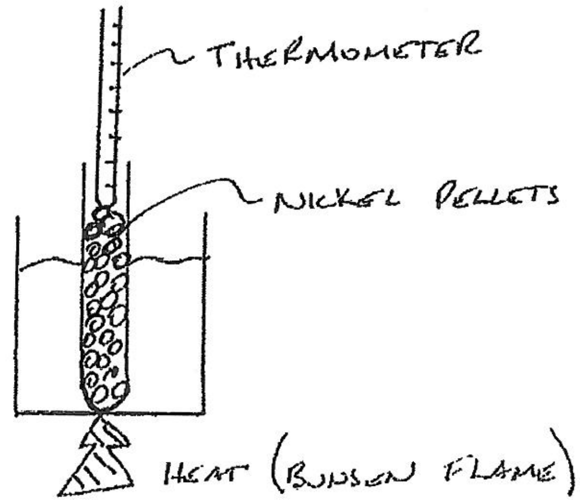
Name: —MASTER—

/20 marks to /5

YR 11 HEAT VALIDATION QUIZ 2011

Specific Heat of Nickel Experiment

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 invalid data.



BEST TWO ERRORS WITH EXPLANATION

Perceived Error	Explanation
PELLETS EXPOSED FROM WATER BATH.	THE SENSED TEMPERATURE OF THE NICKEL WILL BE LOWER THAN IT ACTUALLY IS.
LOCALISED OR CONCENTRATED HEATING OF THE PELLETS AT THE BASE OF THE TEST TUBE.	THE PELLETS AT THE BOTTOM WILL CONTAIN A LOT MORE HEAT THAN SENSED / MEASURED.
THE THERMOMETER SHOULD BE PLACED IN THE WATER BATH AND NOT AMONGST THE PELLETS.	IF THE WATER BATH TEMP. IS IN EQUILIBRIUM WITH THE NICKEL, THEN THE WATER BATH TEMP. WILL PROVIDE THE MOST ACCURATE MEAN TEMP. OF THE PELLETS

(4)

2. During the experiment, Bill followed the instructions and heated the water bath to 90.0 degrees Celsius. He then quickly put the test tube containing the dry nickel pellets, which were initially at room temperature, into the water bath for four minutes. The pellets remained dry. Bill then removed the test tube containing the nickel pellets and quickly but carefully poured the pellets into the receiving water. He then measured the rise in temperature of the receiving water. What is the major flaw in Bill's procedure? Why is this a problem?

MAJOR FLAW – THE NICKEL HAS NOT BEEN IN THE WATER LONG ENOUGH ① TO ATTAIN THE EQUIL– (2)
IBRIUM TEMP. OR KNOWN MEAN TEMP. (90°C).

IN SHORT, THE EXPERIMENTERS BELIEVE THAT THE PELLETS CONTAIN A LOT MORE ENERGY THAN THEY ACTUALLY DO. ①

3. What is the possible error resulting from using the same thermometer to measure the temperature of the heating bath and the receiving water? (2)

THE THERMOMETER WILL TRANSFER HEAT ② TO THE RECEIVING WATER.

& MR BRADBURY SAYS:

MAYBE 4 MINS IS LONG ENOUGH, MAYBE NOT. THE POINT IS THAT IT SHOULD NOT BE 'TIMED'. LEAVE THE PELLETS IN THE WATER UNTIL YOU ARE CONFIDENT THAT THERMAL EQUILIBRIUM HAS BEEN OBTAINED (T STOPS RISING). IN PRACTICE, WE HAD TROUBLE WITH THIS IN OUR LAB BECAUSE WATER WAS BOILING, NOT AT 90°!

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

- mass of Bradburium sample = 57.26g
- mass of receiving water = 45.0g
- initial temp of Bradburium = 93.0 C
- initial temp of receiving water = 19.0 C
- final temp of receiving water and Bradburium = 23.0 C

Q ~~into~~ out of Bradburium = Q into H_2O

$$M_B C_B \Delta T_B = M_W C_W \Delta T_W$$

$$0.05726 \times C_B \times 70 = 0.045 \times 4180 \times 4$$

$$C_B = \frac{752.4}{4.0082}$$

$$= 188 \text{ J kg}^{-1} \text{°C}^{-1}$$

Latent Heat of Fusion of Ice Experiment

(1)

5. If you used an aluminium calorimeter ~~of the~~ same mass as the copper calorimeter you used in your experiment, would you need: **more**, **the same or less** ice (circle your response) to attain the same final temperature of the water as you achieved with the copper calorimeter? With reference to the equation for Q_{gained}, explain your choice above. (3)

WATER + AL

$$Q_G = m_w c_w \Delta t_1 + m_{Al} \overset{900}{c_{Al}} \Delta t_1$$

(1)

SINCE $c_{Al} > c_{Cu}$ $\Rightarrow$ MORE HEAT IS TRANSFERED AND THEREFORE MORE ~~ICE~~ ICE IS REQUIRED TO ACHIEVE THE SAME FINAL TEMP. (1)

$900 > 390$

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 actually initially at minus 2.00 degrees Celsius. Further, they noticed that the ice that they weighed actually had a water film which 1.0% of the total measured "ice mass". Assuming that the water and the ice are pure, use the girls' data to calculate the thermal energy gained by adding 21.75g of"measured ice" when a final water temperature of 3.00C is achieved.
Show full working used to obtain your answer below. (4)

actual mass of ice $= 0.99 \times 21.75 = 21.5325\ g = 21.5325 \times 10^{-3}\ kg$

mass of cold water $(0°) = 0.01 \times 21.75 = 0.2175\ g$ — v. small. OK to ignore this.

Heat gained by ice $-2° \rightarrow 0° = m_I c_I \Delta T$

$= 21.5325 \times 10^{-3} \times 2100 \times 2$

$= 90.4365\ J$ ①

Heat gained melting ice: $= mL_f$

$= 21.5325 \times 334000 \times 10^{-3}$

$= 7191.855\ J$ ②

Heat gained by (melted ice water) $0° - 3°C$ $= m_w c_w \Delta T$

$= 21.75^{⊛} \times 4180 \times 3 \times 10^{-3}$

$= 272.745\ J$ ③

Tot $=$ ① $+$ ② $+$ ③ $= 7.56 \times 10^3\ J$

⊛ Note, can include the 1% of water here, since it is at 0° & goes into calorimeter. However, if using 21.5325g, is OK, as this is such a tiny amount it does not affect final answer to 3 sig figs