**Q1.**

A student wanted to determine the density of a small piece of rock.

(a)  Describe how the student could measure the volume of the piece of rock.

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**(4)**

(b)  The volume of the piece of rock was 18.0 cm3.

The student measured the mass of the piece of rock as 48.6 g.

Calculate the density of the rock in g/cm3.

Use the equation:



\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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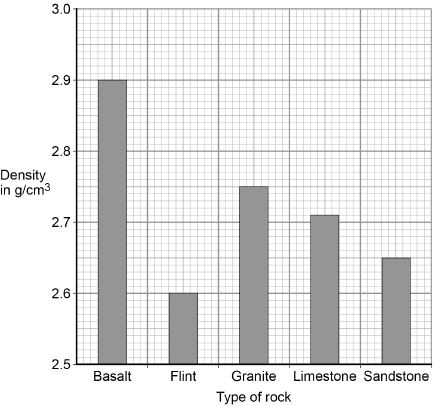
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Density = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g/cm3

**(2)**

The graph below shows the densities of different types of rock.



(c)  What is the most likely type of rock that the student had?

Tick **one** box.

|  |  |
| --- | --- |
| Basalt |  |
| Flint |  |
| Granite |  |
| Limestone |  |
| Sandstone |  |

**(1)**

(d)  Give **one** source of error that may have occurred when the student measured the volume of the rock.

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**(1)**

(e)  How would the error you described in part **(d)** affect the measured volume of the rock?

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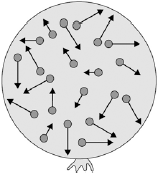
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**(1)**

**(Total 9 marks)**

**Q2.**

The figure below shows a balloon filled with helium gas.



(a)     Describe the movement of the particles of helium gas inside the balloon.

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**(2)**

(b)     What name is given to the total kinetic energy and potential energy of all the particles of helium gas in the balloon?

|  |  |
| --- | --- |
| Tick **one** box. |  |
| External energy |  |
| Internal energy |  |
| Movement energy |  |

**(1)**

(c)     Write down the equation which links density, mass and volume.

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**(1)**

(d)     The helium in the balloon has a mass of 0.00254 kg.

The balloon has a volume of 0.0141 m3.

Calculate the density of helium. Choose the correct unit from the box.

|  |
| --- |
| **m3 / kg**                              **kg / m3**                              **kg m3** |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Density = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Unit \_\_\_\_\_\_\_\_\_

**(3)**

**(Total 7 marks)**

**Q3.**

Solid, liquid and gas are three different states of matter.

(a)     Describe the difference between the solid and gas states, in terms of the arrangement and movement of their particles.

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**(4)**

(b)     What is meant by ‘specific latent heat of vaporisation’?

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**(2)**

(c)     While a kettle boils, 0.018 kg of water changes to steam.

Calculate the amount of energy required for this change.

Specific latent heat of vaporisation of water = 2.3 × 106 J / kg.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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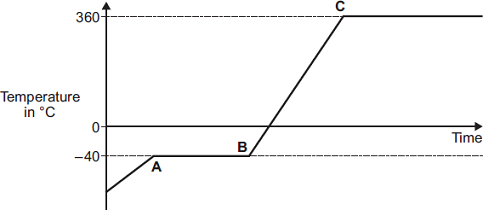
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Energy required = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ J

**(2)**

(d)     The graph shows how temperature varies with time for a substance as it is heated.

The graph is **not** drawn to scale.



Explain what is happening to the substance in sections **AB** and **BC** of the graph.

Section **AB** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Section **BC** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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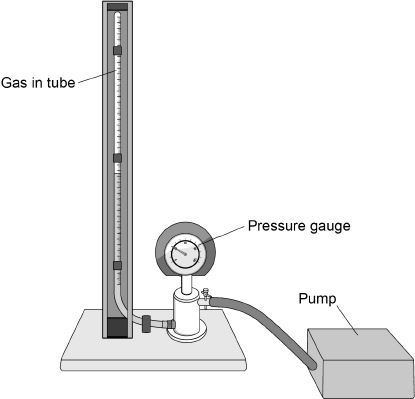
**(Total 12 marks)**

**Q4.**

A student investigated how the pressure exerted by a gas varied with the volume of the gas.

**Figure 1** shows the equipment the student used.

**Figure 1**

****

A pump was used to compress the gas in a tube. As the volume of the gas decreases, the pressure of the gas increases.

(a)  The student only recorded one set of results.

