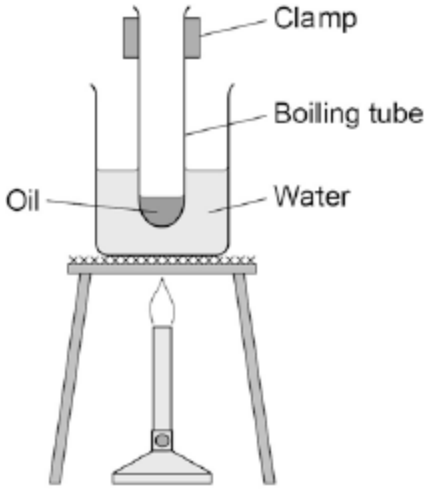
1 A student investigated the change in temperature when oils of different specific heat capacities were heated.

She set up the apparatus shown in the figure below.



This is the method used.

1. Put 25 g of oil into a boiling tube.
2. Pour 100 ml of water into a beaker and heat it with a Bunsen burner.
3. When the water is boiling, put the boiling tube into the beaker.
4. When the temperature of the oil reaches 30 °C, heat for a further 30 seconds and record the rise in temperature.
5. Repeat with different oils.
6. Repeat the whole investigation.

(a) Name **two** pieces of apparatus the student used that are **not** shown in the figure above.

1. _____

2. _____

(2)

(b) What are the independent and dependent variables in the student's investigation?

Independent _____

_____

Dependent _____

_____

(2)

(c) Give **two** safety precautions the student should have taken.

1. _____

_____

2. _____

_____

(2)

(d) Suggest **one** improvement to the student's method.

_____

_____

_____

_____

(2)

(e) The table below shows the student's results.

	Temperature rise in °C			
Type of oil	**1**	**2**	**3**	**Mean**
Castor oil	20	19	21	20
Linseed oil	19	18	19	19
Mineral oil	21	21	21	21
Olive oil	17	17	18	
Sesame oil	23	23	20	22

Calculate the mean temperature rise for olive oil.

Give your answer to two significant figures.

_____

_____

_____

_____

Mean temperature rise = _____ °C

(2)

(f) The mean change in temperature of the castor oil is 20 °C

The specific heat capacity of castor oil is 1 800 J / kg °C

The mass of oil used is 0.025 kg

Calculate the change in thermal energy of the castor oil the student used.

Use the correct equation from the Physics Equations Sheet.

Select the correct unit from the box.

joule	**newton**	**volt**

_____

_____

_____

_____

_____

Change in thermal energy = _____

Unit = _____

(3)

(Total 13 marks)

2 **Figure 1** shows a kettle a student used to determine the specific heat capacity of water.

Figure 1

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The student placed different masses of water into the kettle and timed how long it took for the water to reach boiling point.

The student carried out the experiment three times.

The student's results are shown in the table below.

	Time for water to boil in seconds					
Mass of water in kg	**1**	**2**	**3**	**Mean**	**Mass × change in temperature in kg°C**	**Energy supplied in kJ**
0.25	55	60	63	59	20	131
0.50	105	110	116	110	40	243
0.75	140	148	141	143	60	314
1.00	184	190	183	182	80	401
1.25	216	215	211	214	100	471
1.50	272	263	266	267	120	587
1.75	298	300	302		140	

(a) Suggest how the student was able to ensure that the change in temperature was the same for each mass of water.

_____

_____

_____

_____

(2)

(b) Calculate the uncertainty in the student's measurements of time to boil when the mass of water was 1.75 kg.

_____

_____

Uncertainty = _____ s

(2)

(c) The power rating of the kettle is 2.20 kW.

Calculate the average electrical energy used by the kettle, in kJ, for 1.75 kg of water to reach boiling point.

_____

_____

_____

Average energy = _____ kJ

(2)

(d) Use information from the table above to calculate the change in temperature of the water during the investigation.

_____

_____

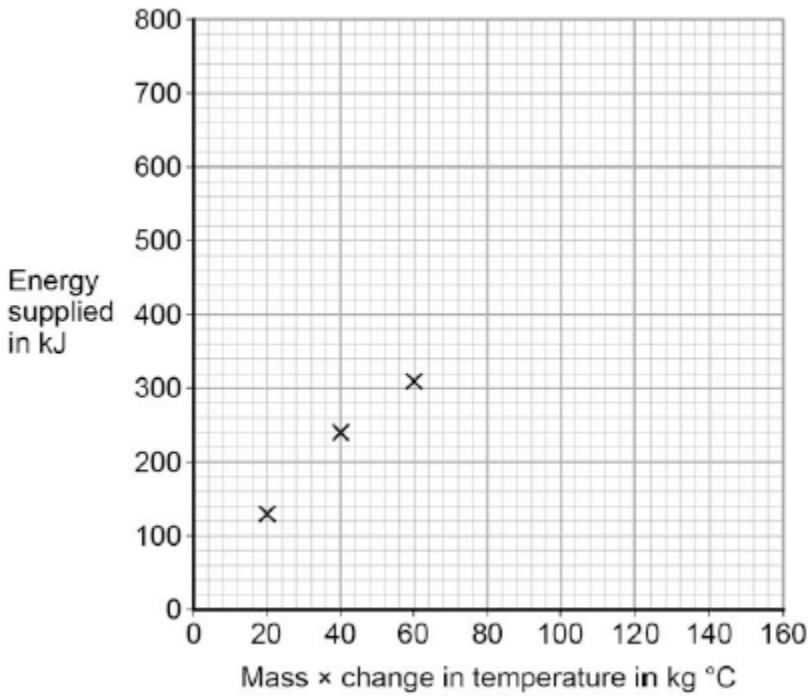
Change in temperature = _____ °C

(2)

(e) The student plotted a graph of energy supplied in kJ against mass × change in temperature in kg °C.

Figure 2 shows the graph the student plotted.

Figure 2



Use data from the table above to plot the four missing points.

Draw a line of best fit on the graph.

(3)

(f) Use the graph to determine the mean value of the specific heat capacity of water, for the student's investigation.

_____

_____

_____

_____

_____

Specific heat capacity of water = _____ J / kg °C

(4)

(g) The student's value for the specific heat capacity of water was greater than the accepted value.

Suggest why.

_____

_____

(1)

(h) The kettle used in the experiment had a label stating that the power rating of the kettle was 2.2 kW.

The student did not measure the power of the kettle.

Suggest why measuring the power of the kettle may improve the student's investigation.

_____

_____

(1)

(Total 17 marks)

3 During the day, the Sun transfers energy to an outdoor swimming pool.

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(a) By which method of energy transfer does the pool receive energy from the Sun?

_____

(1)

(b) (i) The mass of water in the pool is 5000 kg. The specific heat capacity of water is 4200 J/kg°C.

Calculate how much energy needs to be supplied to increase the water temperature by 5°C and state the correct unit.

Use the correct equation from the Physics Equations Sheet.

Give the unit.

_____

_____

_____

Energy = _____

(3)

(ii) The Sun supplies energy to the water in the pool at a rate of 16 kJ every second.

Calculate how much time it would take for energy from the Sun to raise the water temperature by 5 °C.

You will need to use your answer to **(b)(i)** and the correct equation from the Physics Equations Sheet.

_____

_____

_____

Time = _____ seconds

(3)

(iii) On one day, the temperature of the pool is 7 °C lower than the air temperature.

The time it takes for the pool temperature to rise by 5 °C is less than the answer to part **(b)(ii)**.

Suggest a reason why.

_____

_____

(1)

(Total 8 marks)