

Name: _____ Date: _____

1. One mole of an ideal gas is expanded from a volume of 1.00 liter to a volume of 5.75 liters against a constant external pressure of 1.00 atm. How much work (in joules) is performed on the surroundings? Ignore significant figures for this problem. ($T = 300\text{ K}$; $1\text{ L atm} = 101.3\text{ J}$)
- A) 241 J
 - B) 481 J
 - C) 1444 J
 - D) 582 J
 - E) none of these

Use the following to answer questions 2-4:

Consider a gas in a 1.0 L bulb at STP that is connected via a valve to another bulb that is initially evacuated. Answer the following concerning what occurs when the valve between the two bulbs is opened.

2. What is true about the value of q ?
- A) It is greater than zero.
 - B) It is equal to zero.
 - C) It is less than zero.
 - D) More information is needed.
 - E) none of these
3. What is true about the value of ΔH ?
- A) It is greater than zero.
 - B) It is equal to zero.
 - C) It is less than zero.
 - D) More information is needed.
 - E) none of these
4. What is true about the value of ΔE ?
- A) It is greater than zero.
 - B) It is equal to zero.
 - C) It is less than zero.
 - D) More information is needed.
 - E) none of these

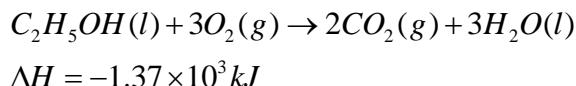
5. Two metals of equal mass with different heat capacities are subjected to the same amount of heat. Which undergoes the smallest change in temperature?
- A) The metal with the higher heat capacity.
 - B) The metal with the lower heat capacity.
 - C) Both undergo the same change in temperature.
 - D) You need to know the initial temperatures of the metals.
 - E) You need to know which metals you have.
6. A 14.5 g piece of aluminum (which has a molar heat capacity of $24.03 \text{ J}/\text{mol}^\circ\text{C}$) is heated to 82.4°C and dropped into a calorimeter containing water (specific heat capacity of water is $4.18 \text{ J/g}^\circ\text{C}$) initially at 22.3°C . The final temperature of the water is 24.9°C . Calculate the mass of water in the calorimeter. Ignore significant figures for this problem.
- A) 68.3 g
 - B) 1843.5 g
 - C) 2.07 g
 - D) 742.6 g
 - E) none of these
7. A 40.2 g sample of a metal is heated to 99.3°C and then placed in a calorimeter containing 120.0 g of water ($c=4.18\text{J/g}^\circ\text{C}$) at 21.8°C . The final temperature of the water is 24.5°C . Which metal was used?
- A) Aluminum ($c=0.89\text{J/g}^\circ\text{C}$)
 - B) Iron ($c=0.45\text{J/g}^\circ\text{C}$)
 - C) Copper ($c = 0.20\text{J/g}^\circ\text{C}$)
 - D) Lead ($c=0.14\text{J/g}^\circ\text{C}$)
 - E) none of these
8. You take 422.8 g of a solid at 30.0°C and let it melt in 400. g of water. The water temperature decreases from 85.1°C to 30.0°C . Calculate the heat of fusion of this solid. Ignore significant figures for this problem.
- A) 243 J/g
 - B) 109 J/g
 - C) 218 J/g
 - D) 823 J/g
 - E) cannot solve without the heat capacity of the solid

9. Consider a rigid insulated box containing 20.0 g of He(g) at 23.8°C and 1.00 atm in one compartment and 20.0 g of N₂(g) at 115.0°C and 2.00 atm in the other compartment. These compartments are connected by a partition which transmits heat. What will be the final temperature in the box at thermal equilibrium? (C_v(He) = 12.5 J/Kmol, C_v(N₂) = 20.7 J/Kmol)
- A) 41.2 °C
 - B) -231.8 °C
 - C) 69.4 °C
 - D) 80.7 °C
 - E) none of these
10. 30.0 mL of pure water at 280. K is mixed with 50.0 mL of pure water at 314 K. What is the final temperature of the mixture? Ignore significant figures for this problem.
- A) 297 K
 - B) 301 K
 - C) 365 K
 - D) 594 K
 - E) 34 K
11. In the lab, you mix two solutions (each originally at the same temperature) and the temperature of the resulting solution decreases. Which of the following is true?
- A) The chemical reaction is releasing energy.
 - B) The energy released is equal to $s \times m \times T$.
 - C) The chemical reaction is absorbing energy.
 - D) The chemical reaction is exothermic.
 - E) More than one of these.
12. What is the heat capacity of mercury if it requires 166.7 J to change the temperature of 15.0 g mercury from 25.00°C to 33.00°C?
- A) 0.720 J/g°C
 - B) 11.1 J/g°C
 - C) 20.8 J/g°C
 - D) 1.39 J/g°C
 - E) 287 J/g°C

13. A 140.0-g sample of water at 25.0°C is mixed with 123.1 g of a certain metal at 100.0°C. After thermal equilibrium is established, the (final) temperature of the mixture is 29.6°C. What is the heat capacity of the metal, assuming it is constant over the temperature range concerned?

