Early E. C.: / 1
Total HW Points Unit 2.B: / 16
Total Lab Points Unit 2.B: / 20
Unit 2.B Apps.: / 5
Late, Incomplete, No Work, No Units Fee? Y / N

2.B.1 Problems – Definition/Units of Heat
Section 11.1 of your book.

Possible 2.B.1 Pts.: 4
Late, Incomplete, No work, No Units Fee: - 1 - 2 - 3
Final Score: / 4

1. (2 Points) A window air conditioner has a rating of 20,000 Btu/h. What is this rating in watts?

2. (2 Points) A typical person's normal metabolic rate (the rate at which food/stored energy is consumed) is about 4.0 E 5 J/hr, and the average food energy in a Big Mac is 6.0 E 2 Calories. If a person lived on nothing but Big Macs, how many per day would he or she have to eat to maintain a constant body weight?

Possible 2.B.2 Pts.: 4
Late, Incomplete, No work, No Units Fee: - 1 - 2 - 3
Final Score: / 4

2.B.2 Problems – Specific Heat & Calorimetry
Section 11.2 of your book.

The temperature of a lead and copper block, both 1.0 kg and at 20.0 °C, is to be raised to 100.0 °C.

1. The copper will require (1) more heat, (2) the same heat, (3) less heat than the lead. Why?

2. For the previous problem, calculate the difference between the heat required for the two blocks to prove your answer to part A.

3. A 5.00 g pellet of aluminum reaches a final temperature of 63.0 °C when gaining 200. J of heat. What is its initial temperature?

4. When resting, a person gives off heat at a rate of about 100. W. If the person is submerged in a tub containing 150 kg of water at 27 °C and the heat from the person goes only into the water, how many hours will it take for the water temperature to rise to 28 °C?

Possible 2.B.3 Pts.: 4
Late, Incomplete, No work, No Units Fee: - 1 - 2 - 3
Final Score: / 4

2.B.3 Problems – Phase Changes & Latent Heat

Section 11.3 of your book.

1. How much heat is required to melt a 2.5 kg block of ice at 0 °C?

2. Converting 1.0 kg of water to steam at 100 °C requires (1) more heat (2) the same amount of heat (3) less heat than converting 1.0 kg of ice at 0 °C to water at 0 °C. Explain.

3. Calculate the difference in heat required to prove your answer in the previous question.

4. An artist wants to melt some lead to make a statue. How much heat would have to be added to 0.75 kg of lead at 20.0 °C to cause it to melt completely?

Possible 2.B.4 Pts.: 4
Late, Incomplete, No work, No Units Fee: - 1 - 2 - 3
Final Score: / 4

2.B.4 Problems – Heat Transfer

Section 11.4 of your book.

1. The single glass pane in a window has dimensions of 2.00 m by 1.50 m and is 4.00 mm thick. How much heat will flow through the glass in 1.00 h if there is a temperature difference of 2.0 °C between the inner and outer surfaces? Consider conduction only.

A house could have a brick wall or a concrete wall with the same thickness. Answer problems 2 and 3.

2. Compared with the concrete wall, the brick wall will conduct heat away from the house (1) faster, (2) at the same rate, (3) slower. Why?

3. Calculate the ratio of the rate of heat flow of the brick wall to that of the concrete wall.

4. Assume that your skin has an emissivity of 0.70, a normal temperature of 34 °C, and a total exposed area of 0.25 m^2. How much heat energy per second do you lose due to radiation if the outside temperature is 22 °C?

AP Physics 2	Unit 2.B.1 Lab - Specific Heat
Reminder: Update Table of Contents	Correction Credit: Half

Lab Overview:

The specific heat capacity of a substance can be determined by using a known substance, in this case water (c = 4186 J/kg·˚C), and calculating how much thermal energy it gains when the heated unknown substance is added to it. Your mission will be to determine the specific heat capacity of a metal of your choosing.

