Particle Model part 3 AQA Triple Physics

Name: ____________________

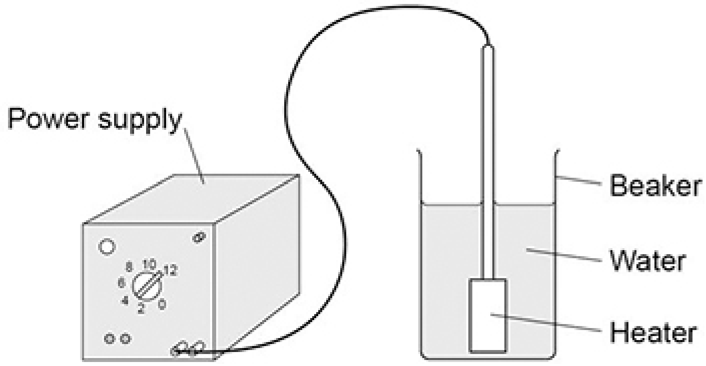
Class: ____________________

Date: ____________________

Time:	**68 minutes**
Marks:	**64 marks**
Comments:	

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

The figure below shows some of the equipment used.



This is the method used:

1. Put 50 cm^3 of water in a beaker.

2. Measure the mass of the beaker and water.

3. Use a heater to boil the water and keep it boiling for 600 seconds.

4. Measure the mass of the beaker and water after 600 seconds.

(a) What measuring instrument should be used to measure the volume of water?

____

(1)

(b) What is a hazard in the student's investigation?

Tick (✓) **one** box.

burns ☐

boiling water ☐

heatproof gloves ☐

safety goggles ☐

(1)

(c) The initial mass of the beaker and water was 0.080 kg.

The final mass of the beaker and water was 0.071 kg.

The energy transferred by the immersion heater as the water boiled was 25 200 J.

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

Give the unit.

Use the Physics Equations Sheet.

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Specific latent heat of vaporisation = ________________ Unit ________

(5)

(d) Some thermal energy was transferred to the surroundings while the water was being heated.

Explain how this affected the student's value for the specific latent heat of vaporisation of water.

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(2)

(e) Some of the water evaporated before its temperature reached 100 °C.

Explain how this affected the student's value for the specific latent heat of vaporisation of water.

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(2)
(Total 11 marks)

2. The figure below shows a rock found by a student on a beach.

To help identify the type of rock, the student took measurements to determine its density.

(a) Describe a method the student could use to determine the density of the rock.

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(6)

The student determined the density of the rock to be 2.55 ± 0.10 g/cm^3.

(b) What are the maximum and minimum values for the density of the rock?

Maximum density = ____________________ g/cm^3

Minimum density = ____________________ g/cm^3

(1)

(c) The table below gives the density of five different types of rock.

Type of rock	**Density in g/cm^3**
Basalt	2.90 ± 0.10
Chalk	2.35 ± 0.15
Flint	2.60 ± 0.10
Sandstone	2.20 ± 0.20
Slate	2.90 ± 0.20

Which two types of rock in above table could be the type of rock the student had?

Tick (✓) **one** box.

Basalt or chalk ☐

Chalk or flint ☐

Flint or sandstone ☐

Sandstone or slate ☐

(1)

(d) The student only took one set of measurements to determine the density of the rock.

Explain why taking the measurements more than once may improve the accuracy of the density value.

