ANSWER ALL QUESTIONS IN THE SPACES PROVIDED ON THIS PAPER.

Full working must be shown to obtain full marks. Should show answers in 3 s.f. and scientific notation.
NOTE: Where necessary use the constants supplied on the SCASA formula sheet.
Number of Questions: 10

Question 1 (7 marks)

a) A 90.0 gram copper rivet has a temperature of 25.0°C. Calculate the heat energy
    required to heat the copper rivet to 210°C. Assume no heat loss to the surroundings. [3]

b) A different rivet with a mass of 112.0 grams at a temperature of 1500°C made from rare
    metal "adamantium", is dropped into an insulated bucket with 5.0 kg of water at 22.0°C.
    If the final temperature of the bucket and water is 25.5°C, what is the specific heat
    capacity of the rare metal? Assume no heat loss to the surroundings.   [4]

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Question 2 (3marks)

Explain why a concrete floor <u>feels</u> colder than a carpeted floor which is at the same temperature?

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Question 3 (4marks)

A mechanic adds 2.75 kg of ethylene glycol antifreeze at 22.0°C to your car's radiator. The radiator already contains 6.00 kg of water at 93.5°C. If the 5.20 kg radiator is made of copper, calculate the final temperature of the mixture. Assume no heat loss to the surroundings.

(c_{copper} = 390 J kg^{-1} K^{-1}, $c_{ethylene\ glycol}$ = 2500 J kg^{-1} K^{-1})

Question 4 (7marks)

A physicist designed a greenhouse friendly water heater using **10 curved metal mirrors** to focus the light from the sun onto a small tank containing **200 kg of water**. If the average amount of energy received from the sun by **each mirror** is **128 W**,

a) What is the maximum energy received by the tank containing the water each second? [2]

b) Calculate the energy required to heat the 200 kg of water in the tank from 22.5°C to 100°C. [2]

c) Calculate the time it takes to raise the temperature from 22.5°C to 100°C. [3]

Question 5 (3marks)

A cooking show gives the following warning when boiling water:
> **"Steam is hotter than boiling water, so take the lids off cooking liquids carefully to prevent steam burns"**

Is the steam hotter than boiling water and why are burns from steam more dangerous than burns from boiling water?
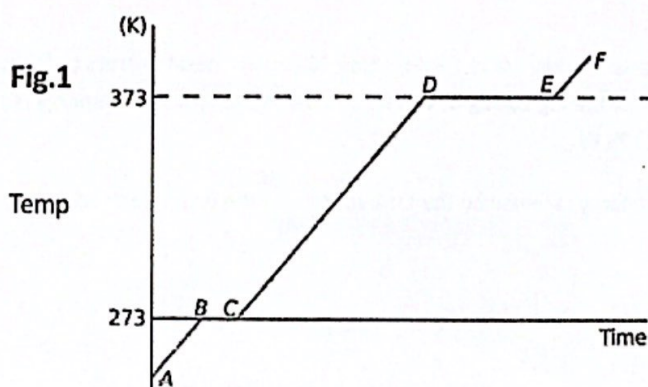
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Question 6 (6marks)

Fig.1

a) Between what two points is **solid and liquid** always present?   [1]

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b) Which segment(s) of the graph represents the substance undergoing a phase change?   [1]

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c) i) Which segment(s) of the graph shows no increase in temperature?   [1]

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ii) Explain in physics terms why energy is absorbed or released, but there is no change in average temperature of the substance?   [2]

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d) During which segment of the graph does the substance have the lowest average kinetic energy?   [1]

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Question 7 (7marks)

A certain solar panel is capable of absorbing 75 J of energy from sunlight every second, and converting only 15 J of that energy to useful electrical energy.

a) How much energy is "wasted" in the form of heat by the solar panel every second?

[1]

b) What is the efficiency of this solar panel? [2]

c) How many solar panels would be needed to fully charge a Tesla Model Y car's battery of 80 kWh, in 0.5 hours? [1 kWh equals one hour of electricity usage at a rate of 1 kW, and the equation is simply kW x time = kWh] [4]

5

Question 8 (12marks)

In an experiment to measure the temperature of a Bunsen burner flame, a 250 gram piece of copper is held in the flame of a Bunsen burner for several minutes. The metal is then quickly transferred to 285 mL of water contained in a 40.0 gram calorimeter (container) at 288 K. Assume no heat loss to the surroundings.
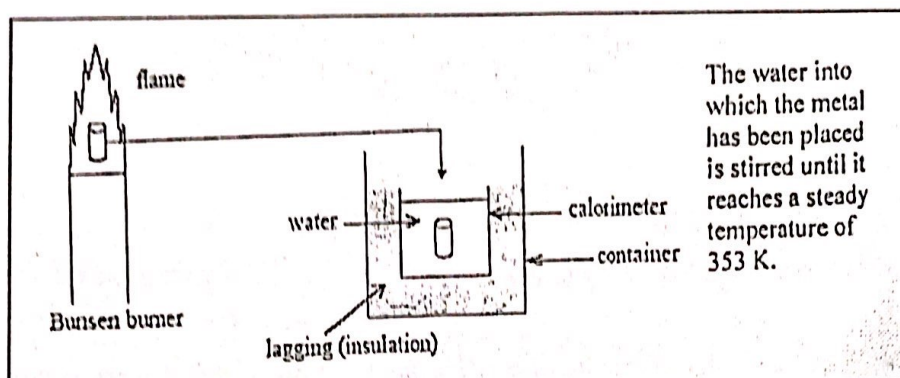
a) Explain why the metal is transferred as quickly as possible from the flame to the water. [1]

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b) Explain why the water is stirred. [1]

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c) Calculate the quantity of heat energy absorbed by the water and the calorimeter. [3]

d) Using your answer from part c (use 75kJ if you could not find an answer for part c), determine the temperature of the Bunsen burner flame. [3]

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e) If instead of water, the same mass of ethylene glycol was used, by what factor would the temperature of the liquid change compared to the water? (Hint: Factor- how many times more will temperature rise by for ethylene glycol than for water). Show all your work. [4]

Question 9 (7marks)

a) Label the diagram below for a refrigerative air conditioner with the words below. [6]

b) Draw arrows to show direction of the flow of refrigerant. [1]

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compressor motor   condenser   evaporator   gaseous refrigerant   liquid refrigerant   fan

Outside   Inside
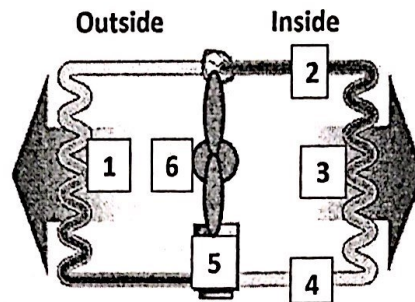
1 ....

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2 ....   5 ....

3 ....   6 ....

Question 10 (4marks)

a) Hot bodies can lose heat by conduction, convection and radiation. State two factors that help to increase the rate of cooling.   [2]

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b) Human bodies maintain a core body temperature of around 37°C. State the two ways our bodies are able to control its core temperature.   [2]

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END OF TEST