Q1.

(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) $1.6 \times 10^5 \times 9.0 \ (= 1.44 \times 10^6)$

1

$1.44 \times 10^6 = 1.8 \times 10^5 \times V$

*allow for **2** marks*

$$V = \frac{1.6 \times 10^5 \times 9.0}{1.8 \times 10^5}$$

1

or

$$V = \frac{1.44 \times 10^6}{1.8 \times 10^5}$$

$V = 8.0 \ (cm^3)$

1

*an answer of 8.0 (cm^3) 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]

Q2.

(a) 0 to 25 cm^3

1

(b) control

1

(c) 2 sets of data recorded from line of best fit to show that the product is the same in both cases (1600)

*allow for **1** mark one set of calculated data for one point on the line of best fit*

2

(d) decreases

1

increases

1

increases

1

[7]

Q3.

(a) 1 (cm^3)

1

(b) pressure is inversely proportional to volume

1

data to prove inversely proportional relationship

eg 8 × 200 = 1600

and 10 × 160 = 1600

*if no other marks score allow for **1** mark: as volume decreases pressure increases*

2

(c) (as the gas is compressed) the volume of gas decreases

1

(so there are) more frequent collisions of gas particles with container walls

1

(and) each particle collision with the wall causes a force

1

(so there is a) greater force on walls

1

[8]

Q4.

(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 / m^3

1

[7]

Q5.

Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1–2 marks)
Considers either solid or gas and describes at least one aspect of the particles.

or

Considers both solids and gases and describes an aspect of each.

Level 2 (3–4 marks)
Considers both solids and gases and describes aspects of the particles.

or

Considers one state and describes aspects of the particles and explains at least one of the properties.

or

Considers both states and describes an aspect of the particles for both and explains a property for solids or gases.

Level 3 (5–6 marks)
Considers both states of matter and describes the spacing and movement / forces between the particles. Explains a property of both solids and gases.

examples of the points made in the response

extra information

Solids

- (particles) close together
- (so) no room for particles to move closer (so hard to compress)
- vibrate about fixed point
- strong forces of attraction (at a distance)
- the forces become repulsive if the particles get closer
- particles strongly held together / not free to move around (shape is fixed)

any explanation of a property must match with the given aspect(s) of the particles.

Gases

- (particles) far apart
- space between particles (so easy to compress)
- move randomly
- negligible / no forces of attraction
- spread out in all directions (to fill the container)

[6]