IB CHEMISTRY 1ST YEAR REVIEW

SUMMER ASSIGNMENT BETWEEN YR. 1 & Y2

This summer assignment is designed to help you review the concepts learned in first year IB Chemistry SL/HL so when you start 2nd year IB Chemistry HL you will be ready to begin the second year successfully. This is separated by topics 1 – 10. You will be responsible for answering the questions and submitting **them to me by the due dates listed**. This will allow you to start the school year with **extra credit points** and do **well on your first IB Chemistry test 2nd year**. You will keep your books over the summer to be used as a resource.

A study session will be held on August 4, from 8:00 – 11:00 in room I-50. Please attend this session to finish up this summer assignment, ask questions, get answers, and start the year ahead!

**SHOW ALL WORK AND FINAL ANSWERS ON YOUR OWN PAPER. FOR CREDIT, YOU MUST SHOW ALL WORK FOR BOTH THE MC QUESTIONS AND FR QUESTIONS. SCAN YOUR ANSWER SHEET INTO YOUR COMPUTER AND EMAIL IT TO ME BY THE DUE DATES ON EACH SECTION:** **cturner@mycuhsd.org** **or up load it into google classroom under the section that says IB Yr 1 \_ 2 Summer Assignment.**

**For every section you complete, you will get 20 points extra credit to start your second year with. The section must be complete to get those points. Potentially, this could give you 100 extra credit points starting next year.**

**Further, this will also count as your final exam review problems. Your final exam review problems will come from this summer assignment. They will be multiple choice questions.**

**TOPIC 1 QUANTITATIVE Due 6-15-19**

1. 3.0 dm3 of sulfur dioxide is reacted with 2.0 dm3 of oxygen according to the equation below.

2SO2(g) + O2(g) → 2SO3(g)

 What volume of sulfur trioxide (in dm3) is formed? (Assume the reaction goes to completion and all gases are measured at the same temperature and pressure.)

A. 5.0

B. 4.0

C. 3.0

D. 2.0

2. What amount (in moles) is present in 2.0 g of sodium hydroxide, NaOH?

A. 0.050

B. 0.10

C. 20

D. 80

(Total 1 mark)

3. A hydrocarbon contains 90% by mass of carbon. What is its empirical formula?

A. CH2

B. C3H4

C. C7H10

D. C9H10

4. Lithium hydroxide reacts with carbon dioxide as follows.

2LiOH + CO2 → Li2 CO3 + H2O

 What mass (in grams) of lithium hydroxide is needed to react with 11 g of carbon dioxide?

A. 6

B. 12

C. 24

D. 48

5. Which change in conditions would increase the volume of a fixed mass of gas?

|  |  |  |
| --- | --- | --- |
|  | **Pressure /kPa** | **Temperature /K** |
| A. | Doubled | Doubled |
| B. | Halved | Halved |
| C. | Doubled | Halved |
| D. | Halved | Doubled |

6. What amount of NaCl (in moles) is required to prepare 250 cm3 of a 0.200 mol dm–3 solution?

A. 50.0

B. 1.25

C. 0.800

D. 0.0500

7. Assuming complete reaction, what volume of 0.200 mol dm–3 HCl(aq) is required to neutralize 25.0 cm3 of 0.200 mol dm–3 Ba(OH)2(aq)?

A. 12.5 cm3

B. 25.0 cm3

C. 50.0 cm3

D. 75.0 cm3

8. A fixed mass of an ideal gas has a volume of 800 cm3 under certain conditions. The pressure (in kPa) and temperature (in K) are both doubled. What is the volume of the gas after these changes with other conditions remaining the same?

A. 200 cm3

B. 800 cm3

C. 1600 cm3

D. 3200 cm3

9. Calcium carbonate decomposes on heating as shown below.

 CaCO3  CaO + CO2

 When 50 g of calcium carbonate are decomposed, 7 g of calcium oxide are formed. What is the percentage yield of calcium oxide?

A. 7

B. 25

C. 50

D. 75

10. What volume of 0.500 mol dm–3 sulfuric acid solution is required to react completely with 10.0 g of calcium carbonate according to the equation below?

 CaCO3(s) + H2SO4(aq)  CaSO4(aq) + H2O(l) + CO2(g)

A. 100 cm3

B. 200 cm3

C. 300 cm3

D. 400 cm3

11. A solution containing ammonia requires 25.0 cm3 of 0.100 mol dm–3 hydrochloric acid to reach the equivalence point of a titration.

(i) Write an equation for the reaction of ammonia with hydrochloric acid

(1)

(ii) Calculate the amount (in mol) of hydrochloric acid and ammonia that react.

(2)

(iii) Calculate the mass of ammonia in the solution.

(2)

(Total 5 marks)

12. An oxide of copper was reduced in a stream of hydrogen as shown below.



 After heating, the stream of hydrogen gas was maintained until the apparatus had cooled.

 The following results were obtained.

 Mass of empty dish = 13.80 g
Mass of dish and contents before heating = 21.75 g
Mass of dish and contents after heating and leaving to cool = 20.15 g

(a) Explain why the stream of hydrogen gas was maintained until the apparatus cooled.

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(1)

(b) Calculate the empirical formula of the oxide of copper using the data above, assuming complete reduction of the oxide.

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(c) Write an equation for the reaction that occurred.

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(1)

(d) State **two** changes that would be observed inside the tube as it was heated.

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(2)

(Total 7 marks)

13. Copper metal may be produced by the reaction of copper(I) oxide and copper(I) sulfide according to the below equation.

 2Cu2O + Cu2S  6Cu + SO2

A mixture of 10.0 kg of copper(I) oxide and 5.00 kg of copper(I) sulfide was heated until no further reaction occurred.

(a) Determine the limiting reagent in this reaction, showing your working.

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(3)

(b) Calculate the maximum mass of copper that could be obtained from these masses of reactants.

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(2)

(Total 5 marks)

14. 0.600 mol of aluminium hydroxide is mixed with 0.600 mol of sulfuric acid, and the following reaction occurs:

2Al(OH)3(s) + 3H2SO4(aq) → Al2(SO4)3(aq) + 6H2O(l)

(a) Determine the limiting reactant.

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(b) Calculate the mass of Al2(SO4)3 produced.

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(c) Determine the amount (in mol) of excess reactant that remains.

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(d) Define a *Brønsted-Lowry* acid and a *Lewis base*.

Brønsted-Lowry acid

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Lewis base

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(2)

(e) H2SO4(aq) is a strong acid. State the name and the formula of any weak acid.

