AP Chemistry - Unit 1 - Pretest - KEY

1/4

4. ANS: D

Estimate! The molar mass of X is close to 75 and the percentage of oxygen is close to 25%.

X_2O-- 2 ? 75 = 150 + 16 = 166, closer to 10% oxygen present

XO-- 75 + 16 = 91, so less than 20% oxygen present

XO_2-- 75 + 32 = 107, so way more than 25% oxygen present

X_2O_3-- 150 + about 50 = 200, so 50/200 = 25/100 which is mighty close to 25%!

DIF: Easy OBJ: 1.1, SP 6.1 TOP: Stoichiometry
MSC: 1989 #25 NOT: 74% answered correctly

5. ANS: C

Expect easy math! Estimate!

2 L is about 1/10 of 22.4 L which is the molar volume of any gas at STP. So 4 g is then about 1/10 of the molar mass of the gas we seek which puts us in the neighborhood of 40ish. Since S has a molar mass of 32, the 2 oxygens make it too heavy. Nitrogen has a molar mass of only 28 and ammonia is a measly 17. Carbon dioxide has a molar mass of 44 and is our winner.

DIF: Medium OBJ: 1.4, SP 7.1 TOP: Stoichiometry
MSC: 2002 #66 NOT: 41% answered correctly

6. ANS: B

Examine the mass spectrum again. The 204 bar is negligible. The 208 bar is about twice as tall as either of the 206 bar, so the "extra" difference in height between the 208 bar and the 206 bar averages to 207 leading to a average atomic mass around 207 amu.

OBJ: 1.14, SP 1.4, 1.5 TOP: Stoichiometry

7. ANS: D

Expect easy math! Since the two isotopes weigh 63 and 65, and the average is *not* 64 (a 50%-50% blend), but rather 63.55, you know answers (A), (B) and (C) can't be correct.
The average lies almost half way between the 50% blend, so 25% it is, Answer (D).

DIF: Medium OBJ: 1.1, SP 6.1 TOP: Stoichiometry
MSC: 2002 #43 NOT: 49% answered correctly

8. ANS: B

You were only given one starting amount (and it says *excess* hydrogen), so you have *not* entered the "land of limiting reactant". Whew! You were given the number of moles of reactant, but must calculate the mass of the product which will require that *you* supply a balanced equation.

2x 0.050 = 0.100 Moles

$Au_2S_3 + H_2 \rightarrow 2Au + H_xS_y$

If 0.0500 moles of Au_2S_3 completely reacts (not a limiting reactant), then 0.100 moles of Au was formed. The *MM* of Au is 197, so 1/10 mole ? 197 g/mol = 19.7 g

DIF: Medium OBJ: 1.4, SP 7.1 TOP: Stoichiometry
MSC: 1999 #20 NOT: 55% answered correctly

AP Chemistry - Unit 1 - Pretest - KEY 2/4

10. ANS: C
Expect easy math! Notice that all of the amounts are simple multiples of the smallest amount given, 0.55 mol. So, simplify into "parts": K = 2, Te = 1 and O = 3 giving an empirical formula of K_2TeO_3

DIF: Easy OBJ: 1.2, SP 6.1 TOP: Stoichiometry
MSC: 2002 #24 NOT: 82% answered correctly

15. ANS: B
Two starting amounts...your limiting reactant alarms should be sounding.

Expect easy math! When given a concentration and volume, use Molarity × V to calculate the number of moles present. Don't forget to track the total volume (20 + 30 = 50 mL).

For Ba^{2+} : (0.200 M × 20.0 mL) + (0.400 M × 30.0 mL) = 4.00 mmol + 12.0 mmol
So, 4.00 mmol of ppt. forms, and 8.00 mmol of excess, unreacted barium ion remains in 50 mL of solution. 8 mmol/50 mL (the milli's cancel) which is equivalent to 16/100 and you get an answer of 0.16 M.

DIF: Medium OBJ: 1.4, SP 7.1 TOP: Stoichiometry
MSC: 1984 #68 NOT: 48% answered correctly

16. ANS: A
The "trick" to getting this one correct is to recognize that you have entered the "land of limiting reagent"! You were given the number of moles of silver, but must calculate the moles of nitric acid, it's two starting amounts either way! Remember that molarity × liters = moles. Determine the limiting reagent and calculate subsequent moles from that limiting amount of moles using the mole:mole.

3 Ag	+ 4 HNO_3	⇄ 3 $AgNO_3$	+ NO	+ 2 H_2O
mole:mole 3 X	4X	3	X	2
# moles 0.10 divide by 3 = 0.033 3X = .1 x = 0.033	=(0.010 ← 10mL liter)(6.0mol/L) = 0.060 mol divide by 4 = 0.015, compare to 0.033 LIMITING! work from this now... 4x = .06M x = .015		If 4 = 0.060, what's "1" equal? 0.015 moles NO formed x = 0.015!	

