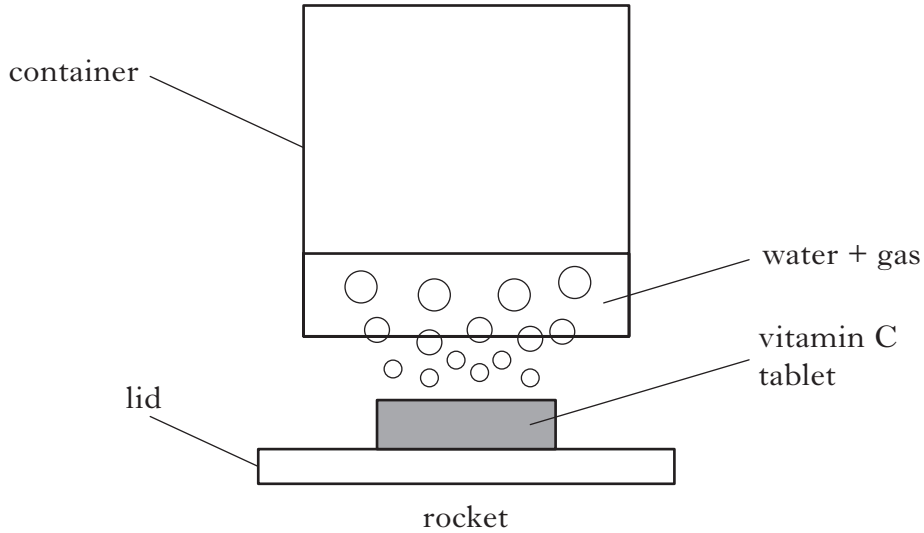
[Turn over

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19. In a science classroom, pupils make "rockets" by adding vitamin C tablets to water in a container.

The vitamin C tablet, attached to the lid, and the water react to give off a gas which causes the container to rise.

container

water + gas

vitamin C
tablet

lid

rocket

(*a*) Complete the passage below, to make the statement correct.

As the container rises, it exerts a force downwards on the gas and water.

The _____ exerts a force

_____ on the container.

1

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19. (continued)

(*b*) The container has a mass of 0·05 kilograms. The upward
force on the container is 2 newtons.

(i) Calculate the weight of the container.

Space for working and answer

2

(ii) Calculate the unbalanced force acting on the container.

Space for working and answer

1

(iii) Calculate the acceleration of the container.

Space for working and answer

2

[*END OF QUESTION PAPER*]

ADDITIONAL SPACE FOR ANSWERS

Make sure you write the correct question number beside each answer.

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ACKNOWLEDGEMENTS