Practice Test for Thermochemistry ANSWERS

1. How many joules are needed to melt a 1057.8 gram block of ice at 0°C into water.

$$q = mH_F$$
$$q = (1057.8\ g)(334\ J/g) = 353{,}305.2\ J$$
$$q = 353{,}310\ J \text{ (with 5 SF)}$$

2. Convert the number of joules you just calculated in question #1 into kilo-joules, calories, and Calories.

A $\frac{353{,}310\ J}{1} \times \frac{1\ kJ}{1000\ J} = 35.310\ kJ$ **with 3 SF**

B $\frac{353{,}310\ J}{1} \times \frac{1\ cal}{4.18\ J} = 84{,}523.9234\ cal = 84{,}524\ cal$ **with 5 SF**

C $\frac{84{,}524\ cal}{1} \times \frac{1\ Calorie}{1000\ cal} = 85.524$ Calories (capital "C" food Calories) **with 5 SF**

3. How many joules are needed to vaporize 4.54 g of liquid water at 373 Kelvin into steam?

$$q = mH_V$$
$$q = (4.54\ g)(2260\ J/g) = 10{,}260.4\ J$$
$$q = 10{,}300\ J \textbf{ with 3 SF}$$

4. How many joules is required to warm 73.2 g pure water at 17.0°C to 29.5°C

$$q = mC\Delta T$$
$$q = (73.2\ g)(4.18\ J/g{\cdot}K)(29.5°C — 17.0°C)$$
$$q = (73.2\ g)(4.18\ J/g{\cdot}K)(12.5\ K)$$
note $\Delta T°C = \Delta TK$
$$q = 3827.4\ J$$
$$q = 3820\ J \quad \textbf{with 3SF}$$

5. Which of each of these pairs of reactions is MOST ENDOTHERMIC?
One mole C_2H_2 synthesizes or Two moles nitrogen monoxide synthesizes

One mole C_2H_2 synthesizes the ΔH here is —84.0 kJ (more exothermic)

Two moles nitrogen monoxide synthesizes the H here is +182.6 kJ (more endothermic)

6. Which of each of these pairs of reactions is MOST EXOTHERMIC?
One mole NaCl ionizes in water or One mole ammonium chloride does the same

One mole NaCl ionizes in water the ΔH here is +3.88 kJ (this is endothermic)

One mole ammonium chloride does the same the H here is +14.78 (this is MORE endothermic)

7. How many KILOjoules are released when you dissolve 5.35 moles of solid NaOH into 2.0 Liters of H_2O that is at 11.0°C?

Look at table I:

$NaOH(s) \xrightarrow{H_2O} Na^+(aq) + OH^-(aq)$	−44.51

This says (or means) when 1 mole NaOH dissolves into water, 44.51 kJ are released.
It's a ratio, 1 mole : 44.51 kJ

MR $\frac{\text{NaOH}}{\text{energy}}$ $\frac{1}{44.51\text{ kJ}} = \frac{5.35}{X\text{ kJ}}$ Solve for X X = 238.1285 kJ = 238 kJ with 3 SF

8. When 11.8 moles of aluminum oxide synthesize, how much energy is released or absorbed?

MR $\frac{Al_2O_3}{\text{energy}}$ $\frac{1}{3351\text{ kJ}} = \frac{11.8}{X\text{ kJ}}$ Solve for X X = 39,541.8 kJ = 39,500 kJ with 3 SF

9. At which temperature does 36.0 grams of copper have the most kinetic energy?
A. 225 K B. 272 K C. 0°C D. 5°C

Temperature and kinetic energy are "connected" and move together.
Hotter = higher KE Cooler = lower KE Steady temp = steady KE
Here, most KE means highest temp = D

10. How much energy is released from 35.0 grams of copper (C= 0.391 J/g·K) if it cools down from 93.5°C to 18.2°C? (a temp change formula is required here)

$q = mC\Delta T$
$q = (35.0\text{ g})(0.391\text{ J/g·K})(75.3\text{ K})$ note ΔT°C = ΔTK

$q = 1030.4805$ joules

q = 1030 J with 3 SF

11. If $I + I \rightarrow I_2$ Which statement best describes this chemical process?

A. a bond forms and energy is absorbed
B. a bond forms and energy is released
C. a bond breaks and energy is absorbed
D. a bond breaks and energy is released

12. 52.3 g Hg changes temperature from 12.00°C to 33.25°C when 155.6 joules of heat are added. Calculate the specific heat capacity for mercury. *Temp change formula needed here*

$$q = mC\Delta T$$

$$155.6 \text{ kJ} = (52.3 \text{ g})(C)(21.25 \text{ K})$$ note $\Delta T°C = \Delta TK$

$$\frac{155.6 \text{ J}}{(52.3 \text{ g})(21.25 \text{ K})} = C$$

$$\frac{155.6 \text{ J}}{1111.375 \text{ g·K}} = C = 0.140 \text{ J/g·K}$$ with 3 SF

13. Skip this one, okay?

14. If $O_{2(G)} \rightarrow O_{(G)} + O_{(G)}$ Which best describes this chemical process?

A. energy is absorbed when a bond is broken
B. energy is absorbed when a bond forms
C. energy is released when a bond is broken
D. energy is released when a bond is formed

