CP Chemistry Name: Answer Key

Energy and Energy Calculations Quiz

1) What is ENERGY?

the ability to do work.

2) The S.I. unit for energy is the joule.

3) As water freezes it becomes less dense than liquid water.

4) Most substances become more dense as they go from liquid phase to liquid phase.

5) Phase changes are physical changes.

6) Phase changes involve overcoming intermolecular forces.

7) The normal boiling point of water is 100°C (number and unit).

8) The normal freezing point of water is 0°C (number and unit).

9) The amount of energy needed to melt ice into water is known as Heat of fusion

10) The amount of energy needed to turn water into steam is known as Heat of vaporization

11) Which is larger, one calorie or one joule?

12) Explain the difference between an endothermic process and an exothermic process. (2 pts)

Endothermic - absorbs energy from surroundings

Exothermic - releases energy into surroundings

13) Describe the energy changes as a piece of ice melts into liquid water and is then boiled into water vapor. Be sure to discuss the relative movement (speed) of the particles. (3 points)

Energy has to be added to ice to make the particles move faster, when the particles are moving fast enough the Ice melts into water. As energy is added particles continue to move faster (increase in temp.) until the water boils into steam

14) My friend Ike is confused after I tell him there is a difference between the calories we talk about in Chemistry and the Calories that are listed on the nutrition label of his granola bar. Please help my friend by explaining, in a few sentences, the difference between a chemistry calorie and a nutritional Calorie. **Be sure to include a definition of a chemistry calorie in your explanation.** (3 points)

A Chemistry calorie (Lower case c) is how much energy it takes to raise the temp. of 1 gram of water 1°C.

A nutritional Calorie (capital C) is actually a Kilocalorie or 1000 calories.

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State whether each of the following examples is exothermic or endothermic.

15) The process of boiling water. endothermic

16) The process of water freezing. exothermic

17) A burning campfire. Exothermic

Energy Conversion Problems: Show your work (2 points)

18) Convert 35.8 calories to kilojoules.

$$\frac{35.8\ \cancel{cal}}{} \bigg| \frac{4.184\ J}{1\ \cancel{cal}} = 149.7872\ J$$

$$\frac{149.7872\ J}{} \bigg| \frac{1\ kJ}{1000\ J} = 0.14979\ kJ$$

0.150 kJ

19) Convert 5670.0 joules to kilocalories.

$$\frac{5670.0\ J}{} \bigg| \frac{1\ cal}{4.184\ J} = 1355.162524\ cal$$

$$\frac{1355.162524\ cal}{} \bigg| \frac{1\ kcal}{1000\ cal}\ 1.355163\ kcal$$

1.3552 kcal

20) Convert 67 joules to calories.

$$\frac{67\ J}{} \bigg| \frac{1\ cal}{4.184\ J} = 16.0134\ cal = 16\ cal$$

21) Convert 455 kilocalories to kilojoules.

$$\frac{455\ kcal}{} \bigg| \frac{1000\ cal}{1\ kcal} = 455000\ cal \qquad \frac{455000\ cal}{} \bigg| \frac{4.184\ J}{1\ cal} = 1903720\ J$$

$$\frac{1903720\ J}{} \bigg| \frac{1\ kJ}{1000\ J} = 1903.72\ kJ = 1.90 \times 10^3\ kJ$$

22) Convert 937 calories to joules.

$$\frac{937\ cal}{} \bigg| \frac{4.184\ J}{1\ cal} = 3920.408\ J = 3920\ J$$

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Specific Heat Calculations: Show your work (3 points)

23) The amount of energy needed to heat 2.00 g of carbon from 50.0°C to 80.0°C is 42.6 J. What is the specific heat capacity of carbon?

$Q = s \times m \times \Delta T$

$42.6 = (s)(2)(30)$

$\frac{42.6}{(2)(30)} = s$

$s = 0.710 \text{ J/g°C}$

24) A 6.75-g sample of gold (specific heat = 0.130 J/g °C) is heated using 50.6 J of energy. If the original temperature of the gold is 25.0°C, what is its **final temperature**? Hint: Final temperature = original temperature + temperature change.

$Q = s \times m \times \Delta T$

$50.6 = (0.130)(6.75)(\Delta T)$

$\frac{50.6}{(0.130)(6.75)} = \Delta T$

$\Delta T = 57.7$

$25 + 57.7 =$

$82.7°C$

25) The specific heat of iron is 0.45 J/g °C. How many joules of energy are needed to warm 1.50 g of iron from 20.00°C to 29.00°C?

$Q = s \times m \times \Delta T$

$Q = (.45)(1.50)(9)$

$Q = 6.075 = 6.1 \text{ J}$

26) How much energy will be needed to heat 60.0 gal of water from 22.0°C to 110.0°C? (Note: 1.00 gal weighs 3770 g and that water has a specific heat of 4.184 J/g °C.)

