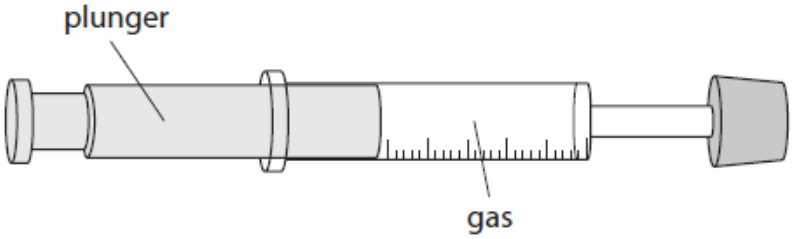
Questions

Q1.

A gas is contained inside a sealed syringe.



(a) The plunger is pushed so that the gas is compressed and its volume reduces at constant temperature.

Explain why decreasing the volume changes the pressure of the gas in the syringe.

You should use ideas about particles in your answer.

(3)

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(b) The plunger of the syringe is released and the gas returns to its original pressure of 100 kPa.

The plunger is then held in position so that the volume of the gas cannot change.

The gas is now heated and its temperature increases.

Describe how the average kinetic energy of the gas particles changes when the temperature of the gas increases.

(3)

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(Total for question = 6 marks)

Q2.

A student uses a syringe containing trapped air to investigate pressure.

Diagram 1 shows the apparatus he uses.

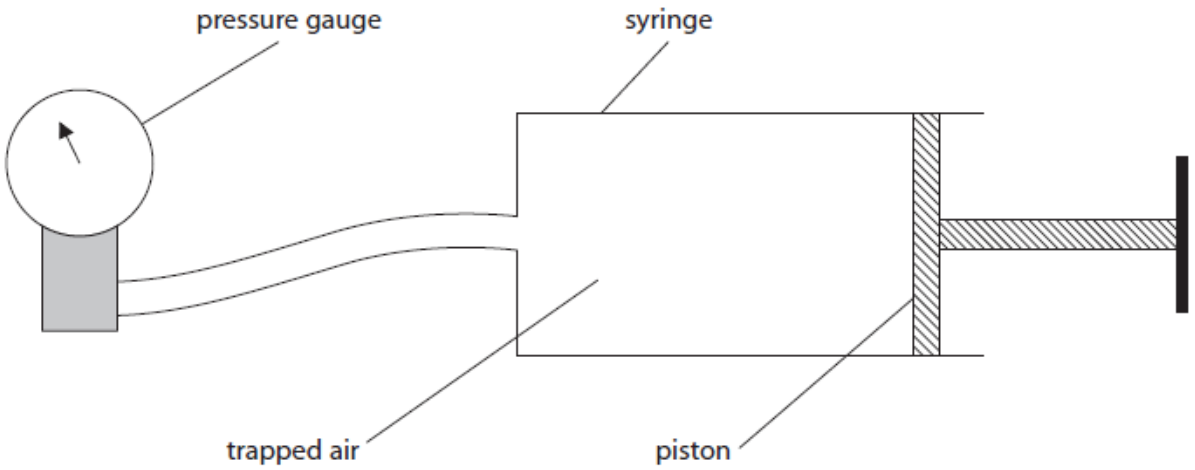

Diagram 1

(a) Diagram 2 shows the pressure gauge when the piston is at its initial position.

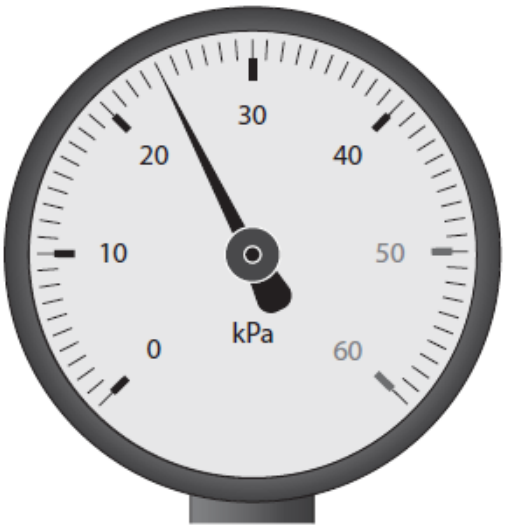

Diagram 2

Determine the reading on the pressure gauge.

