Christ Church Grammar School

Science Department
Year 11 2021

ATAR PHYSICS
UNIT 1: THERMAL PHYSICS
TOPIC TEST 2021

Student Name:

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Teacher: CJO HKR JRM
(Please circle)

Time allowed for this paper
Working time for paper: 50 minutes.

Instructions to candidates:

- You must include **all** working to be awarded full marks for a question.
- Answers should be expressed to 3 significant figures unless otherwise indicated.
- Marks may be deducted if diagrams are not drawn neatly with a ruler and to scale (if specified).
- Marks will be deducted for incorrect or absent units.
- **No** graphics calculators are permitted – scientific calculators only.

Mark:	/ 48
=	%

Question 1 **(7 marks)**

Students are investigating steam. They allow a sample of 85.0 g of steam at a temperature of 115 °C to condense onto a cold stainless steel plate, where its final temperature is measured to be 72.0 °C.

(a) Calculate the heat released during the experiment.

(3 marks)

The stainless steel plate had a mass of 4.62 kg and experienced a temperature rise of 81.0 °C.

($c_{\text{stainless steel}}$ = 490 J kg^{-1} K^{-1})

(b) Calculate the percentage of the total energy that was transferred to the surroundings. (If you could not solve part (a), use heat released = 3.00 x 10^5 J)

(4 marks)

Question 2 **(6 marks)**

Marie is convinced that the temperature display on her oven is not accurate and devises a test to investigate. She places a 320 g copper tray in the oven on a setting of 200 °C for several minutes until thermal equilibrium is reached. She then immerses the tray into an insulated esky containing 1.90 kg of water at 15.0 °C. After a few minutes, the temperature of the water and tray was uniform at 17.6 °C.

(c_{cu}= 390 J kg^{-1} K^{-1})

(a) Calculate the temperature of the oven according to Marie's experimental results, and state whether her oven "runs cool" (lower than the temperature that is set), or "runs hot".

(4 marks)

(b) Explain whether your calculated value for part (a) is likely to be an over or underestimate of the true temperature.

(2 marks)

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Question 3 **(3 marks)**

Explain, with reference to the kinetic theory, how an alcohol in glass thermometer is able to indicate temperature when it is immersed in a hotter substance.

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Question 4 **(3 marks)**

A 42.0 g sample of iron is suspended in a 320 g sample of water and the mixture is left to reach thermal equilibrium at 25.0 °C, before being heated to 100 °C. Calculate the amount of energy required to heat the mixture.

(c_{iron} = 450 J kg^{-1} K^{-1})

Question 5 **(4 marks)**

Explain why evaporation of a substance can occur at any temperature and why the rate of evaporation increases as temperature increases.

Question 6 **(3 marks)**

A common thought experiment is whether it would be possible to cook a raw chicken by slapping it. The idea behind it is that you input energy by slapping the chicken and this will raise the temperature of the chicken and create the chemical change required to cook it.

Explain this experiment with reference to the 1st Law of Thermodynamics.

Question 7 **(5 marks)**

In preparing your insulated water cooler for a hot and long day's work, you fill it up with 3.00 L of water at room temperature (22.0 °C). Calculate the mass of ice at -20.0 °C you should add to the thermos in order to create a nice refreshing 12.0 °C drink.

(Assume for water 1 L = 1 kg)

Question 8 **(4 marks)**

In a cold laboratory, two items, A and B, are in thermal equilibrium with each other. When the laboratory assistant touches these items with her hands, she claims that Item A is far colder than Item B. Explain whether this statement is true and what could explain it.

Question 9 **(7 marks)**

A microwave oven is used to heat up a 250 g mass of water from 20.0 °C to 60.0 °C in 75.0 s, with an efficiency of 68.0%

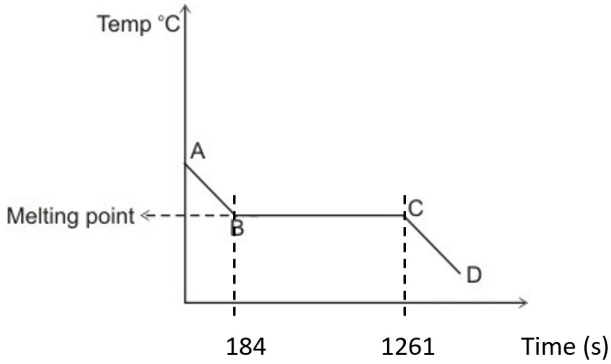
The house is powered by solar panels, each measuring 1500 x 1000 mm. Each panel can produce a total of 275 W averaged over a sunny day.

(a) Calculate the total area of panels that would need to be dedicated to the microwave's operation.
(5 marks)

(b) State two ways that designers could maximise the amount of energy absorbed by the solar panels.
(2 marks)

Question 10 **(6 marks)**

A student would like to estimate the energy required to completely melt 5.75 kg of a particular substance, but he does not know the latent heat of fusion for this substance. Instead he takes a 3.00 g liquid sample of the substance and experimentally obtains this cooling curve by immersing the substance in an ice bath.



He knows from analysing the ice bath that heat is removed as a rate of 0.638 W uniformly throughout the experiment. Using his results, calculate the energy required to melt the 5.75 kg of substance, assuming it starts at its melting point.

END OF TEST