$Q = s \times m \times \Delta T$

$60 \times 3770 = 226200 \text{ g}$

$Q = (4.184)(226200)(88)$

$Q = 83285030.4 = 83,200,000 \text{ J}$

27) What is the mass of my aluminum (specific heat = 0.890 J/g °C) sample if it requires 0.890 kilojoules of energy to raise the temperature of my sample from 22.0°C to 24.0°C?

$Q = s \times m \times \Delta T$

$\frac{0.890 \text{ kJ}}{} \left| \frac{1000 \text{ J}}{1 \text{ kJ}} \right. = 890 \text{ J}$

$890 = (0.890)(m)(2)$

$\frac{890}{(.890)(2)} = m$

$m = 500$

$500. \text{ g}$

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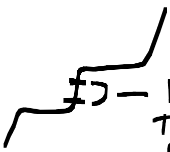
Solve the following problems. Point values listed after each problem.

You may need the following information to answer the questions:
Specific heat of water= 4.184 J/g°C    Specific heat of steam= 1.84 J/g°C
Specific heat of ice= 2.09 J/g°C
Heat of fusion of water= 6.02 kJ/18 grams    Heat of vaporization of water= 40.6 kJ/18 grams

28) Calculate the amount of energy in JOULES required to heat 25 grams of water from 13°C to 89°C. The specific heat of water is 4.184 J/g°C. (3 points) 1 step



1 step temp change

$Q = s \times m \times \Delta T$

$Q = (4.184)(25)(76)$

$Q = 7949.6 = 7900\text{ J}$

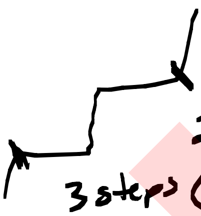
29) Determine the amount of energy required to melt 354 grams of ice at 0.0°C. (3 points)

phase change HOF

$354\text{ g} \times \frac{6.02\text{ kJ}}{18\text{ g}} = 118.39333$

118 kJ

30) Calculate the amount of energy required to heat an 897 gram block of ice from 0.0°C to steam at 100°C. (6 points)



① Phase HOF $897\text{ g} \times \frac{6.02\text{ kJ}}{18\text{ g}} = 299.997\text{ kJ}$

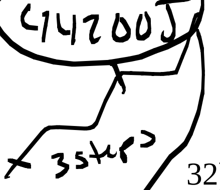
② Temp Change $Q = s \times m \times \Delta T$  $Q = 4.184 \times 897 \times 100$
$Q = 375304.8\text{ J} \times \frac{1\text{ kJ}}{1000\text{ J}} = 375.30\text{ kJ}$

③ Phase HOV $897\text{ g} \times \frac{40.6\text{ kJ}}{18\text{ g}} = 2023.23\text{ kJ}$

Add all

2698.5
3 steps 2700 kJ ← Final Answer

31) Calculate the amount of energy taken away while cooling a 37.2 gram sample of water at 100.0°C to -208.0°C. (6 points)



① Temp. Change $Q = s \times m \times \Delta T$  $Q = 4.184 \times 37.2 \times 100 = 15564.48\text{ J}$

② Phase HOF $37.2\text{ g} \times \frac{6.02\text{ kJ}}{18\text{ g}} = 12.441\text{ kJ} \times \frac{1000\text{ J}}{1\text{ kJ}} = 12441\text{ J}$

③ Temp Change $Q = s \times m \times \Delta T$  $Q = 2.09 \times 37.2 \times 208 = 16171.584\text{ J}$

add all

44177.064 J
44200 J

3 steps
Final answer

32) Calculate the amount of energy needed to take a 45.3 gram sample of ice at -10.0°C to steam at 128.0°C. (10 points)

See next page

5 steps

① Temp $Q = s \times m \times \Delta T$

$Q = 2.09 \times 45.3 \times 10$

$Q = 946.77\,J$

② Phase HoF

$45.3\,g \times \frac{6.02\,kJ}{18\,g} = 15.1503\,kJ$

$\frac{15.1503\,kJ}{} \left| \frac{1000\,J}{1\,kJ} \right. = 15150.33\,J$

③ Temp $Q = s \times m \times \Delta T$

$Q = 4.184 \times 45.3 \times 100$

$Q = 18953.52\,J$

④ Phase HoV

$45.3\,g \times \frac{40.6\,kJ}{18\,g} = 102.17667\,kJ$

$\frac{102.17667\,kJ}{} \left| \frac{1000\,J}{1\,kJ} \right. = 102176.67\,J$

⑤ Temp $Q = s \times m \times \Delta T$

$Q = 1.84 \times 45.3 \times 28$

$Q = 2333.856\,J$

add all

139561.146 J

Final Answer

$1.40 \times 10^5\,J$