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(1)

**IB Chemistry Summer Assignment Yr. 1 & Yr. 2:**

**TOPIC 2 ATOMIC THEORY – Due 6-15-19**

1. Consider the composition of the species W, X, Y and Z below. Which species is an anion?

|  |  |  |  |
| --- | --- | --- | --- |
| **Species** | **Number of protons** | **Number of neutrons** | **Number of electrons** |
| W | 9 | 10 | 10 |
| X | 11 | 12 | 11 |
| Y | 12 | 12 | 12 |
| Z | 13 | 14 | 10 |

A. W

B. X

C. Y

D. Z

2. Which is related to the number of electrons in the outer main energy level of the elements from the alkali metals to the halogens?

I. Group number

II. Period number

A. I only

B. II only

C. Both I and II

D. Neither I nor II

3.How do bond length and bond strength change as the number of bonds between two atoms increases?

|  |  |  |
| --- | --- | --- |
|  | **Bond length** | **Bond strength** |
| A. | Increases | increases |
| B. | Increases | decreases |
| C. | Decreases | increases |
| D. | Decreases | decreases |

4.Which of the following is true for CO2?

|  |  |  |
| --- | --- | --- |
|  | **C****O bond** | **CO2 molecule** |
| A. | Polar | non-polar |
| B. | non-polar | polar |
| C. | Polar | polar |
| D. | non-polar | non-polar |

5.The molar masses of C2H6, CH3OH and CH3F are very similar. How do their boiling points compare?

A. C2H6 < CH3OH < CH3F

B. CH3F < CH3OH < C2H6

C. CH3OH < CH3F < C2H6

D. C2H6 < CH3F < CH3OH

6.Which statement is correct for the emission spectrum of the hydrogen atom?

A. The lines converge at lower energies.

B. The lines are produced when electrons move from lower to higher energy levels.

C. The lines in the visible region involve electron transitions into the energy level closest to the nucleus.

D. The line corresponding to the greatest emission of energy is in the ultraviolet region.

7.Which is the correct description of polarity in F2 and HF molecules?

A. Both molecules contain a polar bond.

B. Neither molecule contains a polar bond.

C. Both molecules are polar.

D. Only one of the molecules is polar.

8.Which types of bonding are present in CH3CHO in the liquid state?

I. Single covalent bonding

II. Double covalent bonding

III. Hydrogen bonding

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

9.A certain sample of element *Z* contains 60% of 69*Z* and 40% of 71*Z*. What is the relative atomic mass of element *Z* in this sample?

A. 69.2

B. 69.8

C. 70.0

D. 70.2

10.How many electrons are there in one  ion?

A. 10

B. 12

C. 14

D. 22

11.The electron arrangement of sodium is 2.8.1. How many occupied main electron energy levels are there in an atom of sodium?

A. 1

B. 3

C. 10

D. 11

12.How many neutrons are there in the ion 18O2–?

A. 8

B. 10

C. 16

D. 20

13.What is the electron arrangement of silicon?

A. 2.4

B. 2.8

C. 2.8.4

D. 2.8.8

14.What is the difference between two neutral atoms represented by the symbols Po and At?

A. The number of neutrons only.

B. The number of protons and electrons only.

C. The number of protons and neutrons only.

D. The number of protons, neutrons and electrons

15.Which statements are correct for the emission spectrum of the hydrogen atom?

I. The lines converge at lower energies.

II. Electron transition to n =1 are responsible for lines in the UV region.

III. Lines are produced when electrons move from higher to lower energy levels.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

16.The percentage composition by mass of a hydrocarbon is C = 85.6% and H = 14.4%.

(a) Calculate the empirical formula of the hydrocarbon.

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(2)

(b) A 1.00 g sample of the hydrocarbon at a temperature of 273 K and a pressure of
1.01×105 Pa (1.00 atm) has a volume of 0.399 dm3.

(i) Calculate the molar mass of the hydrocarbon.

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(ii) Deduce the molecular formula of the hydrocarbon.

17.The element vanadium has two isotopes,  and  and a relative atomic mass of 50.94.

(a) Define the term *isotope*.

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(b) State the number of protons, electrons and neutrons in 

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(c) State and explain which is the more abundant isotope.

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(d) State the name and the mass number of the isotope relative to which **all** atomic masses are measured.

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**IB Chemistry Summer Assignment Yr. 1 & Yr. 2:**

**TOPIC 3 Periodicity – Due 7-2-19**

1.Which pair of elements reacts most readily?

A. Li + Br2

B. Li + Cl2

C. K + Br2

D. K + Cl2

2.Which of the following properties of the halogens increase from F to I?

I. Atomic radius

II. Melting point

III. Electronegativity

A. I only

B. I and II only

C. I and III only

D. I, II and III

3.Which of the physical properties below decrease with increasing atomic number for both the alkali metals and the halogens?

I. Atomic radius

II. Ionization energy

III. Melting point

A. I only

B. II only

C. III only

D. I and III only

4.Rubidium is an element in the same group of the periodic table as lithium and sodium.
It is likely to be a metal which has a

A. high melting point and reacts slowly with water.

B. high melting point and reacts vigorously with water.

C. low melting point and reacts vigorously with water.

D. low melting point and reacts slowly with water.

(Total 1 mark)

**5.** When the following species are arranged in order of **increasing** radius, what is the correct order?

A. Cl–, Ar, K+

B. K+, Ar , Cl–

C. Cl–, K+, Ar

D. Ar, Cl–, K+

(Total 1 mark)

**6.** What increases **in equal steps of one** from left to right in the periodic table for the elements lithium to neon?

A. the number of occupied electron energy levels

B. the number of neutrons in the most common isotope

C. the number of electrons in the atom

D. the atomic mass

(Total 1 mark)

7.Which property decreases down group 7 in the periodic table?

A. atomic radius

B. electronegativity

C. ionic radius

D. melting point

(Total 1 mark)

**8.** Which properties are typical of most non-metals in period 3 (Na to Ar)?

I. They form ions by gaining one or more electrons.

II. They are poor conductors of heat and electricity.

III. They have high melting points.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

(Total 1 mark)

**9.** A potassium atom has a larger atomic radius than a sodium atom. Which statement about potassium correctly explains this difference?

A. It has a larger nuclear charge.

B. It has a lower electronegativity.

C. It has more energy levels occupied by electrons.

D. It has a lower ionization energy.

10.Which factors lead to an element having a low value of first ionization energy?

I. large atomic radius

II. high number of occupied energy levels

III. high nuclear charge

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

11.Which statement is correct for a periodic trend?

