

IB Diploma Chemistry

STANDARD Level**Paper 1 Exam****Questions**

From summer 2012 to 2016 winter
marks in total

Name: _____

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Topic Chem 1 Q# 1/ IB/Paper 1/2016/w/Time Zone 0/Standard Level/

1. Which change of state is exothermic?
- A. $\text{CO}_2(\text{s}) \rightarrow \text{CO}_2(\text{g})$
 - B. $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{g})$
 - C. $\text{NH}_3(\text{g}) \rightarrow \text{NH}_3(\text{l})$
 - D. $\text{Fe}(\text{s}) \rightarrow \text{Fe}(\text{l})$
2. Which volume, in cm^3 , of $0.20 \text{ mol dm}^{-3} \text{ NaOH}(\text{aq})$ is needed to neutralize 0.050 mol of $\text{H}_2\text{S}(\text{g})$?
- $$\text{H}_2\text{S}(\text{g}) + 2\text{NaOH}(\text{aq}) \rightarrow \text{Na}_2\text{S}(\text{aq}) + 2\text{H}_2\text{O}(\text{l})$$
- A. 0.25
 - B. 0.50
 - C. 250
 - D. 500
3. The complete combustion of 15.0 cm^3 of a gaseous hydrocarbon X produces 60.0 cm^3 of carbon dioxide gas and 75.0 cm^3 of water vapour. What is the molecular formula of X? (All volumes are measured at the same temperature and pressure.)
- A. C_2H_6
 - B. C_2H_8
 - C. C_2H_{10}
 - D. C_6H_{10}
4. 5.0 mol of $\text{Fe}_2\text{O}_3(\text{s})$ and 6.0 mol of $\text{CO}(\text{g})$ react according to the equation below. What is the limiting reactant and how many moles of the excess reactant remain unreacted?



	Limiting reactant	Moles of excess reactant remaining
A.	CO	2.0
B.	CO	3.0
C.	Fe_2O_3	1.0
D.	Fe_2O_3	2.0

1. What is the total number of atoms in 0.50 mol of 1,4-diaminobenzene, $\text{H}_2\text{NC}_6\text{H}_4\text{NH}_2$?

(Avogadro's constant (L or N_A) = $6.0 \times 10^{23} \text{ mol}^{-1}$.)

- A. 16.0×10^{23}
 B. 48.0×10^{23}
 C. 96.0×10^{23}
 D. 192.0×10^{23}

2. What is the sum of the coefficients when the equation for the combustion of ammonia is balanced using the smallest possible whole numbers?



- A. 6
 B. 12
 C. 14
 D. 15

4. 5.00 g of calcium carbonate, when heated, produced 2.40 g of calcium oxide. Which is the correct expression for the percentage yield of calcium oxide? ($M_r(\text{CaCO}_3) = 100$; $M_r(\text{CaO}) = 56$.)



- A. $\frac{56 \times 5.00 \times 100}{2.40}$
 B. $\frac{2.40 \times 100 \times 100}{56 \times 5.00}$
 C. $\frac{56 \times 5.00 \times 100}{2.40 \times 100}$
 D. $\frac{2.40 \times 100}{56 \times 5.00}$

1. Which equation represents sublimation?

- A. $2\text{Al}(\text{s}) + 3\text{I}_2(\text{g}) \rightarrow 2\text{AlI}_3(\text{s})$
 B. $\text{HgCl}_2(\text{s}) \rightarrow \text{HgCl}_2(\text{g})$
 C. $\text{I}_2(\text{g}) \rightarrow \text{I}_2(\text{s})$
 D. $\text{CaCO}_3(\text{s}) + 2\text{HCl}(\text{aq}) \rightarrow \text{CaCl}_2(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$

2. For which compound is the empirical formula the same as the molecular formula?

$A_r(\text{H}) = 1$; $A_r(\text{C}) = 12$; $A_r(\text{O}) = 16$

	Empirical formula	Molar mass / g mol^{-1}
A.	CO_2H	90
B.	CH_3O	62
C.	$\text{C}_2\text{H}_4\text{O}$	88
D.	$\text{C}_4\text{H}_8\text{O}$	72

3. In which mixture is NaOH the limiting reagent?

- A. 0.20 mol NaOH + 0.10 mol H_2SO_4
 B. 0.10 mol NaOH + 0.10 mol H_2SO_4
 C. 0.20 mol NaOH + 0.10 mol HNO_3
 D. 0.10 mol NaOH + 0.10 mol HNO_3

4. Why do gases deviate from the ideal gas law at high pressures?

- A. Molecules have finite volume.
 B. Cohesive forces increase the volume from the ideal.
 C. Increasing pressure increases the temperature of the gas.
 D. Collisions between molecules occur more frequently as pressure increases.