(1)

pressure = ... kPa

(b) The piston is pushed in so that the volume of trapped air in the syringe is halved. The temperature of the trapped air remains constant.

Explain how the reading on the pressure gauge will change when the piston is pushed in.

(3)

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(c) The position of the piston is then fixed so that the volume of trapped air in the syringe is now constant.

The air in the syringe is then cooled.

(i) State how the motion of air particles inside the syringe changes when the air is cooled.

(1)

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(ii) Explain how the pressure of the trapped air inside the syringe changes when the air is cooled.

Refer to particles in your answer.

(3)

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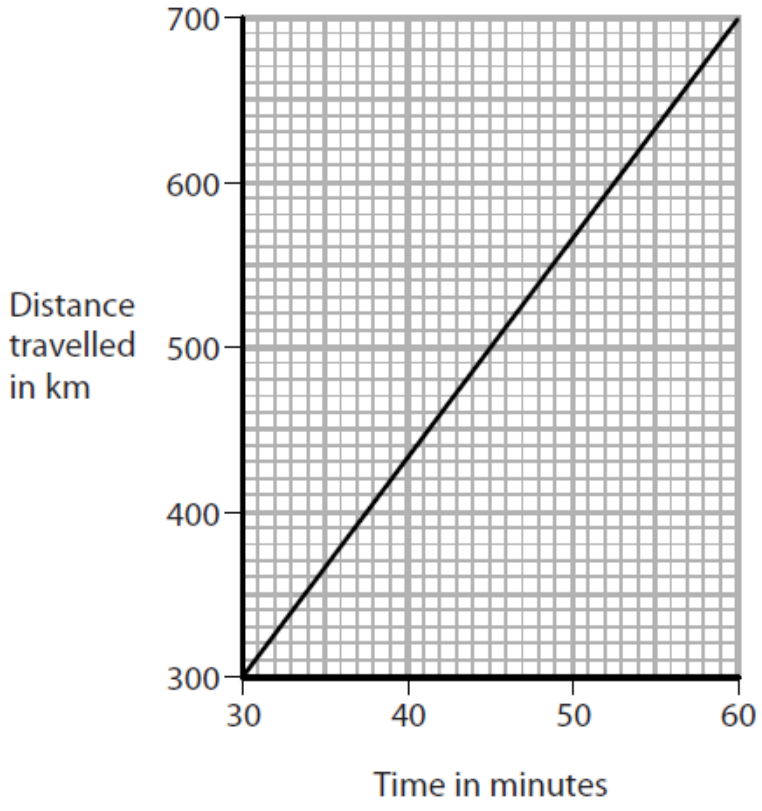
(Total for question = 8 marks)

Q3.

The graph shows how the distance travelled by an aeroplane changes during part of its journey.



(a) (i) State the formula linking average speed, distance moved and time taken.

(1)

(ii) Calculate the average speed of the aeroplane during this part of its journey.

Give a suitable unit.

(4)

average speed = ... unit .....

(b) During the flight, the height of the aeroplane decreases.

As the height of the aeroplane decreases, the temperature outside the aeroplane increases.

Explain how the air pressure outside the aeroplane changes as the height of the aeroplane decreases.

(3)

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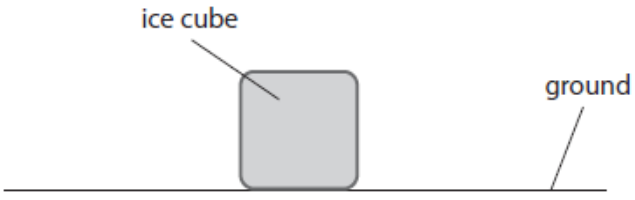
(Total for question = 8 marks)

Q4.