A. Ionization energy increases from Li to Cs.

B. Melting point increases from Li to Cs.

C. Ionization energy increases from F to I.

D. Melting point increases from F to I.

(Total 1 mark)

**12.** Which compound of an element in period 3 reacts with water to form a solution with a pH greater than 7?

A. SiO2

B. SiCl4

C. NaCl

D. Na2O

(Total 1 mark)

**13.** Which equation represents the first ionization energy of fluorine?

A. F(g) + e–  F–(g)

B. F–(g)  F(g) + e–

C. F+(g)  F(g) + e–

D. F(g)  F+(g) + e–

14.Which of the following statements are correct?

I. The melting points decrease from Li  Cs for the alkali metals.

II. The melting points increase from F  I for the halogens.

III. The melting points decrease from Na  Ar for the period 3 elements.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

15.Which oxides produce an acidic solution when added to water?

I. SiO2

II. P4O6

III. SO2

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

16.(i) Explain how the first ionization energy of K compares with that of Na and Ar.

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(ii) Explain the difference between the first ionization energies of Na and Mg.

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(iii) Suggest why much more energy is needed to remove an electron from Na+ than from Mg+.

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17.Table 8 of the Data Booklet gives the atomic and ionic radii of elements. State and explain the difference between

(i) the atomic radius of nitrogen and oxygen.

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(ii) the atomic radius of nitrogen and phosphorus.

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(1)

(iii) the atomic and ionic radius of nitrogen.

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18.Explain the following statements.

(a) The first ionization energy of sodium is

(i) less than that of magnesium.

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(ii) greater than that of potassium.

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(b) The electronegativity of chlorine is higher than that of sulfur.

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**IB Chemistry Summer Assignment Yr. 1 & Yr. 2:**

**TOPIC 4 Bonding – Due 7-2-19**

1.What is the formula for the compound formed by calcium and nitrogen?

A. CaN

B. Ca2N

C. Ca2N3

D. Ca3N2

2.Based on electronegativity values, which bond is the most polar?

A. B―C

B. C―O

C. N―O

D. O―F

3.What is the Lewis (electron dot) structure for sulfur dioxide?

A. 

B. 

C. 

D. 

4.Which substance is most soluble in water (in mol dm–3) at 298 K?

A. CH3CH3

B. CH3OCH3

C. CH3CH2OH

D. CH3CH2CH2CH2OH

5.Which molecule is linear?

A. SO2

B. CO2

C. H2S

D. Cl2O

6.Why is the boiling point of PH3 lower than that of NH3?

A. PH3 is non-polar whereas NH3 is polar.

B. PH3 is not hydrogen bonded whereas NH3 is hydrogen bonded.

C. Van der Waals’ forces are weaker in PH3 than in NH3.

D. The molar mass of PH3 is greater than that of NH3.

(Total 1 mark)

**7.** Which molecule is non-polar?

A. H2CO

B. SO3

C. NF3

D. CHCl3

8.Which substance has the lowest electrical conductivity?

A. Cu(s)

B. Hg(l)

C. H2(g)

D. LiOH(aq)

(Total 1 mark)

**9.** When the following bond types are listed in decreasing order of strength (strongest first), what is the correct order?

A. covalent  hydrogen  van der Waals’

B. covalent  van der Waals’  hydrogen

C. hydrogen  covalent  van der Waals’

D. van der Waals’  hydrogen  covalent

10.Which fluoride is the most ionic?

A. NaF

B. CsF

C. MgF2

D. BaF2

(Total 1 mark)

**11.** Which substance is most similar in shape to NH3?

A. GaI3

B. BF3

C. FeCl3

D. PBr3

12.Which molecule has the smallest bond angle?

A. CO2

B. NH3

C. CH4

D. C2H4

(Total 1 mark)

**13.** In which substance is hydrogen bonding present?

A. CH4

B. CH2F2

C. CH3CHO

D. CH3OH

(Total 1 mark)

**14.** Which is a correct description of metallic bonding?

A. Positively charged metal ions are attracted to negatively charged ions.

B. Negatively charged metal ions are attracted to positively charged metal ions.

C. Positively charged metal ions are attracted to delocalized electrons.

D. Negatively charged metal ions are attracted to delocalized electrons.

(Total 1 mark)

**15.** What intermolecular forces are present in gaseous hydrogen?

A. Hydrogen bonds

B. Covalent bonds

C. Dipole-dipole attractions

D. Van der Waals’ forces

16. What are responsible for the high electrical conductivity of metals?

A. Delocalized positive ions

B. Delocalized valence electrons

C. Delocalized atoms

D. Delocalized negative ions

17.When C2H4, C2H2 and C2H6 are arranged in order of **increasing** C–C bond length, what is the correct order?

A. C2H6, C2H2, C2H4

B. C2H4, C2H2, C2H6

C. C2H2, C2H4, C2H6

D. C2H4, C2H6, C2H2

18. Which species has a trigonal planar shape?

A. CO32–

B. SO32–

C. NF3

D. PCl3

19.What is the formula for an ionic compound formed between an element, X, from group 2 and an element, Y, from group 6?

A. XY

B. X2Y

C. XY2

D. X2Y6

(Total 1 mark)

**20.** In the molecules N2H4, N2H2, and N2, the nitrogen atoms are linked by single, double and triple bonds, respectively. When these molecules are arranged in increasing order of the lengths of their nitrogen to nitrogen bonds (shortest bond first) which order is correct?

A. N2H4, N2, N2H2

B. N2H4, N2H2, N2

C. N2H2, N2, N2H4

D. N2, N2H2, N2H4

21.What is the shape of the CO32– ion and the approximate O–C–O bond angle?

A. Linear, 180

B. Trigonal planar, 90

C. Trigonal planar, 120

D. Pyramidal, 109

(Total 1 mark)

**22.** Which combination of *H*vaporization and boiling point is the result of strong intermolecular forces?

|  |  |  |
| --- | --- | --- |
|  | *H*vaporization | Boiling Point |
| A. | large | high |
| B. | large | low |
| C. | small | low |
| D. | small | high |

23. How many electrons are used in the carbon-carbon bond in C2H2?

A. 4

B. 6

C. 10

D. 12

(Total 1 mark)

**24.** Which compound has the highest boiling point?

A. CH3CH2CH3

B. CH3CH2OH

C. CH3OCH3

D. CH3CHO

25. (i) Draw Lewis (electron dot) structures for CO2 and H2S showing all valence electrons.

(2)

(ii) State the shape of each molecule and explain your answer in terms of VSEPR theory.