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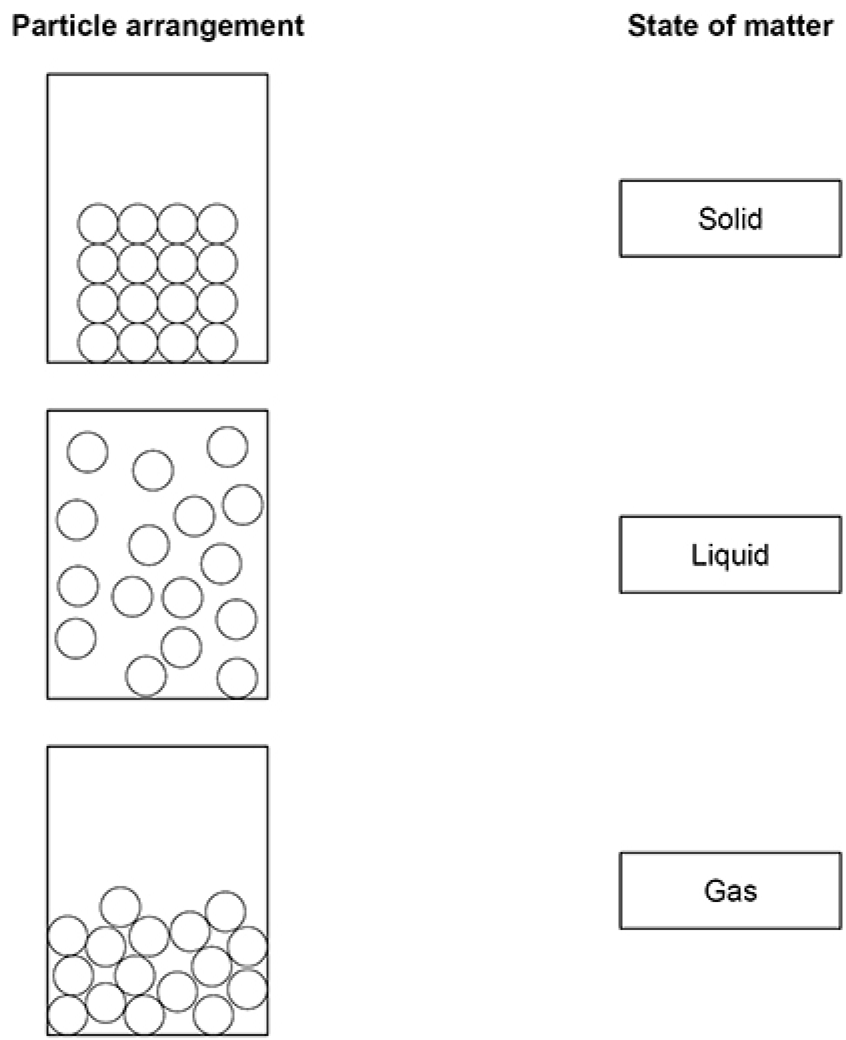
(2)

(Total 10 marks)

3. (a) A student investigated the three states of matter.

The arrangement of particles in the three states of matter are different.

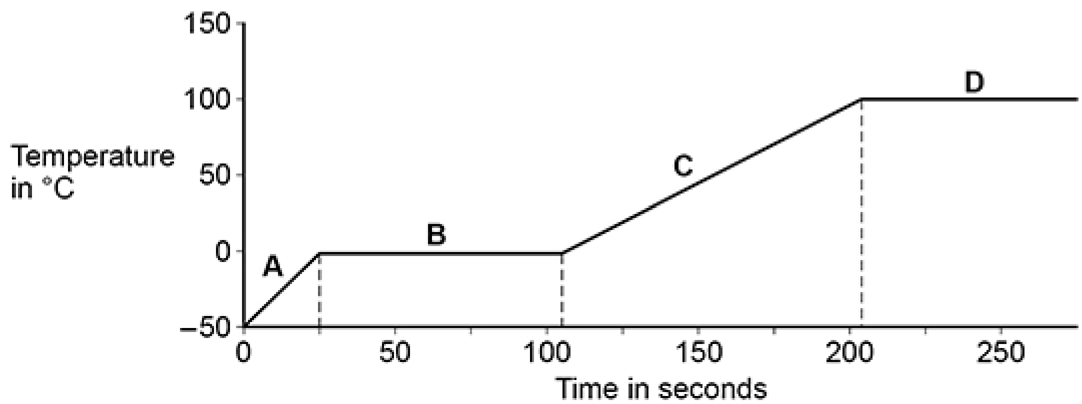
Draw **one** line from each particle arrangement to the state of matter.