This is a question about a melting ice cube.

(a) The diagram shows an ice cube placed on the ground.



(i) The mass of the ice cube is 3.7 g and its area of contact with the ground is 2.6×10^{-4} m^2.

Calculate the pressure the ice cube exerts on the ground.

(4)

pressure = ... Pa

(ii) The ice cube melts and becomes a puddle with a larger cross-sectional area.

Explain how the pressure of the ice cube on the ground changes when it melts.

(2)

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(b) Ice melts at a temperature of 0 °C.

On the axes, sketch how the temperature of the ice cube changes as it rises from a temperature of –10 °C to a temperature of 20 °C.

(3)

(c) Explain the changes that occur when a solid melts.

Refer to particles in your answer.

(2)

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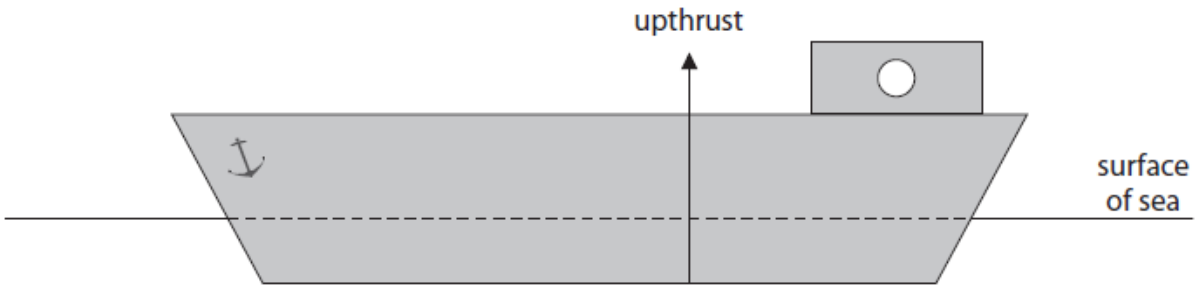
(Total for question = 11 marks)

Q5.

A ship floats on the sea.



(a) The ship floats because of the forces acting on it.

(i) The upward force acting on the ship is called upthrust.

This force is shown on the diagram.

Draw another labelled arrow on the diagram to show the other vertical force acting on the ship.

(2)

(ii) Forces are vector quantities.

State what is meant by the term **vector quantity**.

(2)

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(iii) Give another example of a vector quantity.

(1)

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(b) The upthrust force acting on the ship is proportional to the pressure difference between the bottom of the ship and the surface of the sea.

The pressure acting on the ship at the surface of the sea is 100 kPa.

(i) State the formula linking pressure difference, height, density and gravitational field strength (*g*).

(1)

(ii) The bottom of the ship is 15.8 m below the surface of the sea.

Show that the pressure acting on the bottom of the ship is approximately 260 kPa.

[density of seawater = 1030 kg/m^3]

(3)

(iii) Explain why the bottom of the ship is deeper below the surface of the sea when the ship is fully loaded with cargo.

(2)

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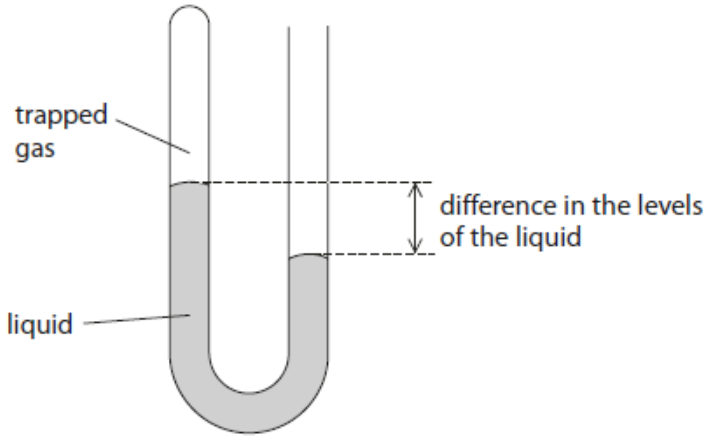
(Total for question = 11 marks)

Q6.