CO2 .............................................................................................................................

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H2S .............................................................................................................................

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(4)

(iii) State and explain whether each molecule is polar or non-polar.

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(2)

(Total 8 marks)

**26.** Identify the strongest type of intermolecular force in each of the following compounds.

CH3Cl ...................................................................................................................................

CH4 .......................................................................................................................................

CH3OH .................................................................................................................................

(Total 3 marks)

**27.** (a) An important compound of nitrogen is ammonia, NH3. The chemistry of ammonia is influenced by its polarity and its ability to form hydrogen bonds. Polarity can be explained in terms of electronegativity.

(i) Explain the term *electronegativity*.

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(2)

(ii) Draw a diagram to show hydrogen bonding between two molecules of NH3.
The diagram should include any dipoles and/or lone pairs of electrons

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(3)

(iii) State the H–N–H bond angle in an ammonia molecule.

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(1)

(iv) Explain why the ammonia molecule is polar.

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(1)

(b) Ammonia reacts with hydrogen ions forming ammonium ions, NH4+.

(i) State the H–N–H bond angle in an ammonium ion.

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(1)

(ii) Explain why the H–N–H bond angle of NH3 is different from the H–N–H bond angle of NH4+; referring to both species in your answer.

**IB Chemistry Summer Assignment Yr. 1 & Yr. 2:**

**TOPIC 5 Energetics – Due 7-16-19**

1.What energy changes occur when chemical bonds are formed and broken?

A. Energy is absorbed when bonds are formed and when they are broken.

B. Energy is released when bonds are formed and when they are broken.

C. Energy is absorbed when bonds are formed and released when they are broken.

D. Energy is released when bonds are formed and absorbed when they are broken.

**2.** The temperature of a 2.0 g sample of aluminium increases from 25°C to 30°C.
How many joules of heat energy were added? (Specific heat of Al = 0.90 J g–1K–1)

A. 0.36

B. 2.3

C. 9.0

D. 11

**3.** Using the equations below:

 C(s) + O2(g) → CO2(g) *∆H* = –390 kJ
Mn(s) + O2(g) → MnO2(s) *∆H* = –520 kJ

 what is ∆*H* (in kJ) for the following reaction?

MnO2(s) + C(s)  Mn(s) + CO2(g)

A. 910

B. 130

C. –130

D. –910

**4.** Which statements about exothermic reactions are correct?

I. They have negative *H* values.

II. The products have a lower enthalpy than the reactants.

III. The products are more energetically stable than the reactants.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

5.Using the equations below

Cu(s) + O2(g) → CuO(s)∆*H*~~ο~~= –156 kJ

2Cu(s) + O2(g) → Cu2O(s)∆*H*~~ο~~= –170 kJ

 what is the value of ∆*H*~~ο~~ (in kJ) for the following reaction?

2CuO(s) → Cu2O(s) + O2(g)

A. 142 B. 15

C. –15 D. –142

**6.** Which of the quantities in the enthalpy level diagram below is (are) affected by the use of a catalyst?


Time

A. I only

B. III only

C. I and II only

D. II and III only

7.Which statements are correct for an endothermic reaction?

I. The system absorbs heat.

II. The enthalpy change is positive.

III. The bond enthalpy total for the reactants is greater than for the products.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

**8.** The mass *m* (in g) of a substance of specific heat capacity *c* (in J g–1 K–1 ) increases by *t°*C. What is the heat change in J?

A. *mct*

B. *mc*(*t* + 273)

C. 

D. 

9.The following equation shows the formation of magnesium oxide from magnesium metal.

 2Mg(s) + O2(g)2MgO(s) *HӨ* = –1204kJ

 Which statement is correct for this reaction?

A. 1204 kJ of energy are released for every mol of magnesium reacted.

B. 602 kJ of energy are absorbed for every mol of magnesium oxide formed.

C. 602 kJ of energy are released for every mol of oxygen gas reacted.

D. 1204 kJ of energy are released for every two mol of magnesium oxide formed.

10.For the reaction

 2H2(g) + O2(g)  2H2O(g)

the bond enthalpies (in kJ mol–1) are

|  |  |
| --- | --- |
| H–H | *x* |
| O=O | *y* |
| O–H | *z* |

 Which calculation will give the value, in kJ mol–1, of *H*Ө for the reaction?

A. 2*x* + *y* –2*z*

B. 4*z* – 2*x* – *y*

C. 2*x* + *y* – 4*z*

D. 2*z* –2*x* – *y*

**11.** Which statement about bond enthalpies is correct?

A. Bond enthalpies have positive values for strong bonds and negative values for weak bonds.

B. Bond enthalpy values are greater for ionic bonds than for covalent bonds.

C. Bond breaking is endothermic and bond making is exothermic.

D. The carbon–carbon bond enthalpy values are the same in ethane and ethene.

12.Consider the specific heat capacity of the following metals.

|  |  |
| --- | --- |
| Metal | Specific heat capacity / J kg–1 K–1 |
| Cu | 385 |
| Ag | 234 |
| Au | 130 |
| Pt | 134 |

13.Which metal will show the greatest temperature increase if 50 J of heat is supplied to a 0.001 kg sample of each metal at the same initial temperature?

A. Cu

B. Ag

C. Au

D. Pt

14.According to the enthalpy level diagram below, what is the sign for *H* and what term is used to refer to the reaction?



|  |  |  |
| --- | --- | --- |
|  | *H* | reaction |
| A. | positive | endothermic |
| B. | negative | exothermic |
| C. | positive | exothermic |
| D. | negative | endothermic |

15.How much energy, in joules, is required to increase the temperature of 2.0 g of aluminium from 25 to 30°C? (Specific heat of Al = 0.90 J g–1 K–1).

A. 0.36

B. 4.5

C. 9.0

D. 54



16. The diagram shows the distribution of energy for the molecules in a sample of gas at a given temperature, T1.

(a) In the diagram *E*a represents the *activation energy* for a reaction. Define this term.

……………………………………………………………………………………….

……………………………………………………………………………………….

(1)

(b) On the diagram above draw another curve to show the energy distribution for the same gas at a higher temperature. Label the curve T2.

(2)

(c) With reference to your diagram, state and explain what happens to the rate of a reaction when the temperature is increased.

……………………………………………………………………………………….

……………………………………………………………………………………….

(a) Define the term *average bond enthalpy*, illustrating your answer with an equation for methane, CH4.

.....................................................................................................................................

 (3)

(b) The equation for the reaction between methane and chlorine is

CH4(g) + Cl2(g) → CH3Cl(g) + HCl(g)

 Use the values from Table 10 of the Data Booklet to calculate the enthalpy change for this reaction.