(2)

A large lump of ice was heated and changed state.

The figure below shows how the temperature varied with time.



(b) Which part of the figure above shows when the ice was melting?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(c) Which part of above the figure above shows when the water was boiling?

Tick (✓) **one** box.

A ☐ **B** ☐ **C** ☐ **D** ☐

(1)

(d) Which property of the water particles changes as the temperature of the water increases?

Tick (✓) **one** box.

The kinetic energy of the particles ☐

The mass of each particle ☐

The number of particles ☐

(1)

(e) Calculate the thermal energy needed to melt 0.250 kg of ice at 0 °C.

specific latent heat of fusion of water = 334 000 J/kg

Use the equation:

thermal energy = mass × specific latent heat

____

____

____

Thermal energy = ________________ J

(2)

(f) Complete the sentence.

Choose the answer from the box.

condenses	**evaporates**	**ionises**	**sublimates**

A substance is heated and changes directly from a solid to a gas.

The substance _______________.

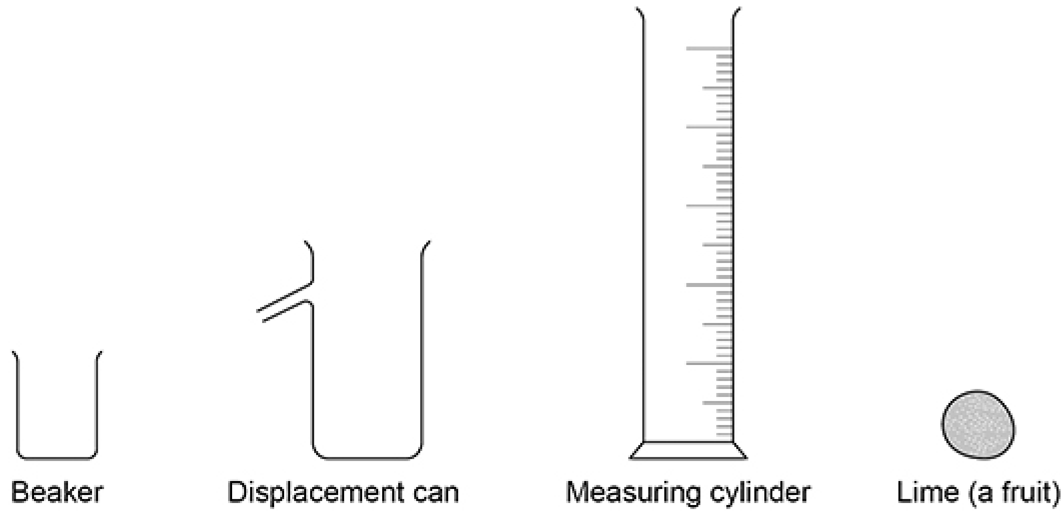
(1)

(Total 8 marks)

4. A student investigated the density of different fruits.

To determine the density of each fruit, the student measured the volume of each fruit.

The figure below shows the equipment the student could have used.



(a) Describe a method the student could have used to measure the volume of the lime.

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(4)

(b) The student measured the volume of each fruit three times and then calculated a mean value.

The three measurements for a grape were

$2.1\ cm^3$ $2.1\ cm^3$ $2.4\ cm^3$

Calculate the mean value.

___

___

___

Mean value = ________________ cm^3

(2)

(c) What are the advantages of taking three measurements and calculating a mean value?

Tick (✓) **two** boxes.

Allows anomalous results to be identified and ignored.	☐
Improves the resolution of the volume measurement.	☐
Increases the precision of the measured volumes.	☐
Reduces the effect of random errors when using the equipment.	☐
Stops all types of error when using the equipment.	☐

(2)

(d) The mass of an apple was 84.0 g.

The volume of the apple was 120 cm^3.

Calculate the density of the apple.

Give your answer in g/cm^3.

