Physics 11 Unit 3 Energy Worksheet #4

Name: _____ Date: _____

- for water c = 4200 J/Kg C for ice c = 2100 J/Kg C

- $E=mc\Delta t$
  - E = energy in joules
  - M = mass in kg
  - C = specific heat capacity, in J/kg C
  - Δt = change in temperature in Celsius (or Kelvin)

1. How much energy is needed to raise the temp of a 56.8 Kg of water by 15 C?

$E = mc\Delta T = (58.6)(15)(4200) = 3,691,800\ J$

2. 1.3 kg of oil cools down from 140 C to 44 C how much energy is released if it takes 3 mins? C = 2050 J/kg C

$\Delta T = 96$C

$E = mc\Delta T = (1.3)(2050)(96)$

$= 255,840\ J$

time does not matter, a distractor

3. Sitting on a table is a large piece (40 kg) of **ice** and a **nail** at room temp in the other hand.

a) In which are the molecules moving faster? nail (ice or nail)

b) In which do the molecules have a higher average translational energy? nail (ice or nail) L means moving faster

c) Which has more thermal energy? ice (ice or nail) - way! more mass

d) If the two were to touch where would the heat flow? nail to ice. (from what to what) hot to cold.

4. a) Why is "water" in a bottle a better thing to warm your feet with than oil in the same bottle?

Water has a higher heat capacity + will therefore give off much more energy as it cools, about twice as much.

b) Compare how much heat would be released by a 1 kg hot water bottle of oil compared to one filled with water if they both cooled from 90 C to 30 C. $\Delta T = 60°C$.

water $E = mc\Delta T = (1)(4200)(60) = 252{,}000$ Joules.

oil $E = mc\Delta T = (1)(~~2100~~ 2050)(60) = 123{,}000$ Joules

5. How powerful a kettle (100% efficient) do you need to boil 1.6 kg of water in 1 min is you assume the water starts at 15 C?

$$P = \frac{W}{t} = \frac{E}{time} = \frac{mc\Delta T}{time} = \frac{(1.6)(4200)(85)}{60\,sec} = 9520\ Watts$$

note, kettles are usually 1500 Watts.

6. How much does it cost you to heat 100 kg of water from 14 C to 50 C if you pay 6 cents per kilowatt hour?

$E = mc\Delta T = (100)(4200)(36) = 15{,}120{,}000\ J = 4.2\ kWhr.$

1 Kilo Watt hour = $1000\ W \times 3600\ sec = 1000\ J/s \times 3600\ sec$

$1\ kWhr = 3{,}600{,}000\ J$

$Cost = 4.2\ kWhr \times 6¢/kWhr = 25.2¢$

note: 1 watt = 1 Joule / sec

7. How much does it cost you to plug in your 100 watt block heater for 8 hours if you pay 6 cents per kilowatt hour?

100 W = .1 KW

.1 KW x 8 hours = .8 KWhrs.

Cost = .8 KWhr x 6 ¢/KWhr = 4.8 ¢

8. Convert the following temperatures

Kelvin = Celsius + 273

Celsius = Kelvin – 273

(Celsius x 1.8) + 32 = Fahrenheit

(Fahrenheit – 32)/1.8 = Celsius

a) 20 C into Kelvin

20 + 273 = 293 K

b) 5 C into Fahrenheit

(5 x 1.8) + 32 = 41 F

c) 90 F into Celsius

(90 - 32) / 1.8 = 58 / 1.8 = 32.2C.

d) 290 K into Celsius

290 - 273 = 17°C