**IB Chemistry Summer Assignment Yr. 1 & Yr. 2:**

**TOPIC 6 Kinetics – Due 7-16-19**

**1.** Which of the following is (are) important in determining whether a reaction occurs?

I. Energy of the molecules

II. Orientation of the molecules

A. I only

B. II only

C. Both I and II

D. Neither I nor II

**2.** Consider the reaction between solid CaCO3 and aqueous HCl. The reaction will be speeded up by an increase in which of the following conditions?

I. Concentration of the HCl

II. Size of the CaCO3 particles

III. Temperature

A. I only

B. I and III only

C. II and III only

D. I, II and III

**3.** The rate of a reaction between two gases increases when the temperature is increased and a catalyst is added. Which statements are both correct for the effect of these changes on the reaction?

|  |  |  |
| --- | --- | --- |
|  | **Increasing the temperature**  | **Adding a catalyst**  |
| A. | Collision frequency increases  | Activation energy increases  |
| B. | Activation energy increases  | Activation energy does not change  |
| C. | Activation energy does not change  | Activation energy decreases  |
| D. | Activation energy increases  | Collision frequency increases  |

**4.** Which of the following is (are) altered when a liquid at its boiling point is converted to a gas at the same temperature?

I. The size of the molecules

II. The distance between the molecules

III. The average kinetic energy of the molecules

A. I only

B. II only

C. III only

D. I and II only

**5.** Based on the definition for rate of reaction, which units are used for a rate?

A. mol dm–3

B. mol time–1

C. dm time–1

D. mol dm–3 time–1

**6.** Which of the quantities in the enthalpy level diagram below is (are) affected by the use of a catalyst?


Time

A. I only

B. III only

C. I and II only

D. II and III only

7. The table shows the concentrations of reactants and products during this reaction.

 2A + B  C + 2D

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | [A] / mol dm–3 | [B] / mol dm–3 | [C] / mol dm–3 | [D] / mol dm–3 |
| at the start | 6 | 3 | 0 | 0 |
| after 1 min | 4 | 2 | 1 | 2 |

 The rate of reaction can be measured by reference to any reactant or product. Which rates are correct for this reaction?

I. rate = –2 mol dm–3 min–1 for A

II. rate = –1 mol dm–3 min–1 for B

III. rate = –1 mol dm–3 min–1 for C

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

**12.** In general, the rate of a reaction can be increased by all of the following **except**

A. increasing the temperature.

B. increasing the activation energy.

C. increasing the concentration of reactants.

D. increasing the surface area of the reactants.

At 25C, 100 cm3 of 1.0 mol dm–3 hydrochloric acid is added to 3.5 g of magnesium carbonate. If the sample of magnesium carbonate is kept constant, which conditions will **not** increase the initial rate of reaction?

|  |  |  |  |
| --- | --- | --- | --- |
|  | Volume of HCl / cm3 | Concentration of HCl / mol dm–3 | Temperature / C |
| A. | 200 | 1.0 | 25 |
| B. | 100 | 2.0 | 25 |
| C. | 100 | 1.0 | 35 |
| D. | 200 | 2.0 | 25 |

Carbon dioxide gas in the atmosphere reacts slightly with rainwater as shown below.

CO2(g) + H2O(l)  H+(aq) + HCO3–(aq)

(i) State the meaning of the  sign.

 ……………………………………………………………………………………………

(1)

(ii) Predict the effect, if any, of the presence of a catalyst on the acidity of rainwater. Give a reason for your answer.

 ……………………………………………………………………………………………

 ……………………………………………………………………………………………

 ……………………………………………………………………………………………

(2)

(iii) Use Le Chatelier’s principle to predict the effect of the addition of a small quantity of an alkali on the acidity of rainwater. Explain what effect, if any, this would have on the equilibrium constant, *K*c.

 …………………………………………………………………………………………

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 …………………………………………………………………………………………

 …………………………………………………………………………………………

 …………………………………………………………………………………………

 …………………………………………………………………………………………

The reaction between two substances A and B

 A + B  C + D

has the following rate expression:

 rate = *k* [B]

Draw the graphical representation of:



**IB Chemistry Summer Assignment Yr. 1 & Yr. 2:**

**TOPIC 7 Equilibrium – Due 7-29-19**

**1.** I2(g) + 3Cl2(g)  2ICl3(g)

 What is the equilibrium constant expression for the reaction above?

A. *K*c = 

B. *K*c = 

C. *K*c = 

D. *K*c = 

**2.** 2SO2(g) + O2 (g)  2SO3(g) ∆H~~ο~~ = –200 kJ

 According to the above information, what temperature and pressure conditions produce the greatest amount of SO3?

|  |  |  |
| --- | --- | --- |
|  | **Temperature** | **Pressure** |
| A. | low | low |
| B. | low | high |
| C. | high | high |
| D. | high | low |

**3.** Which statement(s) is/are true for a mixture of ice and water at equilibrium?

I. The rates of melting and freezing are equal.

II. The amounts of ice and water are equal.

III. The same position of equilibrium can be reached by cooling water and heating ice.

A. I only

B. I and III only

C. II only

D. III only

**4.** What will happen to the position of equilibrium and the value of the equilibrium constant when the temperature is increased in the following reaction?

Br2(g) + Cl2(g)  2BrCl(g) ∆*H* = +14 kJ

|  |  |  |
| --- | --- | --- |
|  | **Position of equilibrium**  | **Value of equilibrium constant**  |
| A. | Shifts towards the reactants  | Decreases  |
| B. | Shifts towards the reactants  | Increases  |
| C. | Shifts towards the products  | Decreases  |
| D. | Shifts towards the products  | Increases  |

**5.** Which statement concerning a chemical reaction at equilibrium is **not** correct?

A. The concentrations of reactants and products remain constant.

B. Equilibrium can be approached from both directions.

C. The rate of the forward reaction equals the rate of the reverse reaction.

D. All reaction stops.

**6.** What will happen if CO2(g) is allowed to escape from the following reaction mixture at equilibrium?

CO2(g) + H2O(l)  H+(aq) + HCO3–(aq)

A. The pH will decrease.

B. The pH will increase.

C. The pH will remain constant.

D. The pH will become zero.

**7.** Which statements are correct for a reaction at equilibrium?

I. The forward and reverse reactions both continue.

II. The rates of the forward and reverse reactions are equal.

III. The concentrations of reactants and products are equal.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

**8.** The manufacture of sulfur trioxide can be represented by the equation below.

2SO2(g) + O2(g)  2SO3(g) ∆*H*~~ο~~ = –197 kJ mol–1

 What happens when a catalyst is added to an equilibrium mixture from this reaction?

