GRADE 12 CHEMISTRY

MID–TERM — PRACTICE REVIEW TEST

Name ______________________________

Student Number ______________________

Attending ❒ **Non-Attending** ❒

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ANSWER KEY

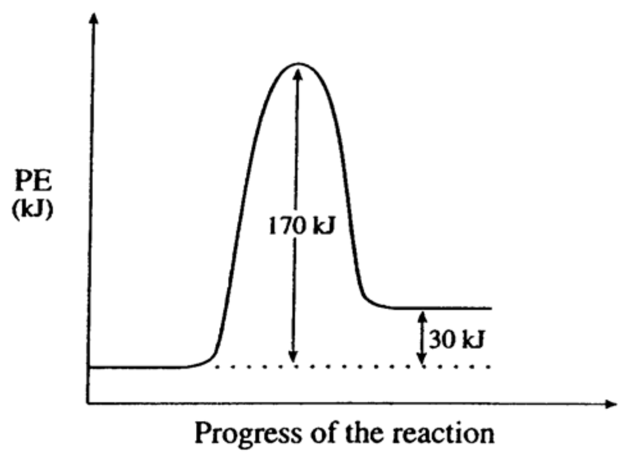
VALUE: TOTAL 100 MARKS

PART A

1. (d) From the equation, we note that the coefficient for NO_2 is"4" whereas for N_2O_5 is 2. Therefore the NO_2 is forming at 4/2 or 2 (twice) the rate at which N_2O_5 is decomposing. Therefore 2 (2.5×10^{-6}) = 5.0×10^{-6} mol/5.

2. (d) Just a straight recall question from your notes.

3. (b) Activation energy for reverse reaction ie from products to reactants = 170kJ – 30kJ = 140 kJ



4. Step 1 $Cl_{(g)} + O_{3(g)} \rightarrow \cancel{ClO_{(g)}} + O_{2(g)}$

Step 2 $O_{(g)} + \cancel{ClO_{(g)}} \rightarrow Cl_{(g)} + O_{2(g)}$

Final Reaction $Cl + O_3 + O \rightarrow Cl + 2O_2$

(d) Reaction intermediate is the substance(s) that would not appear in the final reaction given here. The final reaction is determined by adding step 1 & step 2 reactions and canceling out what is common to both sides. In the is case it is the $ClO_{(g)}$.

5. (c) Straight definition question from the notes.

6. (c) The forward reaction rate decreases immediately and continues to decrease as the reactant molecules are being used up causing reactant molecules to decrease. The converse is true for the reverse reaction rate.

7. (d) Increasing the volume of the system would decrease the concentration of all species (NO_2 included) therefore using Le Chateliers Principle the reaction that produces more particles (NO_2) would be favored since this would again increase the concentration.

8. (c) Any substance which is a liquid or a solid does not appear in the expression, since its concentration is constant and is thus incorporated into the K*eq*.

9. (b) If the equilibrium shifts left then the ΔH appears on the RHS of the equation, meaning forward reaction is exothermic. If exothermic the ΔH is always written with a negative sign in front of it ie ΔH = - ? kJ

10. (b) Equation can be rewritten as follows: $PCl_{5(g)} + 92.5\text{ kJ} \rightleftarrows PCl_{3(g)} + Cl_{2(g)}$ ∴ using Le Chateliers Principle, decreasing the temperature (energy) would favor the reaction which produces energy & that is the reverse reaction. Therefore your PCl_3 and Cl_2 concentrations decrease & your PCl_5 concentration would increase which makes your K*eq* value to decrease since

$$K_{eq} = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

11. (a)

$$K_{eq} = \frac{[CO][H_2]^3}{[CH_4][H_2O]};\ 5.7 = \frac{(0.30)(0.80)^3}{(0.40)[H_2O]}$$

$$\therefore\ [H_2O] = \frac{(0.30)(0.80)^3}{(0.40)(5.7)} = 0.067$$

12. (b) Since K_{TRIAL} is greater than K*eq* the reverse reaction is forward since it decreases the concentration of O_2 and increases the concentration of O_3.

$$K_{eq} = \frac{[O_2]^3}{[O_3]^2};\ 55 = \overbrace{\frac{[0.70]^3}{[0.060]^2}}^{K_{TRIAL}};\ = \frac{0.0343}{0.0036} = 95$$

13. (d) Rate description must have a unit of time in its measurement & only choice d) has this.

14. (c) An increase in T increases the number of collisions per unit of time **and also** increases the number of successful collisions per unit of time (ie particles with the correct amount of activation energy sufficient KE)

15. (b) Using Le Chateliers Principle: Choice b) would shift equilibrium to the right ie increase decomposition

16. (a) Brönsted-Lowry base} Acid = proton donor
Base = proton acceptor

17. (b) All acids have the same concentration & ie 10M. Therefore we have to look at the degree of dissociation of the acid & that we find in the Acid Chart in your notes & this happens to be H_2SO_4 ie it dissociates to the greatest degree & therefore the greatest electrical conductor of the 4 choices.