Use the equation:

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

____

____

____

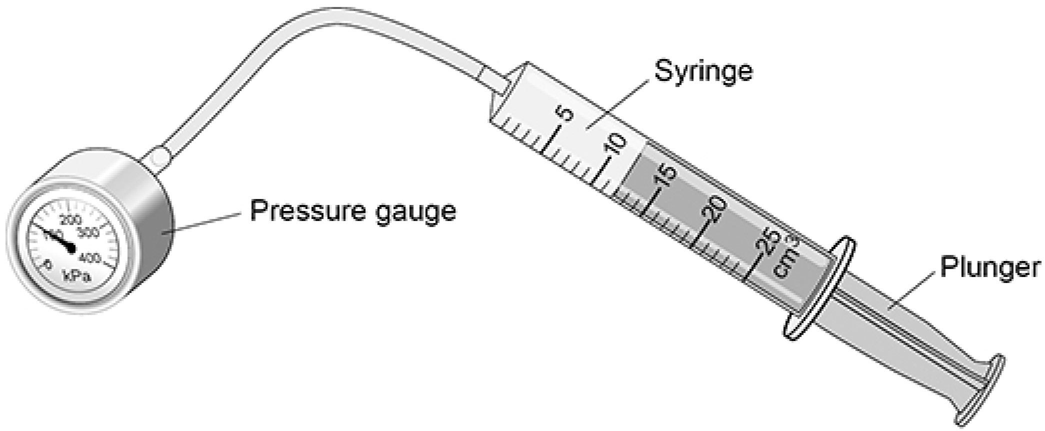
Density = _______________ g/cm^3

(2)

(Total 10 marks)

5. A teacher demonstrated the relationship between the pressure in a gas and the volume of the gas.

The figure below shows the equipment used.



(a) What is the range of the syringe?

Tick (✓) **one** box.

From 0 to 1 cm^3 ☐

From 0 to 5 cm^3 ☐

From 0 to 25 cm^3 ☐

(1)

(b) The relationship between the pressure and volume of a gas is given by the equation:

pressure × volume = constant

Complete the sentence.

For this equation to apply, both the mass of gas and the ________________ of the gas must stay the same.

(1)

(c) The initial volume of the gas in the syringe was 12 cm^3.

The initial pressure of the gas in the syringe was 101 000 Pa.

Calculate the constant in the equation below.

pressure × volume = constant

____

____

____

Constant = ________________ Pa cm^3

(2)

(d) The teacher pulled the plunger slowly outwards and the gas expanded.

The new volume of the gas was 24 cm^3.

Calculate the new pressure in the gas.

The constant has the same value as in part (c)

____

____

____

____

____

New pressure = ________________ Pa

(3)

(e) Which change occurs when the plunger is pulled slowly outwards?

Tick (✓) **one** box.

The gas particles stop moving.	☐
There are more frequent collisions between the gas particles.	☐
There is more space between the gas particles.	☐

(1)

(Total 8 marks)

6. A student investigated the density of different fruits.

The table below shows the results.

Fruit	**Density in g/cm^3**
Apple	0.68
Kiwi	1.03
Lemon	0.95
Lime	1.05

(a) The student determined the volume of each fruit using a displacement can and a measuring cylinder.

What other piece of equipment would the student need to determine the density of each fruit?

____

(1)

(b) Write down the equation which links density (*ρ*), mass (*m*) and volume (*V*).

____

(1)

(c) The mass of the apple was 85 g.

The density of the apple was 0.68 g/cm^3.

Calculate the volume of the apple.

Give your answer in cm^3.

____

____

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____

____

Volume = _______________ cm^3

(3)

(d) The student only measured the volume of each fruit once.

The volume measurements **cannot** be used to show that the method to measure volume gives precise readings.

Give the reason why.