A. The rate of the forward reaction increases and that of the reverse reaction decreases.

B. The rates of both forward and reverse reactions increase.

C. The value of ∆*H*~~ο~~ increases.

D. The yield of sulfur trioxide increases.

**9.** The equation for a reaction used in the manufacture of nitric acid is

 4NH3(g) + 5O2(g)  4NO(g) + 6H2O(g) *H*Ө = –900 kJ

Which changes occur when the temperature of the reaction is increased?

|  |  |
| --- | --- |
| Position of equilibrium | Value of *K*c |
| A. | shifts to the left | increases |
| B. | shifts to the left | decreases |
| C. | shifts to the right | increases |
| D. | shifts to the right | decreases |

**10.** Which changes cause an increase in the equilibrium yield of SO3(g) in this reaction?

 2SO2(g) + O2(g)  2SO3(g) *H*Ө = –196 kJ

I. increasing the pressure

II. decreasing the temperature

III. adding oxygen

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

**11.** Iron(III) ions react with thiocyanate ions as follows.

 Fe3+(aq) + CNS–(aq)  Fe(CNS)2+(aq)

What are the units of the equilibrium constant, *K*c, for the reaction?

A. mol dm–3

B. mol2 dm–6

C. mol–1 dm3

D. mol–2 dm6

**12.** Which of the following equilibria would **not** be affected by pressure changes at constant temperature?

A. 4HCl(g) + O2(g)  2H2O(g) + 2Cl2(g)

B. CO(g) + H2O(g)  H2(g) + CO2(g)

C. C2H4(g) + H2O(g)  C2H5OH(g)

D. PF3Cl2(g)  PF3(g) + Cl2(g)

**13.** The table below gives information about the percentage yield of ammonia obtained in the Haber process under different conditions.

|  |  |  |  |
| --- | --- | --- | --- |
| **Pressure/** |  | **Temperature/**°**C** |  |
| **atmosphere** |  |  |  |
|  | **200** | **300** | **400** | **500** |
|  **10** | 50.7 | 14.7 |  3.9 |  1.2 |
| **100** | 81.7 | 52.5 | 25.2 | 10.6 |
| **200** | 89.1 | 66.7 | 38.8 | 18.3 |
| **300** | 89.9 | 71.1 | 47.1 | 24.4 |
| **400** | 94.6 | 79.7 | 55.4 | 31.9 |
| **600** | 95.4 | 84.2 | 65.2 | 42.3 |

(a) From the table, identify which combination of temperature and pressure gives the highest yield of ammonia.

……………………………………………………………………………………….

(1)

(b) The equation for the main reaction in the Haber process is

N2(g) + 3H2(g)  2NH3(g) ∆*H* is negative

 Use this information to state and explain the effect on the yield of ammonia of increasing

(i) pressure: …………………………….………………………………………..

……………………………………………………………..………………….

………………………………………………………………………………..

(2)

(ii) temperature: ………………………………………………………………….

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(2)

(c) In practice, typical conditions used in the Haber process are a temperature of 500 °C and a pressure of 200 atmospheres. Explain why these conditions are used rather than those that give the highest yield.

……………………………………………………………………………………….

……………………………………………………………………………………….

(2)

(d) Write the equilibrium constant expression, *K*c, for the production of ammonia.

……………………………………………………………………………………….

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**14.** (a) The following equilibrium is established at 1700°C.

CO2(g) + H2(g)  H2O(g) CO(g)

 If only carbon dioxide gas and hydrogen gas are present initially, sketch on a graph a line representing rate against time for (i) the forward reaction **and** (ii) the reverse reaction until shortly after equilibrium is established. Explain the shape of each line.

(7)

(b) *K*c for the equilibrium reaction is determined at two different temperatures. At 850°C,
*K*c = 1.1 whereas at 1700°C, *K*c= 4.9.

 On the basis of these *K*c values explain whether the reaction is exothermic or endothermic.

**15.** The equation for the main reaction in the Haber process is:

 N2(g) + 3H2(g)  2NH3(g) ∆*H* is negative

(i) Determine the equilibrium constant expression for this reaction.

(1)

(ii) State and explain the effect on the equilibrium yield of ammonia with increasing the pressure and the temperature.

(4)

(iii) In practice, typical conditions used in the Haber process involve a temperature of 500°C and a pressure of 200 atm. Explain why these conditions are used rather than those that give the highest yield.

(2)

(iv) At a certain temperature and pressure, 1.1 dm3 of N2(g) reacts with 3.3 dm3 of H2(g). Calculate the volume of NH3(g), that will be produced.

**IB Chemistry Summer Assignment Yr. 1 & Yr. 2:**

**TOPIC 8 Acids/Bases – Due 7-29-19**

**1.** An aqueous solution of which of the following reacts with magnesium metal?

A. Ammonia

B. Hydrogen chloride

C. Potassium hydroxide

D. Sodium hydrogencarbonate

**2.** Which of the following is/are formed when a metal oxide reacts with a dilute acid?

I. A metal salt

II. Water

III. Hydrogen gas

A. I only B. I and II only

C. II and III only D. I, II and III

**3.** Four aqueous solutions, I, II, III and IV, are listed below.

I. 0.100 mol dm–3 HCl

II. 0.010 mol dm–3 HCl

III. 0.100 mol dm–3 NaOH

IV. 0.010 mol dm–3 NaOH

 What is the correct order of **increasing** pH of these solutions?

A. I, II, III, IV

B. I, II, IV, III

C. II, I, III, IV

D. II, I, IV, III

**4.** When the following 1.0 mol dm–3 solutions are listed in increasing order of pH (lowest first), what is the correct order?

A. HNO3  H2 CO3  NH3  Ba(OH)2

B. NH3  Ba (OH)2  H2 CO3  HNO3

C. Ba (OH)2  H2 CO3  NH3  HNO3

D. HNO3  H2 CO3  Ba (OH)2  NH3

**5.** Which species are a conjugate pair according to the Brønsted-Lowry theory?

A. CH3COOH and CH3CHO

B. NH3 and BF3

C. H2NO3+ and NO3–

D. H2SO4 and HSO4–

**6.** Solutions of hydrochloric acid (HCl(aq)) and ethanoic acid (CH3COOH(aq)) of the same concentration reacted completely with 5.0 g of calcium carbonate in separate containers. Which statement is correct?