Specific Heat Lab (2.B.1) Guide		
Table of Contents, Title/Date, Detailed Synopsis, Two Purposes		/ 2
Mission 1: Specific Heat Data Set	Table Present	/ 1
	Tidy	/ 2
	Complete	/ 5
Question 1: Spec. Heat Calculation		/ 4
Question 2: % Error		/ 2
Question 3: Sources of Error		/ 2
Question 4: Water Error		/ 2
Work Not Shown Fee:		-1 -2 -3
Late Lab Fee:		-4
Total:		/ 20

Note: Density of Water; Thermal Contamination

Water's density is approximately 1.0 gram/mL. This will help you determine the mass of water to use in your calorimeter.

Watch out for thermal contamination at every step. Work carefully so no splashing occurs.

Safety

1. Use safety goggles at all times during the lab, and avoid contact with hot objects.
2. Do not use the thermometers to stir anything – use the stirring rod.

Materials:

Burner
Ring Stand & Clamp
600 mL Beaker
Stirring Rod
100 mL Grad. Cylinder
Thermometer
Large Test Tube
Styrofoam Cup
Copper (Cu)
Lead (Pb)
Tin (Sn)
Iron (Fe – 10 pcs)
Aluminum (Al – 2 pcs)
Zinc (Zn)

Mission 1 – Specific Heat Data Gathering

Make the experimental setup shown at station 1. Be sure to record all values into a well formed data table. These values will be necessary to calculate your specific heat – include everything.

Place 100.0 g of water in the foam cup calorimeter. Choose a metal and determine its mass. Carefully put your metal in a large test tube (Al goes in two tubes). Put your tube(s) in the 600 mL beaker and fill the beaker with water until the water level is just over your metal (about 300 mL). Slowly heat the water to boiling; let it heat for 10 minutes. Make sure no water splashes into the tube. Measure and record the temperature of the water in your foam cup calorimeter. Measure and record the temperature of the boiling water. Transfer the metal quickly into your calorimeter using the test tube clamp. Carefully stir the contents of the calorimeter with the glass rod (not thermometer), and record the highest temperature that you read on your thermometer. Clean up.

Questions. Rephrase and answer in complete sentences for full credit.

1. Calculate the specific heat capacity of your metal. Show every step in your calculation (4 pts).

2. What was the percent error in your experiment? You will need to research the accepted specific heat for your metal on the internet or your textbook (2 pts).

$$\%\ \text{Error} = \frac{|\text{Accepted Value} - \text{Experimental Value}|}{\text{Accepted Value}} \times 100\%$$

3. Thoroughly explain the sources of error in your experiment, and how could they be eliminated (2 pts).
4. How could a few drops of water in your large test tube alter your specific heat calculation (2 pts)?

AP Physics 2	Unit 2.B - Heat				
Application Problems, AP Test Preparation Questions					
Presentation Points:	/ 5	Late Fee:	-2	Completion (Booklet Check)	/ 5

Your grade on this problem set will depend on the presentation you provide for your problem, and whether they are complete when you submit your Booklet at the end of the Unit.

1. How much energy does it take to melt 2.0 kg of ice that is at 0.0 $^{\circ}$C?

2. What is the final temperature of 1.00 kg of water at 20.0 $^{\circ}$C, to which 15.0 kJ of energy are added?

3. A typical NBA basketball player does about 3.00 E 6 J of work per hour. If a Big Mac has about 600 Calories of energy, how many big macs should a player eat before a 3 hour game?