18. (c)

$$HC_6H_5O_7^{2-} + HIO_3 \rightleftharpoons H_2C_6H_5O_7^{-} + IO_3^{-}$$

B A A B

19. (d) From the acid strength chart all we need to do is compare HNO_2 with HSO^-_4 & we see from the chart that HSO^-_4 is higher up on the chart than HNO_2 & therefore the reactants are favoured.

20. (a) $HCl + H_2O \rightarrow H_3O^+ + Cl^-$
Addition of HCl essentially increases the [H_3O+] & using Le Chateliers Principle again, this would shift the equilibrium to the left. Therefore your [OH^-] decreases but your [H_3O^+] is still higher than before because you added a strong acid HCI

21. (a) $\left[H_3O^+\right] = \dfrac{1.00 \text{ x } 10^{-14}}{1.5 \text{ x } 10^{-4}} = 0.667 \text{ x } 10^{-10} = 6.67 \text{ x } 10^{-11}$ or $6.7 \text{ x } 10^{-11}$

22. (a) $pOH = 14 - pH \qquad = 14 - 6.52 = 7.48$
$\left[OH^-\right] = anti\log of\,(-7.48) \qquad = 3.3x10^{-8}$

Using a calculator
i) punch in –7.48
ii) then key in 2nd fcn key & log key

23. (b) $NaOH \rightarrow Na^+ + OH^-$
The OH^- from the base would combine with the H_3O^+ in the reaction given & reduce its concentration & causing equilibrium to shift to the light

24. (c) This is a weak acid (HNO_2) and a strong base (NaOH) reaction ∴ $HNO_2 + OH^- \rightarrow NO_2^- + H_2O$. Weak acids are always written in molecular form then & that's why we write HNO_2. Strong bases are just written showing the OH^-.

25. (a) Basic solutions always have metals in their formulas & therefore we need only look for an oxide having a metal in it & that is choice (a)

26. (a) Brönsted-Lowry acid ie lose an H^+; Brönsted-Lowry base ie gain an H^+
$HClO_4 \rightarrow H^+ + ClO_4^-$ not $HClO_4 + H^+ \rightarrow H_2\,ClO_4^+$

27. (d) Strength of acids depend on degree of ionization

28. (d) Since reactants are favored, the reverse reaction was favored over the forward reaction this means that

H_2X was stronger than HZ^-

29. (d) NaOH is a strong base, which means it dissociates complete

ie $NaOH \rightarrow Na^+ + OH^-$

$\therefore$ 0.025 M 0.025 M 0.025 M

$\therefore$ pOH = - log 0.025 M = 1.60

$\therefore$ pH = 14 – 1.60 = 12.40

30. (b) Formula would be identical to that in Module 3, Lesson 4, Page 30, except it would be solved in terms of OH^-.

31. (a) $V_A x C_A = V_B x C_B$

$$C_A = \frac{V_B x C_B}{2V_A} = \frac{\cancel{25.0} x 0.100}{2x\cancel{25.0}} = 0.0500 or 5.00x10^{-2}$$

32. (c) $\underbrace{HCl + NaOH \rightarrow NaCl + HOH}_{\therefore V_A \; x \; C_A \; = \; V_B \; x \; C_B}$

$\underbrace{10.0 \text{ mL x } 0.10 \text{ m}} = \underbrace{25.0 \text{ mL x } 0.040 \text{ m}}$

$\underbrace{\text{moles of } H^+ = 0.0010 = \text{moles of } OH^- = 0.0010}_{\therefore \text{ There is no excess of } H^+ \text{ or } OH^- \text{ \& solution is neutral } \therefore pH = 7.00}$

33. (b) The principal quantum number "n" always indicates the number of sublevels

34. (c) Ionization energy increases from left to right in the periodic table & from the choices given choice d) is the furthest to the right

35. (c) $f = \frac{c}{\lambda} = \frac{3.00 \times 10^8 \text{m/s}}{6.0 \times 10^{-7} \text{m}} = 0.50 \times 10^{15-1} \text{Hz}$

$= 5.0 \times 10^{14}$ Hz

36. (c) $E = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \text{ J/Hz} \times 3.00 \times 10^8 \text{ m/s}}{6.2 \times 10^{-7} \text{ m}} = 3.2 \times 10^{-19}$

37. (b) Correct choice is where the superscripts add up to 20, choice (b), exactly equal to the atomic number for calcium.

38. (c) Valence electrons are the electrons in the outermost orbits subshells "s" and "p" $\therefore$ Valence shell = $3S^2 3P^4$} equals 6e's.

