Physics ATAR - Year 11

Thermal Physics Test 2018

Name:	Mark: / 53
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Teacher: SFZ JRM

Time Allowed: 50 Minutes

Notes to Students:

1. You must include **all** working to be awarded full marks for a question.
2. Marks will be deducted for incorrect or absent units and answers stated to an incorrect number of significant figures.
3. **No** graphics calculators are permitted – scientific calculators only.

ADDITIONAL FORMULAE AND DATA

$\frac{T_\theta}{100} = \frac{X_\theta - X_0}{X_{100} - X_0} = \frac{R_\theta - R_0}{R_{100} - R_0}$ **Note the values below are on the Formula & Data Sheet already**

c_{ice} = 2100 $Jkg^{-1}K^{-1}$

$c_{aluminium}$ = 900 $Jkg^{-1}K^{-1}$

$L_{f\ water}$ = 3.34 x 10^5 Jkg^{-1}

c_{water} = 4180 $Jkg^{-1}K^{-1}$

First Law of Thermodynamics: $\Delta U = Q + W$

K = C + 273.15

Question 1 **(4 marks)**

A bi-metallic strip is made of two different metals, which expand at different rates as they are heated. This causes the strip to bend as the temperature changes. When placed in boiling water it is found to bend **upwards** 23.5 mm from its unexpanded position. When the strip was placed in a mixture of ice and water the strip bent **downwards** by 14.0 mm from its unexpanded position. The bi metallic strip is then left in a room that has a temperature of 25.1˚C. Determine how far the strip would bend from its unexpanded position.

Question 2 **(4 marks)**

In an experiment, students heated 400 copper pellets, each with a mass of 1.00 g, to 95.0˚C before immediately placing them into an insulated calorimeter (of negligible specific heat capacity) containing 0.500 kg of 21.0˚C water. They measured the equilibrium temperature as 26.2˚C using a probe. Determine the experimental value the students determined for the specific heat of copper.

Question 3 **(10 marks)**

An electric hot plate is rated at 2.00kW. A 2.40 kg aluminium pan containing 1.00 L of water at 25.0˚C is placed on top of the hot plate.

(a) Calculate how long it would take, in minutes, to bring the aluminium and the water to the boiling point of water.

(5 marks)

(b) Would the time calculated in (a) above be realistic? Justify your answer.

(2 marks)

(c) It is measured to take a time of 5.50 minutes for the water to come to boil. Calculate the efficiency of the heating process.

(3 marks)

Question 4 **(3 marks)**

In an accident, one boy suffers a steam burn from 0.125 kg of steam at 100˚C, while another is burned by 0.250 kg of boiling water. Explain why the steam burn is more severe than that of the boiling water.

Question 5 **(5 marks)**

A 0.100 kg aluminium container containing 0.180 kg of water sits in the sun until it reaches an equilibrium temperature of 40.0°C. Then 50.0 g of ice at -10.0°C is added to the water. Assuming all of the ice melts, determine the final equilibrium temperature.

Question 6 **(4 marks)**

When using a hand-held pump to pump up a football, the pump suddenly feels much warmer when the piston is pushed. Explain, making reference to the first law of thermodynamics why the pump gets warmer as the piston is pushed into the cylinder.

Question 7 **(10 marks)**

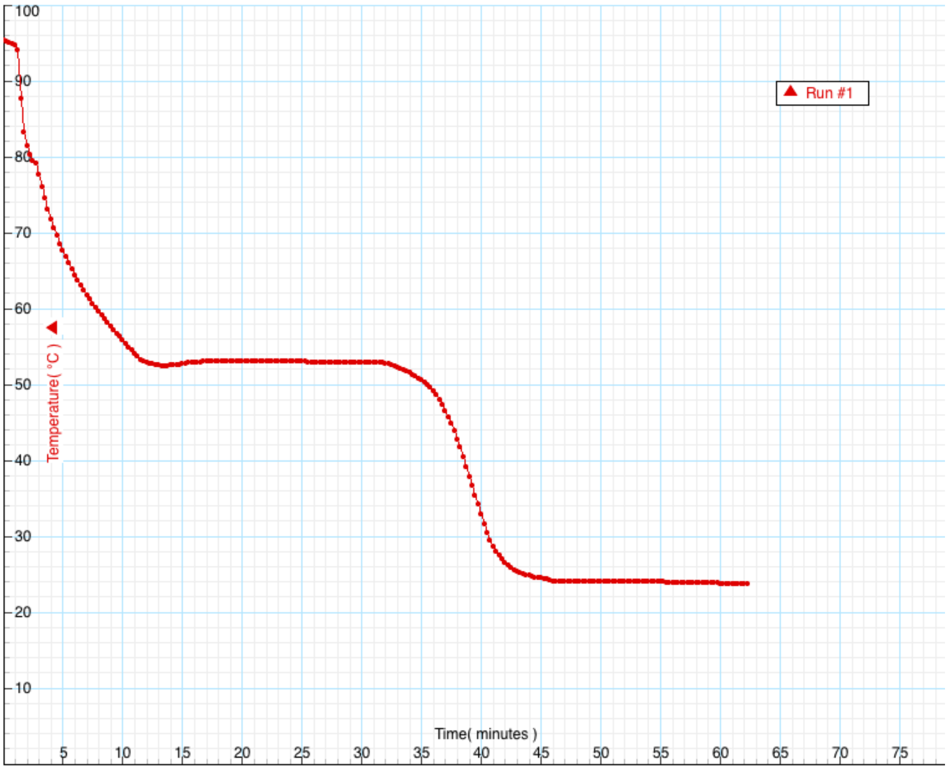
Refrigerators are designed such that there are always pipes on the outside of the cooling compartment, either under or at the back of the refrigerator. When the refrigerator is operating, this piping becomes quite hot.

(a) By making reference to the process of refrigeration, explain why the piping becomes hot. (4 marks)

(b) Describe and explain 3 features of the pipes (e.g. colour, material of construction and shape) that make them efficient at energy transfer. (6 marks)

Question 8 **(13 marks)**

The following graph is a **cooling curve** for 1,4-dichlorobenzene. It shows temperature (°C) plotted against time (minutes) for a 240g sample that was placed in a glass beaker and heated to 95°C to become a liquid, and **then allowed to cool** in room temperature air. After 32 minutes the sample had completely solidified and continued to cool until it reached a steady temperature after 45 minutes.



(a) Define the concept of *Heat* and outline one example where this is apparent in this situation. (3 marks)

(b) Between 12 minutes and 32 minutes the temperature remains constant even though heat was still being transferred out of the sample. Use this context to define and explain the difference between *Internal Energy* and *Temperature.*

(i) Internal Energy (2 marks)

(ii) Temperature (2 marks)

(c) After 45 minutes the temperature remains constant, but the net transfer of energy stops. Explain why this happens. (2 marks)

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(d) During the period from 12 minutes to 32 minutes it is measured that energy is transferred at a rate of 1.42 kJ per minute out of the 0.240 kg sample of 1,4-dichlorobenzene. Use this information to calculate the *Latent Heat of Fusion* for 1,4-dichlorobenzene. (4 marks)

END OF TEST