Names_____

AP Chem Group Quiz Chapters 5 & 6 - Circle and write the letter of the correct answer on the line.

1. _____ Use the information in the table to calculate the enthalpy of this reaction. $C_2H_6(g) + 7/2\ O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l)$

(A) –764 kJ (B) –1560 kJ (C) –1664 kJ
(D) –3120 kJ (E) -595 kJ

Reaction	ΔH_f° , kJ·mol^{-1}
$2C(s) + 3H_2(g) \rightarrow C_2H_6(g)$	–84.7
$C(s) + O_2(g) \rightarrow CO_2(g)$	–393.5
$H_2(g) + ½\ O_2(g) \rightarrow H_2O(l)$	–285.8

2. _____ Under which conditions will a gas behave most ideally?

(A) low P and high T (B) low P and low T (C) high P and low T
(D) high P and high T (E) a gas will be have ideally at all conditions

3. _____ A sample of neon gas has a volume of 248 mL at 30.°C and a certain pressure. What volume would it occupy if it were heated to 60.°C at the same pressure?

(A) 226 mL (B) 273 mL (C) 278 mL (D) 496 mL (E) 124 mL

4. _____ The mass of 560 cm^3 of a gas at 0˚C and 1 atm is 1.60 g. Which gas could it be?

(A) O_2 (B) CO_2 (C) SO_2 (D) Cl_2 (E) Xe

5. _____A gold ring that weighs 3.81 g is heated to 84.0°C and placed in 50.0 g of H_2O at 22.1°C. What is the final temperature?

(A) 22.2°C (B) 24.0°C (C) 26.5°C
(D) 53.1°C (E) 30.5°C

Substance	Specific Heat Capacity (J·g^{-1}·°C^{-1})
Au	0.129
H_2O	4.18

6. _____ A sample of oxygen gas and a sample of an unknown gas are weighed separately in the same evacuated flask. Use the data given to find the molar mass of the unknown gas (assume experiments are carried out at the same pressure and temperature).

Mass of evacuated flask	124.46 g
Mass of flask + oxygen	125.10 g
Mass of flask + unknown gas	125.34 g

(A) 22 g/mol (B) 38 g/mol (C) 44 g/mol (D) 84 g/mol (E) 66 g/mol

7. _____ Given these reactions:

$A \rightarrow 2B$ $\Delta H = 40$ kJ
$B \rightarrow C$ $\Delta H = -50$ kJ
$2C \rightarrow D$ $\Delta H = -20$ kJ

Calculate ΔH for the reaction; $D + A \rightarrow 4C$.

(A) –100 kJ (B) –60 kJ (C) –40 kJ (D) 100 kJ (E) -30 kJ

8. _____ $C_2H_6(g) + 7/2O_2(g) \rightarrow 2CO_2(g) + 3H_2O(g)$ $\Delta H^\circ = -1427.7$ kJ

If the enthalpy of vaporization for $H_2O(l)$ is 44.0 kJ/mol, what is ΔH° for this reaction if $H_2O(l)$ is formed instead of $H_2O(g)$?

(A) –1295.7 kJ (B) –1383.7 kJ (C) –1471.7 kJ (D) –1559.7 kJ (E) -1515.7 kJ

9. _____ For which of these is ΔH_f° not equal to zero?

(A) $Br_2(l)$ (B) $Fe(s)$ (C) $I_2(s)$ (D) $O_3(g)$ (E) $Xe(g)$

10. _____ Helium is often found with methane, CH_4. How do the diffusion rates of helium and methane compare at the same temperature? Helium diffuses

(A) sixteen times as fast as methane. (B) four times as fast as methane.
(C) twice as fast as methane. (D) at the same rate as methane.
(E) half as fast as methane.

11. _____ The enthalpy change for which reaction represents the standard enthalpy of formation for hydrogen cyanide, HCN?

(A) $H(g) + C(graphite) + N(g) \rightarrow HCN(g)$ (B) $½H_2(g) + C(graphite) + ½N_2(g) \rightarrow HCN(g)$
(C) $HCN(g) \rightarrow ½H_2(g) + C(graphite) + ½N_2(g)$ (D) $H_2(g) + 2C(graphite) + N_2(g) \rightarrow 2HCN(g)$
(E) $½H_2(g) + C(graphite) + N(g) \rightarrow HCN(g)$

12. _____ What is the molar mass of a gas if 10.0 grams of it occupy 4.48 liters at 273 K and 101.3 kPa (1.00 atm)?