A. CH3COOH(aq) reacted slower because it has a lower pH than HCl(aq).

B. A smaller volume of CO2(g) was produced with CH3COOH(aq) than with HCl(aq).

C. A greater volume of CO2(g) was produced with CH3COOH(aq) than with HCl(aq).

D. The same volume of CO2(g) was produced with both CH3COOH(aq) and HCl(aq).

**7.** Which species can act as a Lewis acid?

A. BF3

B. OH–

C. H2O

D. NH3

**8.** (a) (i) A solution of hydrochloric acid has a concentration of 0.10 mol dm–3 and a pH value of 1. The solution is diluted by a factor of 100. Determine the concentration of the acid **and** the pH value in the diluted solution.

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(2)

(ii) Explain why 0.10 mol dm–3 ethanoic acid solution and the diluted solution in (a) (i) have similar [H+] values.

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(3)

(b) Suggest **one** method, other than measuring pH, which could be used to distinguish between solutions of a strong acid and a weak acid of the same concentration. State the expected results.

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**9.** (i) Calcium carbonate is added to separate solutions of hydrochloric acid and ethanoic acid of the same concentration. State **one** similarity and **one** difference in the observations you could make.

…………………………………………………………………………………………..

…………………………………………………………………………………………..

…………………………………………………………………………………………..

(2)

(ii) Write an equation for the reaction between hydrochloric acid and calcium carbonate.

…………………………………………………………………………………………..

…………………………………………………………………………………………..

(2)

(iii) Determine the volume of 1.50 mol dm–3 hydrochloric acid that would react with exactly 1.25 g of calcium carbonate.

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…………………………………………………………………………………………..

…………………………………………………………………………………………..

(3)

(iv) Calculate the volume of carbon dioxide, measured at 273 K and
1.01×105 Pa, which would be produced when 1.25 g of calcium carbonate reacts completely with the hydrochloric acid.

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…………………………………………………………………………………………..

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**IB Chemistry Summer Assignment Yr. 1 & Yr. 2:**

**TOPIC 9 Oxidation/Reduction – Due 8-6-19**

**1.** What occurs during the operation of a voltaic cell based on the following reaction?

Ni(s) + Pb2+(aq) → Ni2+(aq) + Pb(s)

|  |  |  |
| --- | --- | --- |
|  | **External circuit** | **Ion movement in solution** |
| A. | electrons move from Ni to Pb | Pb2+(aq) move away from Pb(s) |
| B. | electrons move from Ni to Pb | Pb2+(aq) move toward Pb(s) |
| C. | electrons move from Pb to Ni | Ni2+(aq) move away from Ni(s) |
| D. | electrons move from Pb to Ni | Ni2+(aq) move toward Ni(s) |

(Total 1 mark)

**2.** The oxidation number of chromium is the same in all the following compounds **except**

A. Cr(OH)3

B. Cr2O3

C. Cr2(SO4)3

D. CrO3

(Total 1 mark)

**3.** Magnesium is a more reactive metal than copper. Which is the strongest oxidizing agent?

A. Mg

B. Mg2+

C. Cu

D. Cu2+

**4.** What happens to the Cr3+(aq) ion when it is converted to CrO42–(aq)?

A. Its oxidation number decreases and it undergoes reduction.

B. Its oxidation number decreases and it undergoes oxidation.

C. Its oxidation number increases and it undergoes reduction.

D. Its oxidation number increases and it undergoes oxidation.

(Total 1 mark)

**5.** The following reactions are spontaneous as written.

Fe(s) + Cd2+(aq) → Fe2+(aq) + Cd(s)

Cd(s) + Sn2+(aq) → Cd2+(aq) + Sn(s)

Sn(s) + Pb2+(aq) → Sn2+(aq) + Pb(s)

 Which of the following pairs will react spontaneously?

I. Sn(s) + Fe2+(aq)

II. Cd(s) + Pb2+(aq)

III. Fe(s) + Pb2+(aq)

A. I only

B. II only

C. III only

D. II and III only

**6.** What species are produced at the positive and negative electrodes during the electrolysis of molten sodium chloride?

|  |  |  |
| --- | --- | --- |
|  | **Positive electrode** | **Negative electrode** |
| A. | Na+(l) | Cl2(g) |
| B. | Cl–(l) | Na+(l) |
| C. | Na(l) | Cl2(g) |
| D. | Cl2(g) | Na(l) |

(Total 1 mark)

**7.** Consider the following reaction.

H2SO3(aq) + Sn4+(aq) + H2O(l) → Sn2+(aq) + HSO4–(aq) + 3H+(aq)

 Which statement is correct?

A. H2SO3 is the reducing agent because it undergoes reduction.

B. H2SO3 is the reducing agent because it undergoes oxidation.

C. Sn4+ is the oxidizing agent because it undergoes oxidation.

D. Sn4+ is the reducing agent because it undergoes oxidation.

(Total 1 mark)

**8.** In which change does oxidation occur?

A. CH3CHO → CH3CH2OH

B. CrO42–→ Cr2O72–

C. SO42–→ SO32–

D. NO2– → NO3–

**9.** A voltaic cell is made from copper and zinc half-cells. The equation for the reaction occurring in the cell is

Zn(s) + Cu2+(aq) → Zn2+(aq) + Cu(s)

 Which statement is correct when the cell produces electricity?

A. Electrons are lost from zinc atoms.

B. The mass of the copper electrode decreases.

C. Electrons flow from the copper half-cell to the zinc half-cell.

D. Negative ions flow through the salt bridge from the zinc half-cell to the copper half-cell.

**10.** What are the oxidation numbers of the elements in the compound phosphoric acid, H3PO4?

|  |  |  |  |
| --- | --- | --- | --- |
|  | Hydrogen | Phosphorus | Oxygen |
| A. | +1 | +1 | –2 |
| B. | +1 | +5 | –2 |
| C. | +3 | +1 | –4 |
| D. | +3 | +5 | –8 |

**11.** Which are examples of reduction?

I. Fe3+ becomes Fe2+

II. Cl– becomes Cl2

III. CrO3 becomes Cr3+

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

**12.** Consider the following spontaneous reactions.

 Fe(s) + Cu2+(aq)  Fe2+(aq) + Cu(s)

 Cu(s) + 2Ag+(aq)  Cu2+(aq) + 2Ag(s)

 Zn(s) + Fe2+(aq)  Zn2+(aq) + Fe(s)

Which is the correct combination of strongest oxidizing agent and strongest reducing agent?

|  |  |  |
| --- | --- | --- |
|  | Strongest oxidizing agent | Strongest reducing agent |
| A. | Ag(s) | Zn(s) |
| B. | Ag+(aq) | Zn(s) |
| C. | Zn2+(aq) | Ag(s) |
| D. | Zn(s) | Ag+(aq) |

**13.** Iron in food, in the form of Fe3+, reacts with ascorbic acid (vitamin C), C6H8O6, to form dehydroascorbic acid, C6H6O6.

