

Q1. (2019)

0 2

A scientist cooled the air inside a container.

The air contained water that froze at 0°C The change in internal energy of the water as it froze was 0.70 kJ The specific latent heat of fusion of water is 330 kJ/kg

a)

0 2 . 3

The air also contained oxygen, nitrogen and carbon dioxide.

Oxygen boils at -183°C and freezes at -218°C Nitrogen boils at -195°C and freezes at -210°C Carbon dioxide sublimates at -78°C The scientist continued to cool the air to a temperature of -190°C What is the state of each substance at -190°C ?

[2 marks]

Tick (✓) **one** box for **each** row of the table.

Substance	Solid	Liquid	Gas
Oxygen			
Nitrogen			
Carbon dioxide			

b)

0 2 . 4

The air also contained a small amount of argon.

As the temperature of the air decreased from 20°C to -190°C the argon changed from a gas to a liquid to a solid.

Explain the changes in the arrangement and movement of the particles of the argon as the temperature of the air decreased.

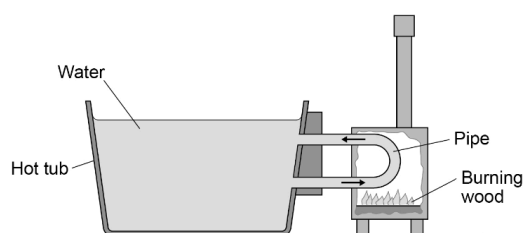
[6 marks]

Q2. (2020)

0 4

Figure 5 shows a wood-fired hot tub.

Figure 5



0 4 . 4

The temperature of the water reaches 42°C

The temperature then stays constant even though the fire continues to burn.

Explain why the temperature of the water stays constant.

[2 marks]

Q3. (2020)

0 5

Ice cream is made by cooling a mixture of liquid ingredients until they freeze.

a)

0 5 . 1

Which statement describes the motion of the particles in solid ice cream?

[1 mark]

Tick (✓) **one** box.

They are stationary.

☐

They move freely.

☐

They vibrate about fixed positions.

☐

b)

0 5 . 2

How do the kinetic energy and the potential energy of the particles change as a liquid is cooled and frozen?

[1 mark]

Tick (✓) **one** box.

Kinetic energy	Potential energy	
Decreases	Decreases	☐
Decreases	Does not change	☐
Does not change	Decreases	☐
Does not change	Does not change	☐

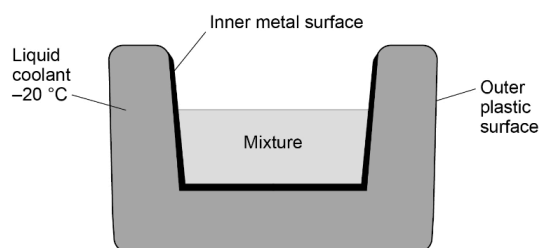
c)

Figure 6 shows a bowl used for making ice cream.

The walls of the bowl contain a liquid coolant.

The bowl is cooled to -20°C before the mixture is put in the bowl.

The bowl causes the mixture to cool down and freeze.

Figure 6

0 5 . 4

The liquid coolant has a freezing point below -20°C Explain **one** other property that the liquid coolant should have.

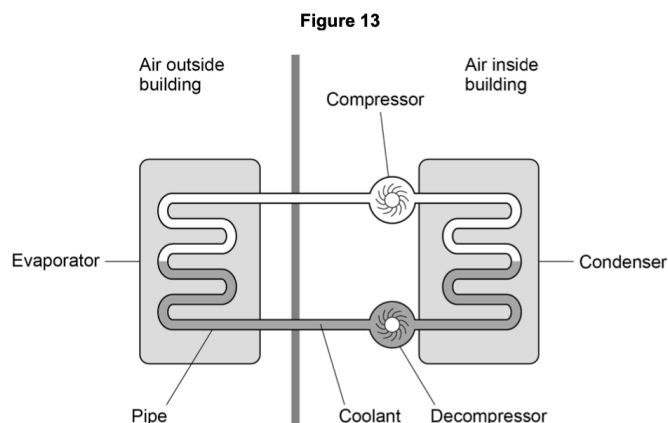
[2 marks]

Q4. (2021)

0 6

An air source heat pump transfers energy from the air outside a building to increase the temperature of the air inside the building.