(A) 2.00 g/mol (B) 25.0 g/mol (C) 50.0 g/mol (D) 100. g/mol (E) 75.0 g/mol

13. _____ For the formation of one mole of each of these gases from their elements, which reaction is most endothermic?

(A) CO ($\Delta H_f° = -110.5$ kJ·mol^{-1}) (B) NO_2 ($\Delta H_f° = +33.9$ kJ·mol^{-1})
(C) O_3 ($\Delta H_f° = +142.2$ kJ·mol^{-1}) (D) SO_2 ($\Delta H_f° = -300.4$ kJ·mol^{-1})
(E) I_2 ($\Delta H_f° = +62.0$ kJ·mol^{-1})

14. _____ The specific heats of several metals are given in the table. If the same number of Joules were applied to the same mass of each metal, which metal would show the greatest temperature change?

(A) Al (B) Au (C) Cu (D) Hg (E) all would be equal

Substance	Specific Heat, J·g^{-1}·°C^{-1}
Al	0.900
Au	0.129
Cu	0.385
Hg	0.139

15. _____ $4Li(s) + O_2(g) \rightarrow 2Li_2O(s)$

At 25°C, $\Delta H°$ for this reaction is –598.8 kilojoules per mole of $Li_2O(s)$ formed. What mass of Li should be reacted with excess $O_2(g)$ in order to release 150. kJ?

(A) 0.874 g (B) 1.74 g (C) 3.48 g (D) 6.98 g (E) 7.52 g

16. _____ A 2.00 liter evacuated container has a mass of 1050.0 g. When the container is filled with an unknown gas at 800. mm Hg pressure and 25.0 °C the mass is 1052.4 g. What is the molar mass of the gas (in g·mol^{-1})?

(A) 28 (B) 31 (C) 54 (D) 56 (E) 62

17. _____ Consider this reaction. $2N_2H_4(l) + N_2O_4(l) \rightarrow 3N_2(g) + 4H_2O(g)$ $\Delta H = -1078$ kJ

How much energy is released by this reaction during the formation of 140. g of $N_2(g)$?

(A) 1078 kJ (B) 1797 kJ (C) 3234 kJ (D) 5390 kJ (E) 16170 kJ

18. _____ Which pair of gases has the same average rate of diffusion at 25°C?

(A) He and Ne (B) N_2 and O_2 (C) N_2O and CO_2 (D) NH_3 and HCl (E) SF_6 and Xe

19. _____ How much heat is required to raise the temperature of 100. g of Fe_2O_3 from 5.0°C to 25.0°C? (Specific heat Fe_2O_3, 0.634 J·g^{-1}·°C^{-1})

(A) 1.58 kJ (B) 1.27 kJ (C) 0.845 kJ (D) 0.0634 kJ (E) 1.902 kJ

20. _____ A gas has a volume of 6.0 L at a pressure of 0.80 atm. What is the volume if the pressure is changed to 0.20 atm at constant temperature?

(A) 1.5 L (B) 3.0 L (C) 12 L (D) 24 L (E) 0.96 L

21. _____ Calculate the amount of energy released when 0.100 mol of diborane, B_2H_6, reacts with oxygen to produce solid B_2O_3 and steam.

Substance	$\Delta H_f°$, (kJ.mol^{-1})
$B_2H_6(g)$	35
$B_2O_3(s)$	-1272
$H_2O(l)$	-285
$H_2O(g)$	-241

(A) 203 kJ (B) 216 kJ (C) 330 kJ (D) 343 kJ (E) 124 kJ

22. _____ Given the thermochemical equations:

$Br_2(l) + F_2(g) \rightarrow 2BrF(g)$ $\Delta H° = -188$ kJ
$Br_2(l) + 3F_2(g) \rightarrow 2BrF_3(g)$ $\Delta H° = -768$ kJ

Determine $\Delta H°$ for the reaction: $BrF(g) + F_2(g) \rightarrow BrF_3(g)$ $\Delta H° = ?$

(A) -956 kJ (B) -580 kJ (C) -478 kJ (D) -290 kJ (E) 580 kJ

23. _____ The enthalpy change of which reaction corresponds to $\Delta H_f°$ for $Na_2CO_3(s)$ at 298 K?