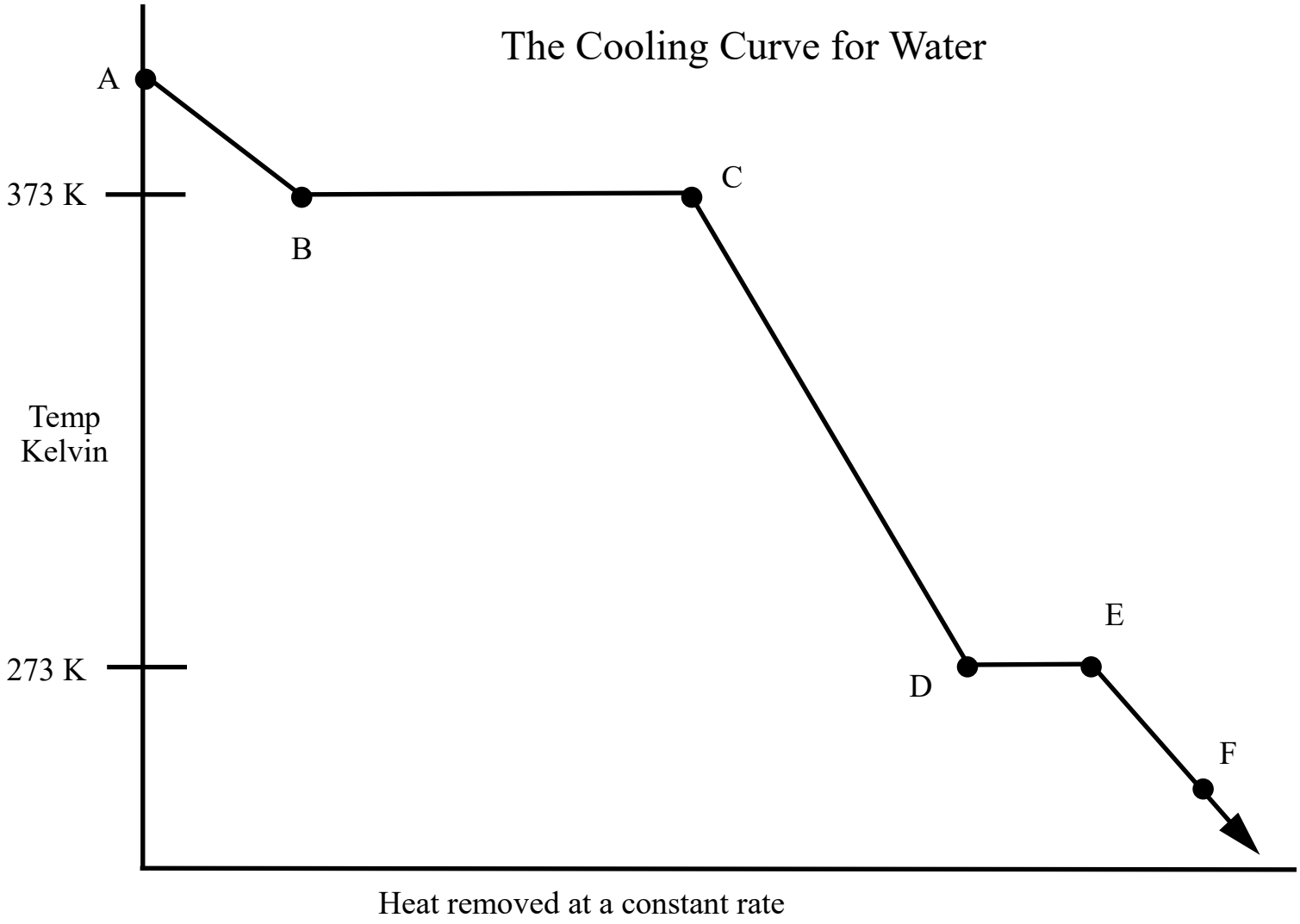
15. In a reaction you find that $\Delta H = -571.6$ kJ. This reaction is

A. endothermic and absorbs energy
B. endothermic and releases energy
C. exothermic and absorbs energy
D. exothermic and releases energy

16. In another reaction on Table I you find that $\Delta H = +182.6$ kJ. This reaction is

A. endothermic and absorbs energy
B. endothermic and releases energy
C. exothermic and absorbs energy
D. exothermic and releases energy

18. On the back of the answer sheet, draw a a cooling curve for water.
Label each of the line segments with letters from left to right (A, B, C, D, E, F)
Fill in the boxes below the graph on the answer sheet.
Make sure the axes are labeled and there are numbers included with units on the Y axis.



In the boxes below use S, L, G, or ↔ or ↑ or ↓ and formulas					
Segment	Phase or phases	Temperature	Kinetic Energy	Potential Energy	Formula for this segment
AB	Gas only	↓	↓	↔	$q = mC\Delta T$
BC	Gas → Liquid	↔	↔	↓	$q = mH_V$
CD	Liquid only	↓	↓	↔	$q = mC\Delta T$
DE	Liquid → Solid	↔	↔	↓	$q = mH_F$
EF	Solid only	↓	↓	↔	$q = mC\Delta T$