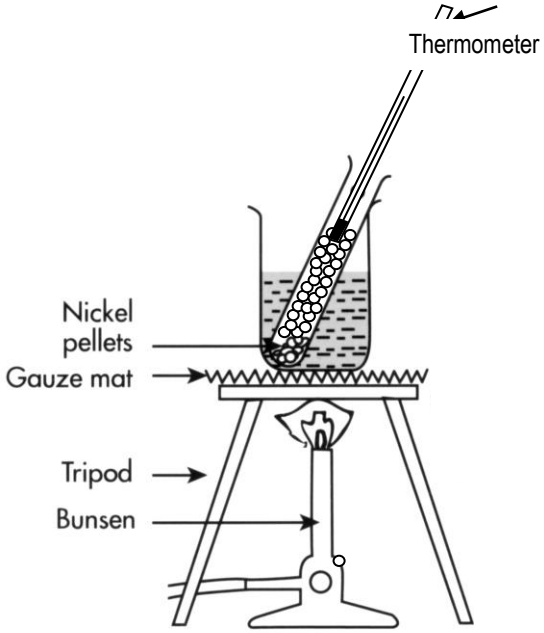
Name:_____

Marks: /20

PHYSICS STAGE 2B HEAT WRITTEN PRACTICAL TEST 2012

Specific Heat of Nickel

1. Bill and Susan set up their equipment to heat their nickel pellets as below. Susan suggests that there are several things wrong with this initial set up. List two major errors in the table below which may give invalid readings. Include explanations as to **why** you think that the errors or perceived errors will produce unreliable data.
(4 marks)



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Perceived Error	Explanation
Pellets are not submerged in water bath.	The temperature of the Ni pellets will be lower than what is recorded.
Thermometer bulb is not in the midst of the Ni pellets or in the water bath.	The thermometer was exposed to the air so temperature of Ni pellets was not recorded accurately.
Localised or concentrated heating of the bottom of the test tube.	Heating of Ni pellets is not uniform so temperature recorded is inaccurate.

2. During the experiment, Bill followed the instructions and heated the nickel pellets to 90.0 ^{o}C. The pellets remained dry. Bill then removed the test tube containing the nickel pellets from the water bath and quickly but carefully poured the pellets into the receiving water in the styrofoam cup. He then measured the temperature of the receiving water. What is the major flaw in Bill's procedure? Why is this a problem? (2 marks)

What? **(Any one)**

1) The Ni pellets have not been in the water in the styrofoam cup long enough to establish thermal equilibrium.

2) No lid on the styrofoam cup.

3) Initial temperature of water was not noted.

Why? **(Any one)**

1) Final temperature of water would be lower so heat gained by water (ΔQ_{gained}) would be lower.
2) Excessive heat loss to the environment.
3) ΔT for ΔQ_{gained} by water will not be recorded.

3. Explain why the nickel pellets have to be dry before they are transferred to the styrofoam cup? (2 marks)

The water on the Ni pellets will contain heat energy which is not accounted for in the calculation for ΔQ_{lost} by the Ni pellets.

The mass of water on the pellets is not taken into consideration when ΔQ_{gained} is calculated for water.

4. Alex and Rory transfer their new found knowledge to calculate the specific heat of a recently discovered metal called Taylorium. Use the students' data as listed below to determine the specific heat capacity of Taylorium. Assume that no energy is transferred to the calorimeter or the environment. Show neat and full working. (4 marks)
   Data provided

   - mass of Taylorium sample, $m_T = 57.26$ g
   - mass of receiving water, $m_w = 45.0$ g
   - initial temp of Taylorium, $T_i = 93.0\ ^oC$
   - initial temp of receiving water, $T_w = 19.0\ ^oC$
   - final temp of receiving water and Taylorium, $T_f = 23.0\ ^oC$

   $\Delta Q_{gained} = \Delta Q_{lost}$

   $m_T \times c_T \times \Delta T = m_w \times c_w \times \Delta T$ **1 mark**

   $c_T = \frac{m_w \times c_w \times \Delta T}{m_T \times \Delta T} = \frac{0.045 \times 4180 \times (23-19)}{0.05726 \times (93-23)}$ **2 marks** – 1 for ΔT calcs and 1 for correct substitution

   $= 1.89 \times 10^2\ J\ kg^{-1}\ K^{-1}$ **1 mark**

Latent Heat of Fusion of Ice

5. If you used an aluminium calorimeter of the same mass instead of the copper calorimeter used in your experiment, would you need; **more, the same or less** ice (**circle your response**) to attain the same final temperature for water that was achieved with the copper calorimeter? With reference to the equation for ΔQ_{gained}, explain the response you circled above. (3 marks)

MORE **1 mark**

Since c_{Al} is greater than c_{Cu}, **1 mark**

Al pellets contain more heat than Cu pellets for the same change in temperature therefore more ice is needed to attain the same final temperature of water. **1 mark**

6. Michelle and Shirley repeat the Latent Heat of Fusion experiment taking into account a better appreciation of what is actually going on. They note that the ice was initially at 0 ^{o}C. Further, they noticed that the ice that they weighed actually had a water film which comprised 1.0 % of the total measured "ice mass". Assuming that the water and the ice are pure, use the students' data to calculate the thermal energy gained by adding 21.75 g of "measured ice" when a final water temperature of 3.00 ^{o}C is achieved. Show full working used to obtain your answer below. (5 marks)

True mass of ice, $m_i = 21.75 – (0.01 \times 21.75) = 21.53$ g **1 mark**

$\Delta Q_{gained} = m_i \times L_f + m \times c_w \times \Delta T$ **1 mark**

$=(0.02153 \times 3.34 \times 10^5) + (0.02175 \times 4180 \times 3)$ **1 mark + 1 mark**

$= 7.46 \times 10^3$ J OR 7.46 kJ **1 mark**