___

___

___

(1)

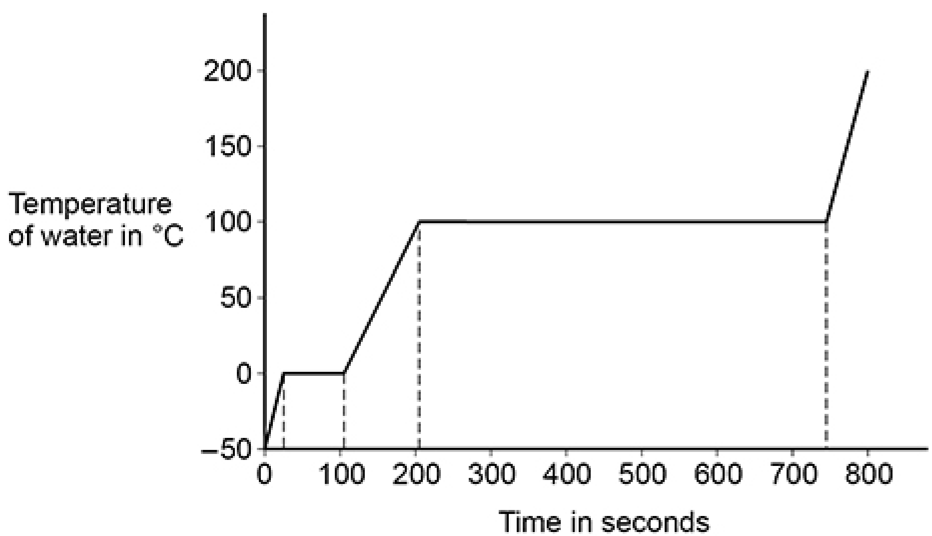
(Total 6 marks)

7. A student investigated how the temperature of a lump of ice varied as the ice was heated.

The student recorded the temperature until the ice melted and then the water produced boiled.

The figure below shows the student's results.

The power output of the heater was constant.



(a) The specific heat capacity of ice is less than the specific heat capacity of water.

Explain how the figure above shows this.

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(2)

(b) The specific latent heat of fusion of ice is less than the specific latent heat of vaporisation of water.

Explain how the figure above shows this.

___

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___

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(2)

(c) A second student did the same investigation and recorded the temperature until the water produced boiled.

In the second student's investigation more thermal energy was transferred to the surroundings.

Describe **two** ways the results of the experiment in the figure above would have been different.

1 ___

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___

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2 ___

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(2)

(d) When the water was boiling, 0.030 kg of water turned into steam.

The energy transferred to the water was 69 kJ.

Calculate the specific latent heat of vaporisation of water.

Give the unit.

___

___

___

___

___

___

___

Specific latent heat of vaporisation = ______________

Unit __________

(5)

(Total 11 marks)

Mark schemes

1. (a) measuring cylinder

allow burette

allow beaker with scale / graduations

1

(b) boiling water

1

(c) change in mass = 0.009 (kg)

1

25 200 = 0.009 *L*

allow a correct substitution using an incorrectly calculated value of m

1

$$L = \frac{25\,200}{0.009}$$

allow a correct rearrangement using an incorrectly calculated value of m

1

$L = 2.8 \times 10^6$
or
L = 2 800 000

allow a correctly calculated answer using an incorrectly calculated value of m

1

J/kg

if a unit other than J/kg is given it must match the numerical answer

1

(d) less energy (than 25 200 J) was transferred to the water

1

(so) student's value of *L* is too high

2nd mark conditional on scoring 1st mark

1

(e) the measured change in mass is too high (for the energy supplied)

allow a smaller mass of water actually changed state at boiling point

1

(so) student's value of *L* is too low

2nd mark conditional on scoring 1st mark

1

[11]

2.

(a) **Level 3**: The method would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

5–6

Level 2: The method would not necessarily lead to a valid outcome. Most steps are identified, but the method is not fully logically sequenced.