39. (c) 0.0128. Only the 1, 2, and 8 are significant digits. The zeroes are not significant because they are neither in between nor following non-zero digits.

40. (c) Answer should have 3 significant figures. See Module 3, page 32, Rule 3 - When multiplying or dividing a value (21.4 g) with uncertainty in order to use a different SI prefix (kg), the original number of sig digits (3) are retained identically.

41. (d) Answer should have 3 significant figures. See Module 3, page 32, Rule 3 – Multiply or divide and then round off to the least number of significant digits found in the question.

$$\underbrace{5.22\text{ m}}_{\text{3 S.F.}} + \underbrace{82.7\text{ m}}_{\text{3 S.F.}} = \underbrace{431.694\text{ m}^2 = 432\text{ m}^2}_{\therefore\text{ answer should have 3 S.F.}}$$

42. (c)

$$\begin{array}{r|l} 4.3 & 75 \\ 14.6 & 2 \\ 327.9 & \\ \hline 346.8 & 95\text{ g} \rightarrow 346.9\text{ g} \end{array}$$

43. d) ∴ electronegativity = S – B = 2.5 – 2.0 = 0.5
∴ covalent with slight polarity

44. (d) The superscripts add up to 25 which is the number of e's in the atom and therefore also the atomic #25=manganese and from its electron configuration ($4S^2$) we see it has 2 e's.

45. (a) When ionization jumps by 10 → 20 times original value (ie E_1, as it does to E_5) it means that electrons are being removed from a different energy level. Therefore E_1, E_2, E_3, E_4 must be the removal of electrons from the valence or outer shell.

46. (b) Al has a valence of 3, i.e., Al^{3+}
S has a valence of -2, i.e., S^{2-} } ∴ Al_2S_3

This is the simplest ratio & ∴ the empirical formula. Other formulas possible are Al_4S_6, Al_6S_9 & so on but these are not empirical formulas

47. (c) $2n^2 = 2(4)^2 = 32$

PART B Written Response

1. a) Reaction is exothermic since the heat of the reaction (394kJ) occurs on the product side. Therefore it should be written as $\Delta H = -394\text{kJ}$

b) Only the sfe e's can collide with the O_2

c) Greater sfe area in dust form results in more collisions/unit time & thus a faster reaction.

2.

	H_2 +	I_2 ⇌	2HI
Initial	?	?	0
React	-0.080	-0.080	+0.160
Equilibrium	χ	χ	+0.160

$$K_{eq} = \frac{[HI]^2}{[H_2][I_2]}; \quad 64 = \frac{[0.160]^2}{\chi^2}$$

$$\chi^2 = \frac{[0.160]^2}{64} = 4.0 \times 10^{-4}$$

$$\chi = \sqrt{4.0 \times 10^{-4}} = 2.0 \times 10^{-2} = [H_2]_{EQUIL}$$

$$[H_2]_{INITIAL} - [H_2]_{REACT} = [H_2]_{EQUIL}$$

$$[H_2]_{INITIAL} = 0.020 + (0.080) = 0.100$$

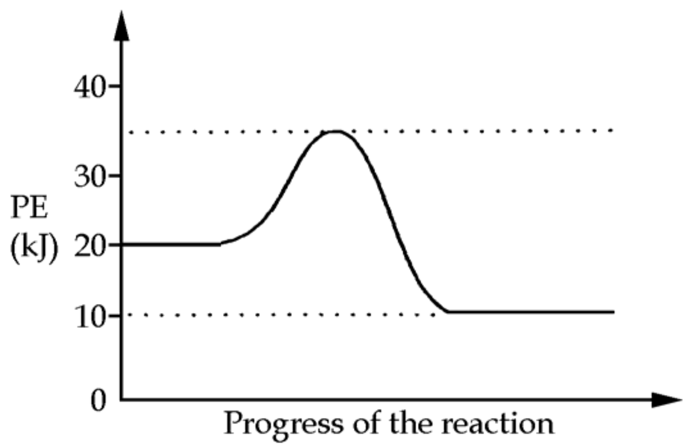
3. a) Indicates a 4 particle collision (2NO and $2H_2$) and this is next to impossible. Most collisions are 2 particle collisions.

b) i)

$$\begin{array}{rl} 2NO + 2H_2 = 2H_2O + N_2 & \text{final reaction} \\ -\left(N_2O + NO + 2H_2 = N + N_2 + 2H_2O\right) & \text{sum of reactions 1 and 3} \\ \hline \underbrace{NO - N_2O = -N}_{NO + N \rightleftharpoons N_2O} & \end{array}$$

ii) Reaction intermediates are the species in the reaction mechanism (step 1, 2 & 3) that do not appear in the final reaction. They are N + N_2O

4.



a) Left to right activation energy = 35 – 20= 15 kJ

b) ΔH_f = 20 – 10 = 10kJ
Since products are at a lower level than reactants the ΔH must be negative ∴ ΔH = -10 kJ

c) A.E. = (35 or 34) – 10 = 25 or 24 kJ

d) Drawn must be lower than 35kJ (peak of the curve) but beginning and ending levels must be the same.