The diagram shows a manometer, a device used for measuring differences in pressure.



(a) One side of the manometer has some trapped gas. The other side is left open to the atmosphere.

The difference in pressure can be calculated using this formula.

[difference in pressure = height × density × 10]

The density of the liquid is 1.3×10^4 kg/m ^{3}.

The difference in the levels of the liquid is 3.8 cm.

Calculate the difference in pressure between the atmosphere and the trapped gas.

(3)

difference in pressure = ... Pa

(b) The temperature and pressure of the trapped gas increase when it is warmed.

(i) Explain, in terms of particles, why the pressure of the trapped gas increases.

(3)

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(ii) The pressure of the trapped gas in the manometer is 9.95×10^4 Pa and the temperature is 16 °C.

Calculate the new pressure of the trapped gas if the temperature increases to 32 °C.

[assume volume of the trapped gas remains constant]

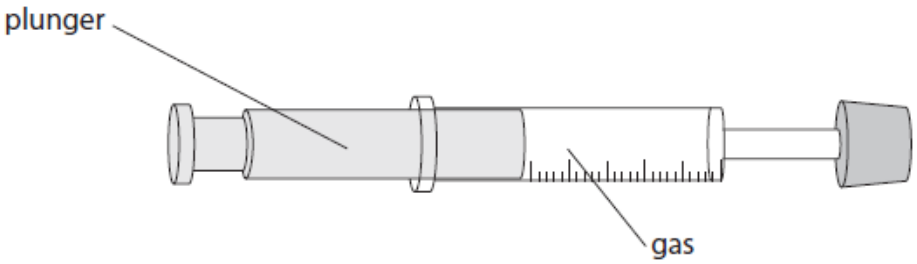
(4)

new pressure = ... Pa

(Total for question = 10 marks)

Q7.

A gas is contained inside a sealed syringe.



(a) The plunger is pushed so that the gas is compressed and its volume reduces at constant temperature.

(i) Before compression, the gas pressure is 100 kPa and the volume of the gas is 7.5 cm^3.

After compression, the volume of the gas is 5.0 cm^3.

Calculate the pressure of the gas after compression.

(3)

pressure = ... kPa

(ii) Explain why decreasing the volume changes the pressure of the gas in the syringe.

You should use ideas about particles in your answer.

(3)

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(b) The plunger of the syringe is released and the gas returns to its original pressure of 100 kPa.

The plunger is then held in position so that the volume of the gas cannot change.

The gas is now heated and its temperature increases.

(i) Describe how the average kinetic energy of the gas particles changes when the temperature of the gas increases.

(3)

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(ii) The temperature of the gas increases from 20 °C to 65 °C.

Calculate the pressure of the gas after it is heated.

(4)

pressure = ... kPa

(Total for question = 13 marks)

Q8.

This question is about heating water.

(a) Liquid water boils and becomes a gas at 100 °C.

Describe the differences between the arrangement and motion of particles in a liquid and in a gas.

You may include a diagram in your answer.

(3)

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(b) A teacher uses a 2200 W kettle to heat water.

The kettle is switched on for 2 minutes.

(i) Calculate the energy transferred by the kettle.

(3)

energy transferred = ... J

(ii) State the equation relating change in thermal energy, mass, specific heat capacity and change in temperature.

(1)

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(iii) The mass of water in the kettle is 1.1 kg and its initial temperature is 20 °C.

Calculate the final temperature of the water after it has been heated for 2.0 minutes.

[the specific heat capacity of water is 4200 J/kg °C]

(4)

final temperature = ... °C

(c) The teacher measures the final temperature of the water after heating it for 2 minutes.

(i) Name a piece of equipment the teacher could use to measure the temperature of the water.

(1)

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(ii) Explain why the measured final temperature is different from your calculated value.

(2)

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(Total for question = 14 marks)