3–4

Level 1: The method would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content:

- measure mass using a balance / scales

- part fill a measuring cylinder with water and measure initial volume
- place rock in water and measure final volume
- volume of rock = final volume − initial volume

- fill a displacement / eureka can with water level with spout
- place rock in water and collect displaced water
- measuring cylinder used to determine volume of displaced water
- volume of rock = volume of displaced water

- use mass and volume to calculate density

- use of: density = $\frac{\text{mass}}{\text{volume}}$

(b) maximum density = 2.65 (g/cm^3)

both required

minimum density = 2.45 (g/cm^3)

1

(c) chalk or flint

1

(d) a mean can be calculated

1

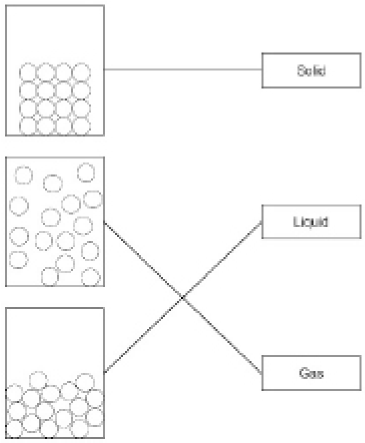
which reduces the effect of random errors

allow anomalies can be identified / removed

1

[10]

3. (a)



2 marks for all correct

1 mark for 1 or 2 correct

2

(b) **B**

1

(c) **D**

1

(d) the kinetic energy of the particles

1

(e) E = 0.250 × 334 000

1

E = 83 500 (J)

1

(f) sublimates

1

[8]

4. (a) **Level 2**: The method would lead to the production of a valid outcome. The key steps are identified and logically sequenced.

3–4

Level 1: The method would not necessarily lead to a valid outcome. Some steps are identified, but the method is not fully logically sequenced.

1–2

No relevant content

0

Indicative content

- use a eureka/displacement can
- fill the eureka/displacement can with water
- fill the eureka/displacement can up to the spout
- place lime in eureka/displacement can
- collect water that overflows
- use a measuring cylinder to measure volume of water

OR

- use a measuring cylinder
- part fill the measuring cylinder with water
- measure the initial volume of water
- place lime in measuring cylinder
- record new volume of water
- volume of lime = new volume – initial volume

(b) mean = $\frac{(2.1+2.1+2.4)}{3}$ 1

mean = 2.2 (cm^3) 1

(c) allows anomalous results to be identified and ignored 1

reduces the effect of random errors when using the equipment 1

(d) density = $\frac{84}{120}$ 1

density = 0.70 (g/cm^3) 1

[10]

5. (a) 0 to 25 cm^3 1

(b) temperature 1

(c) 101 000 × 12 = constant 1

constant = 1 212 000 (Pa cm^3) 1

(d) $p \times 24 = 1\,212\,000$

allow ecf from question (c)

1

$$p = \frac{1\,212\,000}{24}$$

1

p = 50 500 (Pa)

1

(e) there is more space between the gas particles

1

[8]

6. (a) balance / scales

1

(b) $$\text{density} = \frac{\text{mass}}{\text{volume}}$$

or

$$\rho = \frac{m}{V}$$

1

(c) $$0.68 = \frac{85}{V}$$

1

$$V = \frac{85}{0.68}$$

1

V = 125 (cm^3)

1

(d) repeat readings (of volume) need taking (of each fruit) to show that the readings are close together

allow 'the same' for 'close together'

1

[6]

7. (a) the gradient for ice is steeper than the gradient for water (liquid)

allow the temperature of the ice increased faster than the temperature of the water

1

which means that less energy is needed to increase the temperature by a fixed amount

1

(b) water took more time to vaporise than the ice took to melt

1

which means that less energy is needed to change the state from solid to liquid (than from liquid to vapour)

1

(c) any **two** from:

- ice/water would take more time to increase in temperature
  allow gradients would be less steep
- ice/water would take more time to change state
- the change in temperature with time would not be linear
  allow horizontal lines would be longer

2

(d) E = 69 000 (J)

1

69 000 = 0.030 × L

allow a correct substitution of an incorrectly/not converted value of E

1

$$L = \frac{69\ 000}{0.030}$$

allow a correct rearrangement using an incorrectly/not converted value of E

1

L = 2 300 000
or
$L = 2.3 \times 10^6$

allow a correct calculation using an incorrectly/not converted value of E

1

J/kg

allow a unit consistent with their numerical answer

eg 2300 kJ/kg

1

[11]