Give **two** reasons why taking repeat readings could provide more accurate data.

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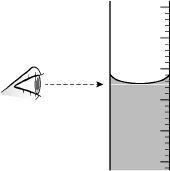
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2)**

(b)  **Figure 2** shows the position of the student’s eye when taking volume measurements.

**Figure 2**

****

Explain what type of error would be caused if the student’s eye was **not** in line with the level of the liquid in the tube.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2)**

(c)  If the gas is compressed too quickly the temperature of the gas increases.

Explain how the temperature increase would affect the pressure exerted by the gas.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2)**

(d)  One of the student’s results is given below.

pressure = 1.6 × 105 Pa

volume = 9.0 cm3

Calculate the volume of the gas when the pressure was 1.8 × 105 Pa.

The temperature of the gas was constant.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Volume = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cm3

**(3)**

(e)  **Figure 3** shows a person using a bicycle pump to inflate a tyre.

**Figure 3**

****

The internal energy of the air increases as the tyre is inflated.

Explain why.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2)**

**(Total 11 marks)**

Mark schemes

**Q1.**

(a)  **Level 2:** The method would lead to the production of a valid outcome. Key steps are identified and logically sequenced.

**3−4**

**Level 1:** The method would not necessarily lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

**1−2**

**No relevant content**

**0**

**Indicative content**

•   part fill a measuring cylinder with water

•   measure initial volume

•   place object in water

•   measure final volume

•   volume of object = final volume − initial volume

•   fill a displacement / eureka can with water

•   water level with spout

•   place object in water

•   collect displaced water

•   measuring cylinder used to determine volume of displaced water

(b)  

**1**

density = 2.70 (g/cm3)

**1**

*an answer of 2.70 (g/cm3) scores* ***2*** *marks*

(c)  limestone

**1**

(d)  eye position when using measuring cylinder

**or**

water level in can (at start) not at level of spout

**or**

not all water displaced by stone is collected in container

**1**

(e)  volume would be lower / higher

**1**

**[9]**

**Q2.**

(a)     range of speeds

**1**

moving in different directions

*accept random motion*

**1**

(b)     internal energy

**1**

(c)     density = mass / volume

**1**

(d)     0.00254 / 0.0141

**1**

0.18

**1**

*accept 0.18 with no working shown for the* ***2*** *calculation marks*

kg / m3

**1**

**[7]**

**Q3.**

(a)     **solid**particles vibrate about fixed positions

**1**

closely packed

*accept regular*

**1**

**gas**particles move randomly

*accept particles move faster*

*accept freely for randomly*

**1**

far apart

**1**

(b)     amount of energy required to change the state of a substance from liquid to gas (vapour)

**1**

unit mass / 1 kg

*dependent on first marking point*

**1**

(c)     41000 **or** 4.1 × 104 (J)

*accept*

*41400 or 4.14 × 104*

*correct substitution of*

*0.018 × 2.3 × 106 gains* ***1*** *mark*

**2**

(d)     **AB**changing state from solid to liquid / melting

**1**

at steady temperature

*dependent on first* ***AB*** *mark*

**1**

**BC**temperature of liquid rises

**1**

until it reaches boiling point

*dependent on first* ***BC*** *mark*

**1**

**[12]**

**Q4.**

(a)  any **two** from:

•   calculate a mean

•   reduces the effect of random errors

*reduces human error is insufficient*

•   identify / remove anomalies

*allow to assess the repeatability of the data*

**2**

(b)  random error

*allow a parallax error*

*human error is insufficient*

**1**

(because) eye position would not be the same each time (relative to the liquid)

*allow systematic error only if it is clear that the student always viewed liquid level from above meniscus (or below)*

**1**

(c)  (a temperature increase would) increase the pressure in the tube

(even if the volume was constant)

**1**

(because a higher temperature would mean) higher (average) kinetic energy of molecules / particles

*allow higher (average) speed for higher (average) kinetic energy*

**1**

(d)  1.6 × 105 × 9.0 (= 1.44 × 106)

**1**

1.44 × 106 = 1.8 × 105 × V

*allow for* ***2*** *marks*

**

**1**

**or**

****

V = 8.0 (cm3)

**1**

*an answer of 8.0 (cm3) scores* ***3*** *marks*

(e)  work is done on the air (in the tyre)

**1**

so the temperature (of the air) increases

*allow the (average) kinetic energy of the particles increases*

**1**

**[11]**