Chapter 2·1 Solutions

Answer 1

(a) Calculate the specific heat capacity (including the units) of the rock sample, given the rock absorbs 1.57×10^6 J of energy to increase its temperature by 1050°C. (3 marks)

Description	Marks
$c=Q/[m(\Delta T)]$ rearrange formula $=1.57 \times 10^6/[1.78 \times (1050)]$ values in right spot OR substitute values into equation	1
= 840 magnitude	1
$J\ kg^{-1}\ K^{-1}$ or $J\ kg^{-1}\ °C^{-1}$ units	1
Total	**3**

(b) The geologist could have estimated the specific heat capacity of the rock by measuring the temperature of the water in the bucket before and after adding the molten rock and hammer to it. Give a reason why this method would not give an accurate result. (1 mark)

Description	Marks
Any valid reason, such as: • splashing/water loss, • production of steam • heat lost in transfer or to hammer	1
Total	**1**

Answer 2

(3 marks)

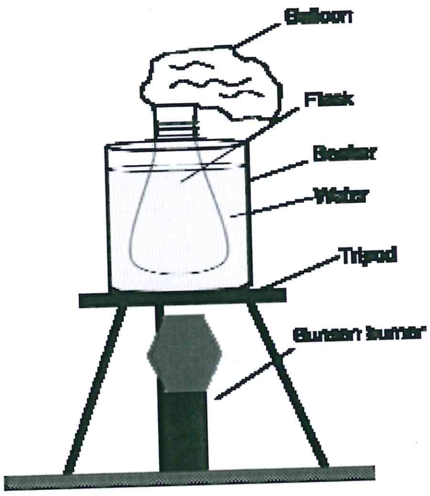
When we go to bed on a winter's night we usually cover ourselves with a blanket, doona or quilt to keep warm. Explain briefly how this keeps us warm by referring to the three methods of heat transfer listed below.

Description	Marks
Conduction: covering is a poor conductor, absorbing little heat from the body and losing little to the air.	1
Radiation: covering absorbs heat being radiated from the body. This heats the covering and the air trapped in it so its temperature rises.	1
Convection: covering traps convection currents keeping warm air in contact with the body.	1
	Total 3

Answer 3

(12 marks)

An empty, clean and clear flask was put into a refrigerator for one hour. The flask was then taken from the refrigerator and a balloon was placed on the open end of the flask. The flask was then placed into a beaker with hot water, as shown below.



(a) Explain what was seen to happen to the balloon as the gas in the flask absorbed the thermal energy from the hot water. (2 marks)

Description	Marks
the volume increases so the balloon gets bigger	1
Particles move faster and spread out	1
	Total 2

(b) Indicate the form of energy transfer (conduction, convection or radiation) that occurred in the following situations: (3 marks)

(i) between the Bunsen burner flames and the tripod: ______

(ii) between the tripod and the beaker: ______

(iii) between the water and the flask: ______

Description	Marks
(i) Convection or radiation	1
(ii) Conduction	1
(iii) Conduction	1
	Total 3

(c) Consider the following statements describing what happens when the water and the gas in the balloon are at the same temperature. (2 marks)

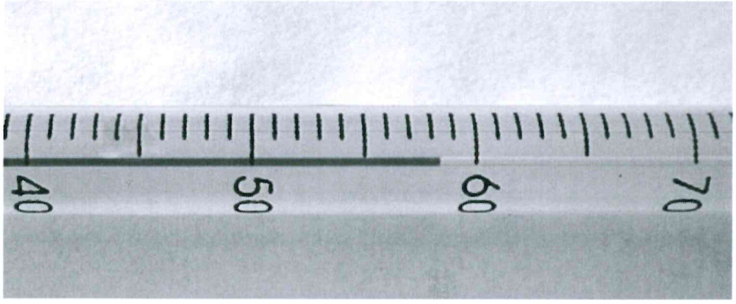
A The water has more internal energy overall than the gas.
B The average energy of the water's molecules is greater than the average energy of the gas molecules.
C The heat will flow from the water to the gas.

Which of the above statements is or are true? ______

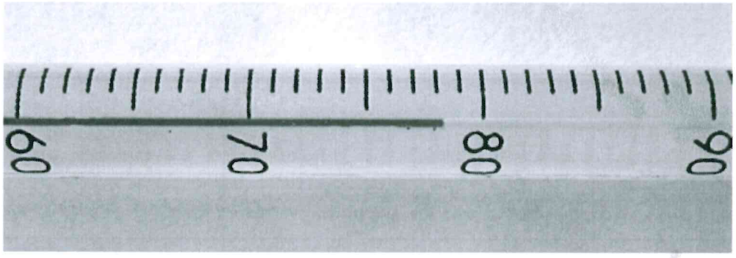
Description	Marks
A (one mark off for each error)	1-2
	Total 2

Answer 3 cont

(d) A thermometer was used to measure the temperature of the water in degrees Celsius at two different times, labelled 'before' and 'after'. Determine the readings, then calculate the temperature change and the Absolute temperature uncertainty. Use appropriate significant figures. (5 marks)



Temperature before: ______________________________



Temperature after: ______________

Temperature difference ______________

Absolute temperature uncertainty: ______________

Description	Marks
58°C (May be read as 58.3 – accept 58.0 – 58.5)	1
78°C (May be read as 78.2 – accept 78.0 – 78.5)	1
20°C (May be 19.9 – 3 sig figs)	1
±0.5 + ±0.5 = ±1.0°C	1
Observes appropriate significant figures (depends on whether 2 or 3 sig figs used in measurements.)	1
	Total 5

Answer 4

(11 marks)

(a) Calculate the specific heat capacity of the unknown metal given the above information. (4 marks)

Description	Marks
Setting them equal: $[m \times c \times (T_f - T_i)]_{metal} = [m \times c \times (T_f - T_i)]_{copper} + [m \times c \times (T_f - T_i)]_{water}$	1
Temperature change values in the right spots	1
$0.0787 \times c \times (95.0-25.0) = 0.0443 \times 440 \times (25.0-18.0) + 0.0750 \times 4180 \times (25.0-18.0)$ $5.509 \times c_{metal} = 136.4 + 2194.5$	1
$c_{metal} = 423$ J kg^{-1} K^{-1} (units not tested here)	1
Total	**4**

Answer 4 cont

(b) It is difficult to determine the exact value of the specific heat due to laboratory conditions.

(i) What is one possible source of error that Jess and Ben might have encountered? (1 mark)

Description	Marks
Error source: Heat lost on transfer; to the surrounds; touching sample; specific measurement error, etc	1
Total	**1**

(ii) How would you expect the students' calculated specific heat to compare to the known value? (2 marks)

Description	Marks
Comparison of values acknowledges it is different (1 mark only) Greater (could be lower, depending on reason from (i))	1–2
Total	**2**

(iii) What could they do to improve their results? (1 mark)

Description	Marks
Improvement: Limit heat lost; repeat experiment; etc	1
Total	**1**

(c) Jess and Ben had to write a conclusion to their experiment, but found it difficult to distinguish between heat and temperature. Write a simple definition for the terms 'heat' and 'temperature' as they would apply to the experiment above. (3 marks)

Description	Marks
Heat – transfer of energy OR energy held by particles because of their position or movement	1
From hotter to cooler objects	1
Total	**2**

Description	Marks
Temperature – a measure of the average kinetic energy of the particles OR a measure of the hotness of an object	1
Total	**1**