5. $$Keq = \frac{[HI]^2}{[H_2][I_2]}; 7.1x10^2 = \frac{(0.40)^2}{(0.012)(I_2)}$$

$$[I_2] = \frac{(0.40)^2}{(0.012)(7.1x10^2)}$$

$$[I_2] = 0.019$$

6. i) $V_1xC_1 = C_2xC_2$

$40.0mL \times 0.040 = 100.0mL \times C_2$

$0.016 = C_2 = [KOH]$

ii) $KOH \rightarrow K^+ + OH^-$

0.016 0.016 0.016

iii) $$\left[H_3O^+\right] = \frac{1.00 \times 10^{-14}}{0.016} = 6.25 \times 10^{-13}$$

7. $$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

$$K_A = \frac{\left[H^+\right]\left[CH_3COO^-\right]}{CH_3COOH}$$

8. a) A weak Brönsted-Lowry base is a poor acceptor of protons.

$1.8 \times 10^{-5} = \frac{x^2}{0.400};\ x^2 = 1.8 \times 10^{-5} \times 0.400$

$= 0.72 \times 10^{-5}$

$= 7.2 \times 10^{-6}$

$x = \sqrt{7.2 \times 10^{-6}} = 2.7 \times 10^{-3} = H^+$ pHz - log $2.7 \times 10^{-3} = 2.6$

b) Any species high up on RHS of the Acid Strength chart $C10_4^-$, I^-, Br^- etc

9. $$C_2H_5OCOOH \rightleftharpoons C_2H_5OCOO^- + H^+$$

$$pHof\, 2.95 = \left[H^+\right] = 1.12x10^{-3}$$

$$K_A = \frac{\left[C_2H_5OCOO^-\right]\left[H^+\right]}{\left[C_2H_5OCOOH\right]} = \frac{\left(1.12x10^{-3}\right)\left(1.12x10^{-3}\right)}{1.00x10^{-1}}$$

$$K_A = 1.25x10^{-5}$$

10. $NaCN_{(s)} \rightarrow Na^+_{(aq)} + CN^-_{(aq)}$; $CN^-_{(aq)} + HOH \rightarrow HCN + OH^-_{(aq)}$

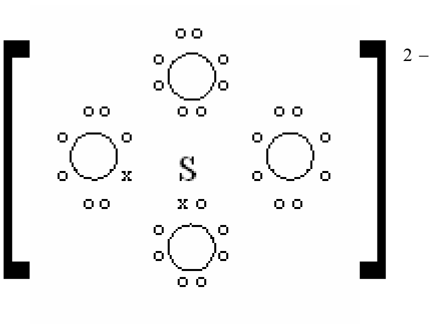
11. a) at # of (2 + 2 + 6 + 2 + 6 + 2 + 3) = 23 = Vanadium

b) at # of (2 + 2 + 6 + 2 + 6 + 2 + 10 + 6 + 2 + 2) = 40 = Zirconium

12. a) $T\ell = 1S^2 2S^2 2P^6 3S^2 3P^6 4S^2 3D^{10} 4P^6 5S^2 4D^{10} 5P^6 6S^2 4F^{14} 5D^{10} 6P^1$

b) $Fe = 1S^2 2S^2 2P^6 3S^2 3P^6 4S^2 3D^6$

13. Total # of electrons: 1 x S = 1 x 6 = 6
4 x 0 = 4 x 6 = 24
2 – charge = 2
$32e^-$



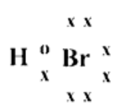
14. $f = \frac{c}{\lambda} = \frac{3.00 \times 10^{+8}\ \text{m/s}}{6.10 \times 110^{-7}\ \text{m}} = 4.92 \times 10^{14}\ \text{Hz}$

15. a) $\lambda = \frac{c}{f} = \frac{3.00 \times 10^{+8}\ \text{m/s}}{9.62 \times 10^{12}\ \text{Hz}} = 3.12 \times 10^{-5}\ \text{m}$

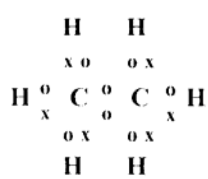
b) $E = hf = 6.63 \times 10^{-34}\ \text{J/Hz} \times 9.62 \times 10^{12}\ \text{Hz}$

$E = 6.41 \times 10^{-21}\ \text{J}$

16. **a)** **i)**

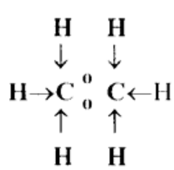


ii)



b) **i)** **H→Br**

ii)



c) Molecule in

i) is polar covalent

ii) is nonpolar covalent