(i) Write an ionic half-equation to show the conversion of ascorbic acid to dehydroascorbic acid in aqueous solution.

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(1)

(ii) In the other ionic half-equation Fe3+ is converted to Fe2+. Deduce the overall equation for the reaction between C6H8O6 and Fe3+.

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(1)

(Total 2 marks)

**14.** (i) Draw a diagram of apparatus that could be used to electrolyse molten potassium bromide. Label the diagram to show the polarity of each electrode and the product formed.

(3)

(ii) Describe the **two** different ways in which electricity is conducted in the apparatus.

(2)

(iii) Write an equation to show the formation of the product at each electrode.

(2)

**IB Chemistry Summer Assignment Yr. 1 & Yr. 2:**

**TOPIC 10 Organic Reactions – Due 8-6-19**

**1.** Which of the structures below is an aldehyde?

A. 

B. 

C. 

D. 

(Total 1 mark)

**2.** What is the final product formed when CH3CH2OH is refluxed with acidified potassium dichromate(VI)?

A. CH3CHO

B. CH2==CH2

C. CH3COOH

D. HCOOCH3

(Total 1 mark)

**3.** Which formulas represent butane or its isomer?

I. CH3(CH2)2CH3

II. CH3CH(CH3)CH3

III. (CH3)3CH

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

(Total 1 mark)

 **4.** What is the IUPAC name for CH3CH2CH(CH3)2?

A. 1,1-dimethylpropane

B. 2-methylbutane

C. isopentane

D. ethyldimethylmethane

(Total 1 mark)

**5.** Which compound has the lowest boiling point?

A. CH3CH2CH(CH3)CH3

B. (CH3)4C

C. CH3CH2CH2CH2CH3

D. CH3CH2OCH2CH3

(Total 1 mark)

**6.** What type of reaction does the equation below represent?

CH2=CH2 + Br2 → BrCH2CH2Br

A. substitution

B. condensation

C. reduction

D. addition

(Total 1 mark)

**7.** How many structural isomers are possible with the molecular formula C6 H14?

A. 4

B. 5

C. 6

D. 7

(Total 1 mark)

**8.** Which compound is a member of the aldehyde homologous series?

A. CH3COCH3

B. CH3CH2CH2OH

C. CH3CH2COOH

D. CH3CH2CHO

(Total 1 mark)

**9.** Which substance is **not** readily oxidized by acidified potassium dichromate(VI) solution?

A. propan-1-ol

B. propan-2-ol

C. propanal

D. propanone

(Total 1 mark)

**10.** Propane, C3H8, undergoes incomplete combustion in a limited amount of air. Which products are most likely to be formed during this reaction?

A. Carbon monoxide and water

B. Carbon monoxide and hydrogen

C. Carbon dioxide and hydrogen

D. Carbon dioxide and water

(Total 1 mark)

**11.** What is/are the product(s) of the reaction between ethene and hydrogen bromide?

A. CH3CH2Br

B. CH3CH2Br and H2

C. CH2BrCH2Br

D. CH3BrCH2 Br and H2

(Total 1 mark)

**12.** Which are characteristics typical of a free radical?

I. It has a lone pair of electrons.

II. It can be formed by the homolytic fission of a covalent bond.

III. It is uncharged.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

(Total 1 mark)

**13.** Which species is a free radical?

A. •CH3

B. +CH3

C. –CH3

D. :CH3

(Total 1 mark)

**14.** Which compound is a tertiary halogenoalkane?

A. (CH3CH2)2CHBr

B. CH3(CH2)3CH2Br

C. (CH3)2CHCH2CH2Br

D. CH3CH2C(CH3)2Br

(Total 1 mark)

**15.** The following is a three-dimensional representation of an organic molecule.



Which statement is correct?

A. The correct IUPAC name of the molecule is 2-methylpentane.

B. All the bond angles will be approximately 90°.

C. One isomer of this molecule is pentane.

D. The boiling point of this compound would be higher than that of pentane.

(Total 1 mark)

**16.** Which compound forms when hydrogen bromide is added to but-2-ene?

A. 2-bromobutane

B. 2,3-dibromobutane

C. 1-bromobutane

D. 1,2-dibromobutane

(Total 1 mark)

**17.** Two reactions of an alkene, **B**, are shown below.



(i) State the name of **A** and write an equation for its complete combustion. Explain why the incomplete combustion of **A** is dangerous.

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(5)

(ii) Outline a test to distinguish between **A** and **B**, stating the result in each case.

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(3)

(iii) Write an equation for the conversion of **B** to **C**.State the type of reaction taking place and draw the structure of **C**.

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(3)

(Total 11 marks)

**18.** Some alcohols are oxidized by heating with acidified potassium dichromate(VI). If oxidation does occur, identify the possible oxidation products formed by each of the alcohols below. Indicate if no oxidation occurs.

Butan-1-ol

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Butan-2-ol

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2-methylpropan-2-ol

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(Total 4 marks)

**19.** CH3COCH3 is the first member of the ketone homologous series. Draw the full structural formula of the next member of this homologous series and predict how its melting point compares with that of CH3COCH3.

(Total 2 marks)

**20.** Ethene, propene and but-2-ene are members of the alkene homologous series.

(a) Describe **three** features of members of a homologous series.

(3)

(b) State and explain which compound has the highest boiling point.

(3)

(c) Draw the structural formula and give the name of an alkene containing five carbon atoms.

(2)

(d) Write an equation for the reaction between but-2-ene and hydrogen bromide, showing the structure of the organic product. State the type of reaction occurring.

(3)

(e) Propene can be converted to propanoic acid in three steps:

 step1 step 2 step 3

propene  propan-1-ol  propanal  propanoic acid

 State the type of reaction occurring in steps 2 and 3 and the reagents needed. Describe how the conditions of the reaction can be altered to obtain the maximum amount of propanal, and in a separate experiment, to obtain the maximum amount of propanoic acid.

(5)

(f) Identify the strongest type of intermolecular force present in each of the compounds propan-1-ol, propanal and propanoic acid. List these compounds in decreasing order of boiling point.

(4)

(Total 20 marks)