Figure 13 shows an air source heat pump.



The compressor is connected to the mains electricity supply.

The pipe in the heat pump contains a substance called coolant.

In the evaporator, energy is transferred from the air outside the building to the liquid coolant.

The temperature of the coolant increases and it evaporates.

a)

0 6 . 1

Explain what happens to the internal energy of the coolant as its temperature increases.

[2 marks]

b)

0 6 . 3

What happens to the mass of the coolant as it evaporates and becomes a vapour?

[1 mark]

Tick (✓) **one** box.

Decreases

☐

Stays the same

☐

Increases

☐

Q5. (2022)

0 2 . 7

Some chips were put in the deep fryer.

In the deep fryer, water in the chips underwent a physical change and became steam.

Why is this a physical change?

[1 mark]

Tick (✓) **one** box.

All water can change to steam.

☐

No chemicals are involved when water changes to steam.

☐

The change from water to steam can be detected visually.

☐

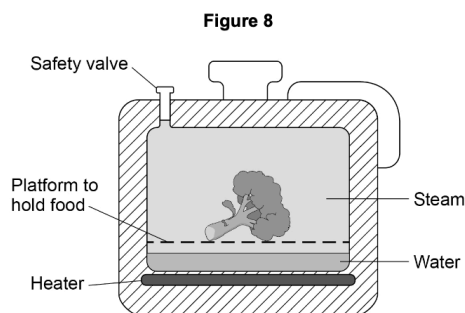
The water will recover its original properties if the steam is cooled

☐

Q6. (2022)

A pressure cooker is a sealed pot that uses steam to cook food.

Figure 8 shows a pressure cooker.



0 4 . 4 When the water in the pressure cooker starts to boil:

- the amount of steam in the pressure cooker increases
- the temperature of the steam increases above 100 °C

Explain why these changes make the pressure in the cooker increase.

[5 marks]

Q7. (2023)

0 6 . Figure 12 shows a device that uses a mug of hot coffee to turn a wheel.



a)

0 6 . 2 For the device to work, the air in the chamber must increase in temperature quickly.

Explain why the bottom of the air chamber is made of metal rather than plastic.

[2 marks]

b)

0 6 . 3 The mass of air in the chamber is constant.

What property of air allows a small change in internal energy to cause a large temperature change to the air in the chamber?

[1 mark]

c)

0 6 . 5 The temperature of the coffee decreases as the device is used.

The initial temperature of the coffee was 76°C .

The internal energy of the coffee decreased by 15 kJ.

density of coffee = $1.1 \times 10^3 \text{ kg/m}^3$

volume of coffee = $1.9 \times 10^{-4} \text{ m}^3$

specific heat capacity of coffee = $4200 \text{ J/kg }^{\circ}\text{C}$

Calculate the final temperature of the coffee.

Use the Physics Equations Sheet.

[6 marks]

Q8. (2024)

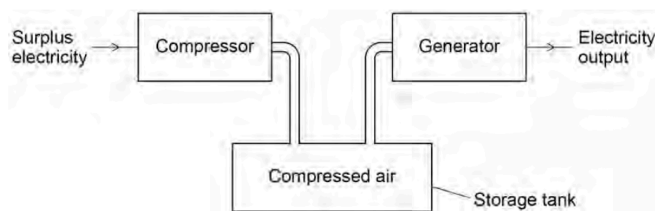
0 6 Energy can be stored using a Compressed Air Energy Storage (CAES) system.

When more electricity is generated than is needed, a CAES system uses the surplus electricity to compress air in a storage tank.

When there is a greater demand for electricity, the CAES system releases the compressed air to generate electricity.

Figure 7 shows a diagram of the CAES system.

Figure 7



The generator works when forces from the compressed air cause a turbine to rotate.

When particles of air collide with the turbine they transfer energy to the turbine.

In warm weather the temperature of the compressed air increases, increasing the pressure inside the storage tank.

0 6 . 3 The volume of the storage tank is $5.0 \times 10^5 \text{ m}^3$.

The density of the compressed air is 48 kg/m^3 .

specific heat capacity of air = $1100 \text{ J/kg }^{\circ}\text{C}$

The temperature of the compressed air increases from 12°C to 27°C .

Calculate the energy transferred to the compressed air in the storage tank.

Use the Physics Equations Sheet.

Give your answer in standard form.

[6 marks]