- A) 0.31 J/g°C
- B) 0.62 J/g°C
- C) 0.24 J/g°C
- D) 3.2 J/g°C
- E) none of these

14. Consider the reaction



When a 13.3-g sample of ethyl alcohol (molar mass = 46.1 g/mol) is burned, how much energy is released as heat?

- A) 0.289 kJ
- B) 0.395 kJ
- C) 3.95e2 kJ
- D) 1.82e4 kJ
- E) 3.47 kJ

15. The ΔH value for the reaction $\frac{1}{2}O_2(g) + Hg(l) \rightarrow HgO(s)$ is -90.8 kJ. How much heat is released when 43.3 g Hg is reacted with oxygen?

- A) 0.216 kJ
- B) 3.93e3 kJ
- C) 19.6 kJ
- D) 90.8 kJ
- E) none of these

16. Exactly 174.6 J will raise the temperature of 10.0 g of a metal from 25.0°C to 60.0°C. What is the specific heat capacity of the metal?

- A) 2.00 J/g°C
- B) 0.499 J/g°C
- C) 17.6 J/g°C
- D) 41.8 J/g°C
- E) none of these

17. How much heat is required to raise the temperature of a 5.53-g sample of iron (specific heat = 0.450 J/g°C) from 25.0°C to 79.8°C?
- A) 2.44 J
 - B) 303 J
 - C) 673 J
 - D) 816 J
 - E) 136 J

18. At 25°C, the following heats of reaction are known:

| | ΔH (kJ/mol) |
|---|---------------------|
| $2\text{ClF} + \text{O}_2 \rightarrow \text{Cl}_2\text{O} + \text{F}_2\text{O}$ | 167.4 |
| $2\text{ClF}_3 + 2\text{O}_2 \rightarrow \text{Cl}_2\text{O} + 3\text{F}_2\text{O}$ | 341.4 |
| $2\text{F}_2 + \text{O}_2 \rightarrow 2\text{F}_2\text{O}$ | −43.4 |

At the same temperature, calculate ΔH for the reaction:

- A) −217.5 kJ/mol
- B) −130.2 kJ/mol
- C) +217.5 kJ/mol
- D) −108.7 kJ/mol
- E) none of these

19. Calculate ΔH° for the reaction $\text{C}_4\text{H}_4(\text{g}) + 2\text{H}_2(\text{g}) \rightarrow \text{C}_4\text{H}_8(\text{g})$, using the following data:

$$\Delta H^\circ_{\text{combustion}} \text{ for } \text{C}_4\text{H}_4(\text{g}) = -2341 \text{ kJ/mol}$$

$$\Delta H^\circ_{\text{combustion}} \text{ for } \text{H}_2(\text{g}) = -286 \text{ kJ/mol}$$

$$\Delta H^\circ_{\text{combustion}} \text{ for } \text{C}_4\text{H}_8(\text{g}) = -2755 \text{ kJ/mol}$$

- A) −128 kJ
- B) −158 kJ
- C) 128 kJ
- D) 158 kJ
- E) none of these

20. Consider the following standard heats of formation:

$$\text{P}_4\text{O}_{10}(\text{s}) = -3110 \text{ kJ/mol}$$

$$\text{H}_2\text{O}(\text{l}) = -286 \text{ kJ/mol}$$

$$\text{H}_3\text{PO}_4(\text{s}) = -1279 \text{ kJ/mol}$$

Calculate the change in enthalpy for the following process:



21. The coal with the highest energy available per unit burned is
- A) lignite.
 - B) subbituminous.
 - C) bituminous.
 - D) anthracite.
 - E) They are equal in energy value.
22. Which of the following is *not* being considered as an energy source for the future?
- A) ethanol
 - B) methanol
 - C) seed oil
 - D) shale oil
 - E) carbon dioxide
23. In exothermic reaction, potential energy stored in chemical bonds is being converted to thermal energy via heat.
- A) True
 - B) False
24. On a cold winter day, a steel metal fence post feels colder than a wooden fence post of identical size because
- A) The specific heat capacity of steel is higher than the specific heat capacity of wood.
 - B) The specific heat capacity of steel is lower than the specific heat capacity of wood.
 - C) Steel has the ability to resist a temperature change better than wood.
 - D) The mass of steel is less than wood so it loses heat faster.
 - E) Two of the above statements are true.
25. When a system performs work on the surroundings, the work is reported with a negative sign.
- A) True
 - B) False
26. Calculate the work for the expansion of CO₂ from 1.0 to 4.5 liters against a pressure of 1.0 atm at constant temperature.
- A) 3.5 liter atm
 - B) 4.5 liter atm
 - C) 0
 - D) -3.5 liter atm
 - E) -4.5 liter atm

Answer Key

1. B
2. B
3. B
4. B
5. A
6. A
7. B
8. C
9. A
10. B
11. C
12. D
13. A
14. C
15. C
16. B
17. E
18. D
19. B
20. -290 kJ
21. D
22. E
23. A
24. B
25. A
26. D