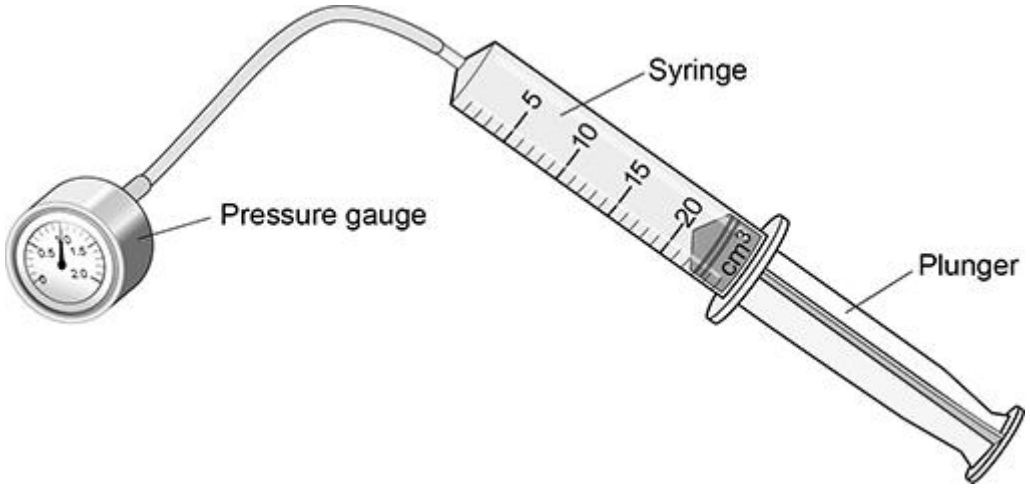
Questions are for both separate science and combined science students

Q1.

A student investigated how the pressure in a fixed mass of air varies with the volume of the air.

Figure 1 shows the equipment used.

Figure 1



When the plunger was pushed slowly into the syringe, the temperature of the air stayed the same.

(a) How did pushing the plunger in affect the volume of air in the syringe?

Tick (✓) **one** box.

The volume decreased. ☐

The volume stayed the same. ☐

The volume increased. ☐

(1)

(b) How did pushing the plunger in affect the distance between the air particles in the syringe?

Tick (✓) **one** box.

The distance decreased. ☐

The distance stayed the same. ☐

The distance increased. ☐

(1)

(c) How did pushing the plunger in affect the frequency of collisions between the air particles and the syringe walls?

Tick (✓) **one** box.

The frequency of collisions decreased. ☐

The frequency of collisions stayed the same. ☐

The frequency of collisions increased. ☐

(1)

(d) How did pushing the plunger in affect the air pressure in the syringe?

Tick (✓) **one** box.

The air pressure decreased. ☐

The air pressure stayed the same. ☐

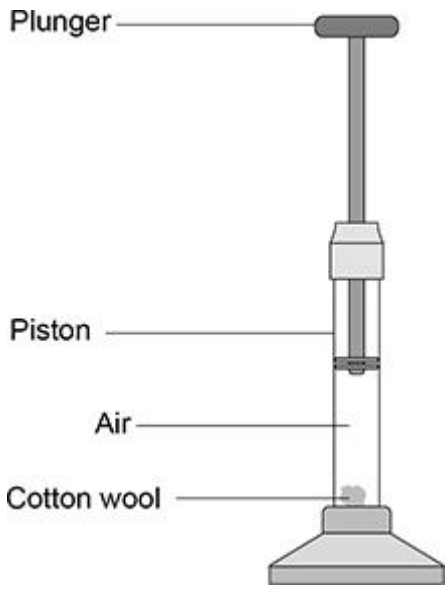
The air pressure increased. ☐

(1)

A fire piston is a special type of syringe that can be used to start fires.

Figure 2 shows a fire piston.

Figure 2



The plunger is pushed quickly downwards and compresses the air.

When the air is compressed quickly, the temperature of the air increases.

(e) How does an increase in temperature affect the mean speed of the air particles inside the syringe?

Tick (✓) **one** box.

The mean speed of the particles decreases. ☐

The mean speed of the particles does not change. ☐

The mean speed of the particles increases. ☐

(1)

(f) When the air is hot enough, a small piece of cotton wool in the piston catches fire.

The energy transferred to the air in the piston is 0.0130 J.

The mass of air in the piston is 2.60×10^{-8} kg.

specific heat capacity of air = 1010 J/kg °C

Calculate the temperature change of the air.

Use the Physics Equations Sheet.

