<u>**2008 soultions**</u>

1. PV=nRT

   101.1kPa(10.0L)= n(8.31kPaL/(Kmol)(26.2+271)K

   n =.4093561569 moles

   molar mass = mass/moles =(513.03 g-500.0g)/0. 4093561569 moles = 31.8 g/mole

   closest : O_2 (32.0 g /mole)

2. $$\frac{P_1 V_1}{n_1 T_1} = \frac{P_2 V_2}{n_2 T_2}$$

   $$\frac{101.3 \text{kPa}(0.600)\text{L}}{n_1(10.00+273)} = \frac{95.4 \text{kPaV}_2}{n_1(1.00+273)}$$

   V_2 = 0.617 L = 617 ml (notice that the question and answers did not respect sig figs)

3. **B** (C) is not the answer because it describes something more similar to activation energy and not enthalpy change.

4. **C** To heat 200.0 g of water (assuming a density of 1.00 g/ml for liquid water at that temp)from 15 to the boiling point of 100°C, we need:

   $$Q = mc\Delta T$$

   $$Q = 200.0 \text{g} * 4.19 \text{J}/(\text{g}°\text{C}) * (100 - 15) \quad °\text{C} = 71230 \text{ J}$$

   mole C_3H_8/2044.5 kJ (71.23 kJ) = 0.03483981414 mole C_3H_8

   0.03483981414 mole C_3H_8(44.0 g/mole) = 1.53 g

5. **A** ΔH = 10 kJ but the question is flawed because HI as a product has more than zero enthalpy.

6. **B**

7. **A**

8. **D** (Le Chatelier's principle; raising heat would have encouraged the reverse reaction, which is not what we wanted)

9. will not be on exam but the answer is A; C is not balanced

10. C   exclude solids

11. not on exam but answer is D

12. The external pressure is constant so under such conditions volume will decrease with decreasing temp because the molecules have a lower average speed and will cover less distance in a given time frame.

13. We will smell the one with the lowest molar mass because if temp is the same and therefore kinetic energy is the same, the one with the lower molar mass will have the higher average velocity ($E_k = 0.5mv^2$)

$$0.5m_1v_1^2 = 0.5m_2v_2^2$$

14. a)   endo; energy is absorbed

b) exo; $\Delta H = (-)$

c) exo: $H_2O_{(l)} \rightarrow H_2O_{(s)}$ + heat   recal that the reverse(melting is endo)

d) exo

15. Sit 1: increase in temperature; how do we know? The middle of the peak has shifted to the right, meaning that the avg. E_k and the speed has increased.

Sit2: A_e has not changed and neither has the avg. E_k, so all they did was repeated the expt. with more moles.

16. Strength is based on Ka:

$H_2PO_4^{2-}$ < HX < HF < HNO_2(has highest Ka value)
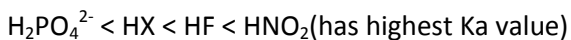
17. and 18. not on exam

19. According to Avogadro's Law, under the same conditions of pressure and temp. , equal volumes of gas (same container) will have the same number of moles.

$$PV = nRT$$

300.7*(2.00) = n*8.31*(28+273)

n = 0.2404 moles

ammonia = NH_3 = 0.2404 moles* 17.0 g/mole = 4.1 g

Another method: density will be proportional to molar mass under same T,P because of Avogadro's law, so 2.00L*(5.29 g/L)*(17.0g/mole*44.0g/mole) = 4.1 g

20.   -82 C = -82 + 273 = 191 K where the pressure is 177.5 kPa.

To attain this pressure,

$$PV = nRT$$

177.5($5X10^8$)=n(8.31)(191)

n= 55915726.34 moles

n = 55915726.34 moles* 16 g/mole = 894 651 621.4 g of methane = 8.94 X 10^5 kg would be needed, so 3 X 10^6 kg is more than enough to create this pressure; in fact, you will have leftover methane.

Alternate solution: Use 3 X 10^9 g to convert to moles and then PV = NRT to solve for P. You will get an answer for P (595 kPa) which is more than the required 177.5 kPa.

21. -Q_{hot} = Q_{cold}

$$-(mc\Delta T)_{hot} = (mc\Delta T)_{cold}$$

- 37.5 L*(1000g/L)4.19 J/(g^{o}C)(60-75°C) = x*(1000g/L)(4.19 J/(g^{o}C)(60-22°C)

X = 14.8 L

22. He must add NH_4Cl because it's the only one that will cause the temperature to drop again.

First find ΔT for the first reaction:

25.5g LiCl(mole/42.5 g) = 0.600 mole

ΔH = -35 kJ/mole * 0.600 mole = -21 kJ, but Q = 21 kJ

Q = 21000 J = 12000g * c * ΔT
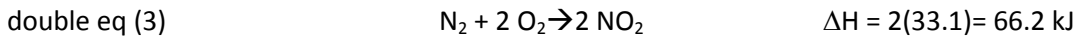
To get the opposite ΔT, we need

-21000 = 12000*c * (-ΔT)

But ΔH = 21000 J = 21 kJ

21 kJ (mole/16 kJ) = 1.3125 mole of NH_4Cl

1.3125 mole of NH_4Cl(53.5g/mole) = 70 g of NH_4Cl are needed

23.

double eq (3)	$N_2 + 2 O_2 \rightarrow 2 NO_2$	ΔH = 2(33.1)= 66.2 kJ
leave eq (2)	$2 C + 3H2 \rightarrow C_2H_6$	ΔH =-84.5 kJ
reverse and double eq(4)	$2 CO_2 \rightarrow 2 C + 2 O_2$	ΔH = 2*(+393.5)kJ
reverse and double eq(1)	$2NH_3 \rightarrow N_2+3H_2$	ΔH = 2*(+46.0)kJ
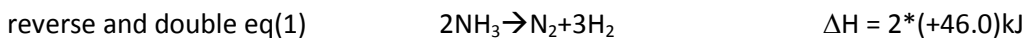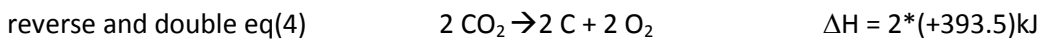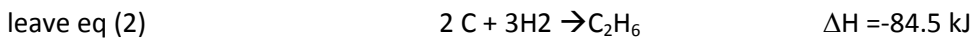
overall: ΔH =861 kJ

24. 65g N_2(mole/28.0g)(2 KNO_3/1 N_2)*101.g.mole = 468.93 g KNO_3

Avg rate = $\Delta m/\Delta t$ = 468.93 g KNO_3/0.05 s =9.4 X10^3 g/s

25.

	HF	H^+	F^-
I	20.0 g/(20.0g/mole)/2.0 L =0.50 M	0	0
C	2.0×10^{-2} M	2.0×10^{-2} M	2.0×10^{-2} M
E	=0.50 – 0.02 = 0.48 M	4.0×10^{-2}/2.0 L = 2.0×10^{-2} M	2.0×10^{-2} M

Ka = $[H^+][F^+]$/[HF] = $(2.0 \times 10^{-2})^2$/0.48 = 8.3×10^{-4}

Remember this exam did not cover bond energies, partial pressures and Ksp, which can all be covered by 2012 exam