DIF: Medium OBJ: 1.4, SP 7.1 TOP: Stoichiometry
MSC: 1984 #52 NOT: 63% answered correctly

17. ANS: B
Expect easy math! 9 grams of Al is 1/3 mole.

1 mole = 27g ∴ $\frac{1}{3}(27) = 9g$

2 Al + 6 HCl → 2 $AlCl_3$ + 3 H_2
1/3 mol
therefore divide 1/3 by 2 and multiply by 3 which equal 0.5 mol or 11.2 liters at STP

$\frac{1}{3}$ mole Al $\left(\frac{3\text{ mole } H_2}{2\text{ mole Al}}\right)\left(\frac{22.4\text{ L}}{1\text{ mole}}\right)$

$\frac{1}{2}(22.4L)$
$= 11.2L$

DIF: Hard OBJ: 1.4, SP 7.1 TOP: Stoichiometry
MSC: 1984 #85 NOT: 30% answered correctly

AP Chemistry - Unit 1 - Pretest - KEY

18. ANS: A
Expect easy math! Think in round numbers of 35 and 37 as the masses of the 2 isotopes. If both isotopes were in the same abundance, then the average would be 36. BUT, alas it's not...it's stated as about 35.5 so the sample should contain mostly the 35 amu isotope (tall bar on the graph) with a bit of the 37 isotope (much shorter bar on the graph) present to raise the average above 35 but not to 36.

OBJ: 1.14, SP 1.4, 1.5 TOP: Stoichiometry

20. ANS: C
Expect easy math and ESTIMATE!
Also, resist the urge to get an exact answer. AND look for easy math groupings rather than always working solely from left to right. For instance 0.05 × 100 = 5 (move the decimal to the right twice) and 5 × 6 = 30 and you're done! The "math" answer choices will be spread apart enough in magnitude to allow for serious estimation. Units will save your hide in such cases as well.

$$\frac{6\text{ mol}}{\text{L}} \times 0.05\text{ L} \times \frac{\approx 100\text{ g}}{\text{mol}} \approx 30\text{ g}$$

DIF: Easy OBJ: 1.4, SP 7.1 TOP: Solutions MSC: 1989 #15
NOT: 88% answered correctly

21. ANS: D
A classic "hydrocarbon burned...what's the empirical formula? what's the molecular formula?" type of problem.

Expect easy math!
moles CO_2 = 88/44 = 2 moles CO_2, therefore 2 moles C
moles H_2O = 27/18 = 1.5 moles water, therefore 3.0 moles hydrogen

EF = C_2H_3 which is not an answer choice, so double, triple, quadruple, etc.
C_4H_6 has the same ratio as our empirical formula.

DIF: Medium TOP: Stoichiometry MSC: 1984 #73
NOT: 44% answered correctly

AP Chemistry - Unit 1 - Pretest - KEY

23. ANS: C

Expect easy math and estimate!

A gas's density at STP is calculated using this formula : $density = \frac{MM}{22.4\ ^{L}/_{mol}}$ so, MM = ($density$? 22.4 L/mol) = (about 2 g/L ? 22.4 L/mol) = about 45ish g/mol, so C_3H_6 is the best answer choice.

DIF: Medium OBJ: 1.1, SP 6.1 TOP: Stoichiometry
MSC: 1994 #33 NOT: 52% answered correctly

24. ANS: D

The "trick" to getting this one correct is to recognize that you have entered the "land of limiting reagent"! You were given the number of moles of *three* reactants. Determine the limiting reagent. Start by using I_2 since it is the smallest starting amount coupled with the highest coefficient.

If 5 = 2.5 mol, then 10 = 5.0 mol. Calculate ***subsequent moles*** (if 10 = 5 mol, then 1 = 1/2 mol, so 2 = 1.0 mol and 3 = 1.5 mol) from that limiting amount of moles using the mole:mole.

10 HI	2 $KMnO_4$	3 H_2SO_4	$\rightarrow$	5 I_2	2 $MnSO_4$	K_2SO_4	8 H_2O
? mol	4.0 mol	3.0 mol		2.5 mol			
5.0 mol	***1.0 mol***, so plenty is available	***1.5 mol***, so plenty is available		***limit!***			

DIF: Easy OBJ: 1.4, SP 7.1 TOP: Stoichiometry
MSC: 1999 #55 NOT: 69% answered correctly

25. ANS: A

The "trick" to getting this one correct is to recognize that you have entered the "land of limiting reagent"! You were given two starting amounts. Determine the limiting reagent and calculate subsequent moles from that limiting amount of moles using the mole:mole.