Temperature change = _____ °C

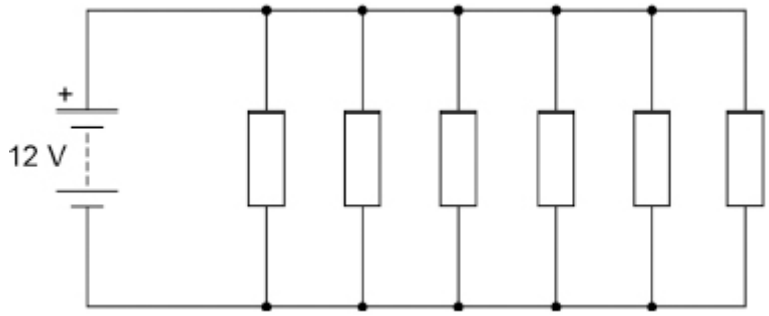
(3)

(Total 8 marks)

Q2.

The figure below shows an electrical circuit used to heat the windscreen of a car.

Each resistor in the circuit represents a heating element.



(a) The 12 V battery supplies direct potential difference.

What is meant by 'direct potential difference'?

_____

_____

_____

(1)

Use the Physics Equations Sheet to answer parts (b) and (c).

(b) Which equation links charge flow (Q), energy (E) and potential difference (V)?

Tick (✓) **one** box.

$E = \frac{V}{Q}$ ☐

$E = QV$ ☐

$E = \frac{Q}{V}$ ☐

$E = \frac{V^2}{Q}$ ☐

(1)

(c) Calculate the charge flow through the 12 V battery when the battery transfers 5010 J of energy.

Charge flow = _____ C

(3)

(d) Ice forms on the windscreen at a temperature of 0 °C.

The electrical circuit transfers 5010 J of energy to the ice.

A mass of 0.015 kg of ice melts.

Calculate the specific latent heat of fusion of water.

Use the Physics Equations Sheet.

Specific latent heat of fusion of water = _____ J/kg

(3)

(e) The electrical circuit was left switched on while the ice changed from a solid to a liquid and increased in temperature to 5 °C.

Explain the changes in the arrangement **and** movement of the particles as the ice melted and the temperature increased to 5 °C.

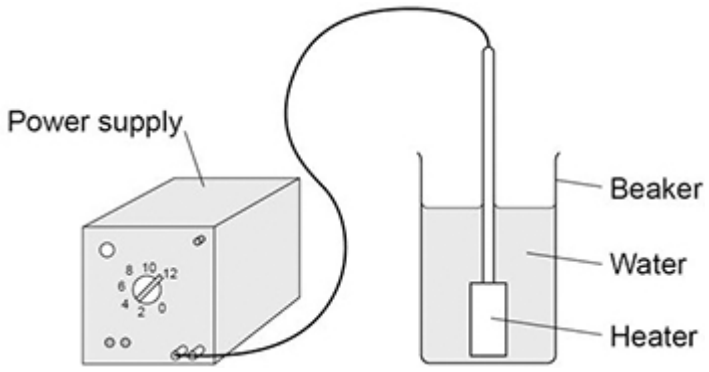
(6)

(Total 14 marks)

Q3.

A student determined the specific latent heat of vaporisation of water.

The figure shows some of the equipment used.



(a) The student measured a mass of water and put it into the beaker.

What measuring instrument should the student have used to measure the mass of the water?

Tick (✓) **one** box.

balance ☐

joulemeter ☐

newtonmeter ☐

thermometer ☐

(1)

(b) The power output of the heater stayed the same throughout the experiment.

What type of variable was the power output of the heater?

Tick (✓) **one** box.

Categoric variable	☐
Control variable	☐
Dependent variable	☐
Independent variable	☐

(1)

(c) The student turned on the heater and heated the water until it reached boiling point.

The student continued to heat the water so that it boiled for several minutes.

The mass of the water remaining in the beaker was measured again.

Give **one** way the beaker of boiling water could be moved safely to measure its new mass.

_____

_____

_____

(1)

(d) The mass of water that turned into steam was 0.0090 kg.

The heater transferred 25 200 J of energy to the water to turn it into steam.

Calculate the specific latent heat of vaporisation of water given by the student s data.

Use the Physics Equations Sheet.

Choose the unit from the box.

J	kg	J/kg

Specific latent heat of vaporisation = _____ Unit _____

(4)

(e) What was a source of error in the student s experiment?

Tick (✓) **one** box.

The transfer of thermal energy from the heater to the water	☐
The transfer of thermal energy from the surroundings to the water	☐
The transfer of thermal energy from the water to the heater	☐
The transfer of thermal energy from the water to the surroundings	☐

(1)

(Total 8 marks)