(A) $2Na(s) + C(s) + 3/2O_2(g) \rightarrow Na_2CO_3(s)$ (B) $Na_2O(s) + CO_2(g) \rightarrow Na_2CO_3(s)$
(C) $2Na^+(aq) + CO_3^{2-}(aq) \rightarrow Na_2CO_3(s)$ (D) $Na_2(g) + CO_3(g) \rightarrow Na_2CO_3(s)$
(E) $2Na^+(aq) + 2OH^-(aq) + CO_2(aq) \rightarrow Na_2CO_3(s) + H_2O$

24. _____ When a bomb calorimeter is used to determine the heat of reaction, which property of the system under investigation is most likely to remain constant?

(A) number of molecules (B) pressure (C) temperature (D) volume (E) number of moles

25. _____ For the reaction shown, which is closest to the value of ΔH? $2Cr^{3+}(aq) + 3Ni(s) \rightarrow 2Cr(s) + 3Ni^{2+}(aq)$

Substance	$\Delta H_f°$ (kJ.mol^{-1})
$Cr^{3+}(aq)$	-143
$Ni^{2+}(aq)$	-54

(A) 124 kJ (B) 89 kJ (C) -89 kJ (D) -124 kJ (E) 197 kJ

26. _____ Which equation represents the reaction for the standard enthalpy of formation, $\Delta H_f°$, for $B_5H_9(g)$ at 298 K and 1 atm?

(A) $5B(s) + 9H(g) \rightarrow B_5H_9(g)$ (B) $2B(s) + 3BH_3(g) \rightarrow B_5H_9(g)$
(C) $5/2\ B_2(g) + 9/2H_2(g) \rightarrow B_5H_9(g)$ (D) $5\ B(s) + 9/2H_2(g) \rightarrow B_5H_9(g)$
(E) $5/2\ B_2(g) + 9H(g) \rightarrow B_5H_9(g)$

27. _____

Substance	$\Delta H_f°$ (kJ·mol^{-1})
$H_2O(g)$	–241.8

Calculate the change in enthalpy, ΔH, for the combustion of 11.2 L of hydrogen gas, measured at 0 °C and 1 atm pressure, to form $H_2O(g)$.

(A) –60.5 kJ (B) –121 kJ (C) –484 kJ (D) –2710 kJ (E) -242 kJ

28. _____ A 0.239 g sample of a gas in a 100-mL flask exerts a pressure of 600 mmHg at 14 °C. What is the gas?

(A) chlorine (B) nitrogen (C) krypton (D) xenon (E) oxygen

29. _____ What pressure (in atm) will be exerted by a 1.00 g sample of methane, CH_4, in a 4.25 L flask at 115°C?

(A) 0.139 (B) 0.330 (C) 0.467 (D) 7.50 (E) 8.46

30._____ What is the standard enthalpy of formation of MgO*(s)* if 300.9 kJ is evolved when 20.15 g of MgO*(s)* is formed by the combustion of magnesium under standard conditions?

(A) –601.8 kJ·mol^{-1} (B) –300.9 kJ·mol^{-1} (C) +300.9 kJ·mol^{-1}
(D) +601.8 kJ·mol^{-1} (E) +1203.6 kJ·mol^{-1}

Part II: Free Response. Show ALL work. Work should be done in a clear and orderly fashion. Box and label all answers.

Consider the hydrocarbon hexane, C_6H_{14} (molar mass 86.18 g).

(a) Write the balanced equation for the combustion of hexane to yield carbon dioxide and water.

(b) The complete combustion of 10.00 g of hexane releases 483 kJ of heat. On the basis of this information, calculate the value of ΔH for the complete combustion of one mole of hexane.

In another experiment, butane, $C_4H_{10}(g)$, is completely combusted to produce $CO_2(g)$ and $H_2O(l)$, as represented by the following equation. $2\ C_4H_{10}(g) + 13\ O_2(g) \rightarrow 8\ CO_2(g) + 10\ H_2O(l)$

The heat of combustion, $\Delta H_{comb}°$, for one mole of $C_4H_{10}(l)$ is -2877.5 kJ.

(c) Using the information in the table below, calculate the value of $\Delta H_f°$ for $C_4H_{10}(l)$ in kJ mol^{-1}.

Compound	$\Delta H_f°$, at 25°C (kJ mol^{-1})
$CO_2(g)$	–393.5
$H_2O(l)$	–285.8

(d) A 0.368 mol sample of $C_4H_{10}(l)$ is combusted.

(i) Calculate the amount of heat released in the combustion of 0.368 moles of butane.

(ii) If all of the heat produced from the combustion of 0.368 moles of butane is used to heat 3.33 kg of H_2O at 17.0°C, what is the final temperature of the water? The specific heat capacity of water is 4.184 J/g°C.