2 N_2H_4	+ N_2O_4	$\rightleftarrows$	+ 3 N_2	+ 4 H_2O
mole:mole 2	1		3	4
# moles (8/32) = 0.25 IF 2 = 0.25 mol, then 1 = 0.125, so this is clearly the LIMITING reactant. Work from this number...	= (92/92) = 1 mol Excess! Not limiting.			4(0.125) = 0.50 mol, therefore 9.0 g since molar mass of water is 18g

DIF: Medium OBJ: 1.4, SP 7.1 TOP: Stoichiometry
MSC: 2002 #58 NOT: 47% answered correctly

AP Chemistry - Unit 1 - Pretest $1/2$

FR #1

1) A) <u>Given:</u>

0.2800 g Sample $CaCO_3 + MgCO_3$ heated CO_2 produced

@ 750. mm Hg, 20°C,

75.0 ml

? g CO_2

<u>Soln:</u>

$$\left(\frac{750.\ mmHg}{1}\right)\left(\frac{1\ Atm}{760\ mmHg}\right) = 0.987\ Atm \qquad \left(\frac{75.0\ ml}{1}\right)\left(\frac{1\ L}{1000\ ml}\right) = 0.0750\ L$$

$20°C + 273 = 293\ K$

$PV = nRT$

$$n = \frac{PV}{RT} \qquad \frac{(0.987\ Atm)(0.0750\ L)}{\left(0.0821\ \frac{L\ Atm}{mol\ K}\right)(293\ K)} = 3.08 \times 10^{-3}\ mole\ CO_2$$

$$\left(\frac{3.08 \times 10^{-3}\ mole\ CO_2}{1}\right)\left(\frac{44.01\ g\ CO_2}{1\ mole\ CO_2}\right) = \boxed{0.136\ g\ CO_2}$$

B) $CaCO_{3(s)} \xrightarrow{\Delta} CO_{2(g)} + CaO_{(s)}$ $\quad MgCO_3 \xrightarrow{\Delta} CO_{2(g)} + MgO_{(s)}$

C) 0.2800 g sample of $CaCO_3 + MgCO_3$ has 0.0448 g Ca

? % mass of sample is $CaCO_3$

$$\left(\frac{0.0448\ g\ Ca}{1}\right)\left(\frac{1\ mole\ Ca}{40.08\ g\ Ca}\right)\left(\frac{1\ mole\ CaCO_3}{1\ mole\ Ca}\right)\left(\frac{100.09\ g\ CaCO_3}{1\ mole\ CaCO_3}\right) = 0.112\ g\ CaCO_3$$

$$\frac{0.112\ g\ CaCO_3}{0.2800\ g\ Sample} \times 100\% = \boxed{40.0\%\ CaCO_3}$$

D) ? g MgO produced

$$\begin{array}{r} .2800\ g\ Sample \\ -\ .112\ g\ CaCO_3 \\ \hline 0.168\ g\ MgCO_3 \end{array}$$

$$\left(\frac{0.168\ g\ MgCO_3}{1}\right)\left(\frac{1\ mole\ MgCO_3}{84.31\ g\ MgCO_3}\right)\left(\frac{1\ mole\ MgO}{1\ mole\ MgCO_3}\right)\left(\frac{40.30\ g\ MgO}{1\ mole\ MgO}\right)$$

$$\boxed{= 0.0803\ g\ MgO}$$

FR #2

A) C H N O + O_2 $\xrightarrow{\Delta}$ $CO_{2(g)}$

1.2359g Excess 2.241g

H 0.0648g

i) ?g C in Sample

$$\left(\frac{2.241g\ CO_2}{1}\right)\left(\frac{1\ mole\ CO_2}{44.01g\ CO_2}\right)\left(\frac{1\ mole\ C}{1\ mole\ CO_2}\right)\left(\frac{12.01g\ C}{1\ mole\ C}\right) = \boxed{0.6116\ g\ C}$$

ii) mass % of N 28.84% of Compound sample

?g N in 1.2359g sample

$$(1.2359g)(.2884) = \boxed{0.3564g\ N}$$

iii) ?g O in 1.2359g sample

1.2359g sample CNHO

− 0.3564g N

− 0.0648g H

− 0.6116 g C

$\boxed{0.2031g\ O}$

iv) Empirical formula?

$$\left(\frac{0.6116g\ C}{1}\right)\left(\frac{1\ mole\ C}{12.01g\ C}\right) = 0.05092\ mole\ C / 0.01269\ mole = 4$$

$$\left(\frac{.0648gH}{1}\right)\left(\frac{1\ mole\ H}{1.008gH}\right) = 0.06429\ mole\ H / 0.01269\ mole = 5$$

$$\left(\frac{0.3564gN}{1}\right)\left(\frac{1\ mole\ N}{14.01gN}\right) = 0.02544\ mole\ N / 0.01269\ mole = 2$$

$$\left(\frac{0.2031g\ O}{1}\right)\left(\frac{1\ mole\ O}{16.00g\ O}\right) = 0.01269\ mole\ O / 0.01269\ mole = 1$$

$$\boxed{C_4H_5N_2O}$$