**1** This question is about temperature and pressure in gases.

(a) A gas is heated in a container which has a constant volume.

The particles in the gas

**(1)**

- ☒ **A** expand
- ☒ **B** hit the walls of the container harder
- ☒ **C** move closer together
- ☒ **D** have a lower average speed

(b) Describe what happens to the average kinetic energy of particles as the temperature decreases from 10 K towards 0 K.

**(2)**

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(c) (i) Convert a temperature of 27 °C into kelvin (K).

**(1)**

temperature = ..... K

(ii) The gas in a cylinder has a pressure of 210 kPa at a temperature of 27 °C.

Calculate the new pressure when the temperature of the gas rises to 81 °C.

**(3)**

pressure = ..... kPa

**(Total for Question 1 = 7 marks)**

**2** A soldering iron is a tool used when joining electronic components in a circuit.

It has an electric heater.

(a) Soldering iron A operates when connected to the mains supply.




Soldering iron A

Soldering iron A is labelled 230 V, 30 W.

(i) What does **30 W** tell you about the energy transfer in the soldering iron?

**(2)**

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(ii) This soldering iron has an earth connection.

Explain how an earth connection protects the user.

**(2)**

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(b) Soldering iron B is connected to a low voltage power supply.




Soldering iron B

Soldering iron B is labelled 24 V, 70 W.

A student says:



I think that both soldering irons need a 3 A fuse.

(i) Use information from the soldering iron labels to evaluate this statement.

**(3)**

(ii) There is a step-down transformer in the power supply for soldering iron B.

Describe the structure of a step-down transformer.

You may draw a labelled diagram to help your answer.

**(3)**

**(Total for Question 2 = 10 marks)**

**3** James Dewar was a scientist who investigated liquid oxygen.

(a) He discovered that the boiling point of liquid oxygen is –183 °C.

(i) Convert –183 °C to a temperature on the Kelvin scale.

**(1)**

Temperature = ..... K

(ii) Use ideas about particles to describe the changes that happen when a liquid boils to form a gas.

**(3)**

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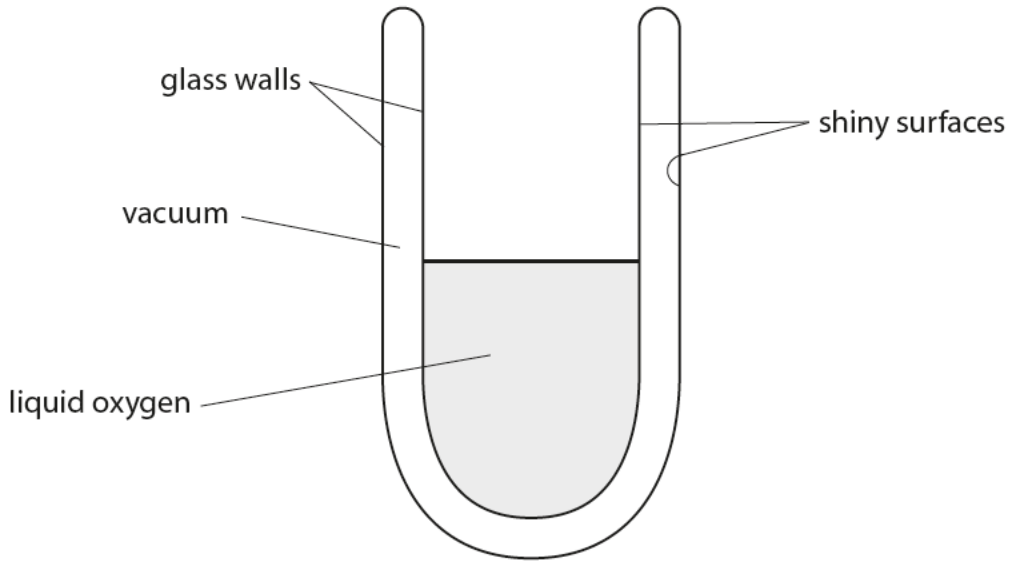
(b) Dewar invented a special flask for storing liquid oxygen in the laboratory.

It was designed to reduce heat flow from the air outside to the liquid oxygen inside.

The flask had two glass walls with a vacuum between them.

The inside glass surfaces were each covered with a thin layer of shiny metal.

The diagram shows a cross section of the flask.




(i) Explain how the **shiny surfaces** reduce the thermal energy transferred to the liquid oxygen from the laboratory.

**(2)**

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(ii) Explain how the **vacuum** reduces the thermal energy transferred to the liquid oxygen from the laboratory.

**(2)**

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(c) Dewar's flask did not have a lid when it was holding liquid oxygen.

Suggest why a lid was not needed.

**(2)**

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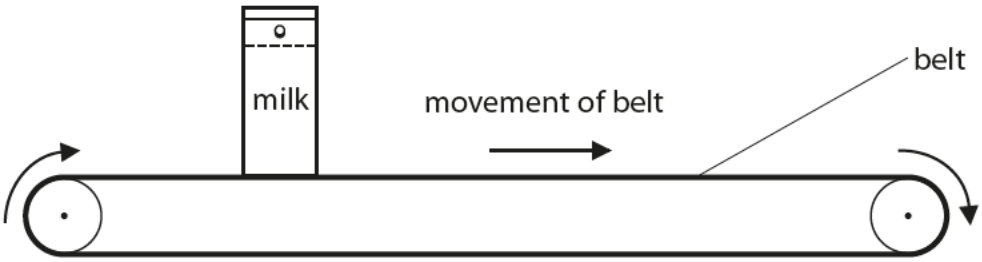
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**(Total for Question 3 = 10 marks)**

**4** Supermarkets use conveyer belts to move shopping at the till.

The diagram shows a carton of milk being pulled along by a horizontal conveyer belt.




The horizontal force on the carton from the belt is 1.7 N.

The carton moves a distance of 0.46 m.

(a) (i) State the equation linking work done, force and distance.

**(1)**

(ii) Calculate the work done moving the carton.

**(2)**

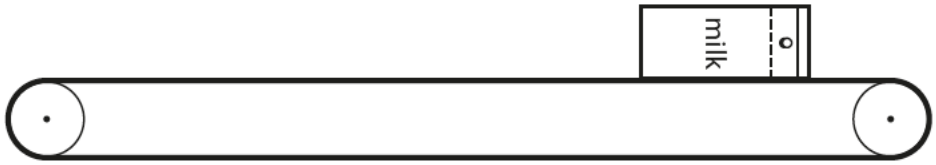
Work done = ..... J

(iii) State how much energy is transferred to the carton.

**(1)**

Energy transferred = ..... J

(b) The belt stops suddenly and the carton falls over.




(i) How does this affect the kinetic energy of the carton?

**(1)**

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(ii) Why does falling over reduce the gravitational potential energy of the carton?

**(1)**

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**(Total for Question 4 = 6 marks)**