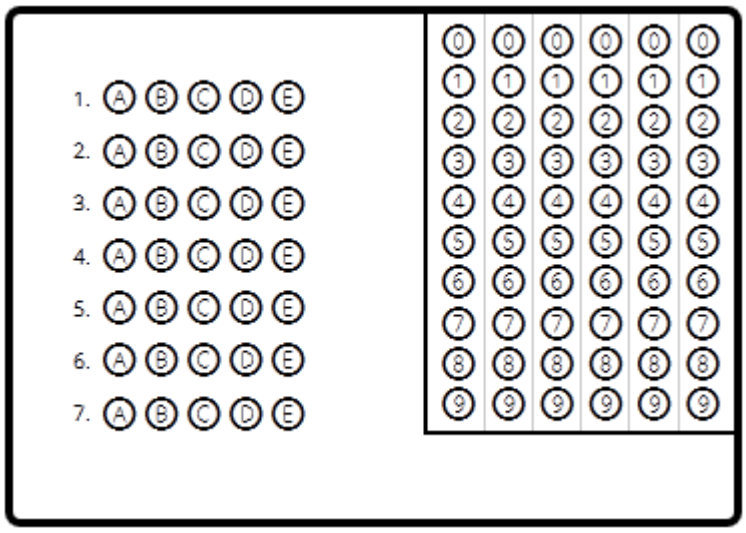
4. Blood can carry excess heat from the interior of the body to the exterior, where heat is transferred to the outside environment. If 0.250 kg of blood at 37.0 °C flows to the surface and loses 1500 J of heat, what is the temperature of the blood as it flows back into the interior? Assume that the specific heat of blood is equal to that of water.

5. The U. S. nickel has a mass of 5.1 g, a volume of 0.719 cm^3, and a total surface area of 8.54 cm^2. Assuming that a nickel is an ideal radiator, how much radiant energy per second comes from the nickel if it is at 20.0 °C in a surrounding temperature of 0.0 °C?

AP Physics 2		Unit 2.B Review - Heat					
Points:	/ 14	Late or Incomplete Fee:	-2 -4 -6	Correction Credit:		Final Score:	

Solve these problems here, THEN enter your responses in the bubble sheet provided.

Each question is worth two points.



1. The water flowing over Niagara Falls drops a distance of 50. m. Assuming that all the gravitational energy is converted to thermal energy, by what temperature does the water rise?

A) 0.05 °C B) 0.12 °C C) 0.50 °C D) 1.0 °C E) 1.2 °C

2. The heat of fusion of lead is 5.9 kcal/kg, the heat of vaporization is 207 cal/kg, and its melting point is 328°C. How much heat is required to melt 50. g of lead initially at 23°C? (The specific heat of lead is 0.031 kcal/kg•C°.)

A) 1.2 kcal B) 0.5 kcal C) 0.77 kcal D) -0.50 kcal E) -.0.77 kcal

3. 0.45 kg of a metal at 90.0 °C is added to 0.40 kg of water at 20.0 °C. If the final temperature of the mixture is 26.0 °C, what is the specific heat of the metal?

A) 350 J/kg•°C B) 375 J/kg•°C C) 325 J/kg•°C D) 500 J/kg•°C E) 520 J/kg•°C

4. The thermal conductivity of concrete is 0.80 W/m-°C and the thermal conductivity of wood is 0.10 W/m-°C. How thick would a solid concrete wall have to be in order to have the same rate of flow through it as an 8.0 cm thick wall made of solid wood? (Assume both walls have the same surface area.)

A) 32 cm B) 51 cm C) 130 cm D) 64 cm E) 95 cm

5. In grinding a steel knife blade (specific heat = 0.11 cal/g-C°), the metal can get as hot as 400.°C. If the blade's mass is 80.0 g, what is the minimum amount of 20°C water needed for quenching the hot blade if the water is not to rise above boiling?

A) 21 g B) 33 g C) 54 g D) 66 g E)

6. Consider a light bulb, in empty space, radiating 200. watts with its filament heated to 2800.°C. Assuming it is a good approximation to a black body (e = 1) what is the area of the filament?

A) 21.1 mm^2 B) 25.3 mm^2 C) 33.8 mm^2 D) 39.6 mm^2 E) 44.2 mm^2

7. If placed in an 800. °C oven, what is the net power radiated now?

A) 197 W B) 194 W C) 190. W D) 186 W E) 182 W