1. What is the number of atoms of oxygen in 0.250 mol of hydrated zinc nitrate, $Zn(NO_3)_2 \cdot 6H_2O$?

A. 3.00
 B. 12.0
 C. 1.81×10^{24}
 D. 7.22×10^{24}

2. What is the mass, in g, of 0.500 mol of 1,2-dibromoethane, CH_2BrCH_2Br ?

$A_r(H) = 1$; $A_r(C) = 12$; $A_r(Br) = 80$

A. 23.5
 B. 47.0
 C. 94.0
 D. 188

3. The equation for the **complete** combustion of propene, C_3H_6 , is shown below.



Which mixture, when ignited, will lead to **incomplete** combustion and the formation of CO(g)?

A. 2 dm³ of propene and 10 dm³ of oxygen
 B. 0.5 dm³ of propene and 2.3 dm³ of oxygen
 C. 1 dm³ of propene and 4 dm³ of oxygen
 D. 3 dm³ of propene and 14 dm³ of oxygen

4. What is the percentage yield when 1.1 g of ethanal, CH_3CHO , is obtained from 4.6 g of ethanol, CH_3CH_2OH ? $M_r(CH_3CH_2OH) = 46$; $M_r(CH_3CHO) = 44$



A. $\frac{1.1 \times 46 \times 100}{44 \times 4.6}$
 B. $\frac{1.1 \times 100}{4.6}$
 C. $\frac{4.6 \times 44 \times 100}{4.6 \times 1.1}$
 D. $\frac{1.1 \times 46}{44 \times 4.6}$

1. What is the total number of protons and electrons in one mole of hydrogen gas?

A. 2
 B. 4
 C. 1.2×10^{24}
 D. 2.4×10^{24}

2. A hydrocarbon contains 85.7 % carbon by mass. What is the empirical formula of the hydrocarbon?

A. C_2H_3
 B. CH_2
 C. C_2H_5
 D. CH_3

3. What is the sum of all coefficients for the combustion of one mole of propane?



A. 8
 B. 12
 C. 13
 D. 15

4. A gas with a molar mass (M) of 44 g mol^{-1} occupies a volume of $2.00 \times 10^3 \text{ cm}^3$ at a pressure of $1.01 \times 10^5 \text{ Pa}$ and a temperature of 25°C . Which expression is correct for the calculation of the mass of the gas, in g? ($R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$)

A. $\frac{44 \times 1.01 \times 10^5 \times 2.00 \times 10^{-3}}{8.31 \times 298}$
 B. $\frac{44 \times 1.01 \times 10^5 \times 2.00 \times 10^3}{8.31 \times 25}$
 C. $\frac{1.01 \times 10^5 \times 2.00 \times 10^{-3}}{44 \times 8.31 \times 298}$
 D. $\frac{44 \times 1.01 \times 10^5 \times 2.00 \times 10^3}{8.31 \times 298}$

1. Combustion of ethanol takes place according to the following unbalanced equation.



What is the mole ratio of ethanol to oxygen in the balanced equation?

- A. 1:1
B. 2:1
C. 1:3
D. 2:7

2. Which sample contains the largest amount, in mol, of oxygen atoms?

- A. 0.20 mol P_2O_5
B. 0.30 mol O_3
C. 0.40 mol CH_3COOH
D. 0.80 mol H_2O

3. Which compound has the highest percentage of carbon by mass?

- A. CH_4
B. C_2H_4
C. C_4H_{10}
D. C_6H_6

4. Which solution contains the biggest amount, in mol, of chloride ions?

- A. 20 cm^3 of $0.50 \text{ mol dm}^{-3} \text{ NH}_4\text{Cl}$
B. 60 cm^3 of $0.20 \text{ mol dm}^{-3} \text{ MgCl}_2$
C. 70 cm^3 of $0.30 \text{ mol dm}^{-3} \text{ NaCl}$
D. 100 cm^3 of $0.30 \text{ mol dm}^{-3} \text{ ClCH}_2\text{COOH}$

1. 0.040 mol of $(\text{NH}_4)_2\text{Ni}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$ is dissolved in water to give 200 cm^3 of aqueous solution. What is the concentration, in mol dm^{-3} , of ammonium ions?

- A. 0.00040
B. 0.0080
C. 0.20
D. 0.40

2. When sodium bromate(V), NaBrO_3 , is heated, it reacts according to the equation below.



What amount, in mol, of NaBrO_3 produces 2.4 dm^3 of oxygen gas, measured at room temperature and pressure? (Molar volume of gas = $24 \text{ dm}^3 \text{ mol}^{-1}$ at room temperature and pressure.)

- A. 0.017
B. 0.067
C. 0.10
D. 0.15

3. Aluminium carbide reacts with water according to the equation below. What is the sum of all the coefficients when the equation is balanced?



- A. 13
B. 14
C. 19
D. 20

4. At which temperature, in K, assuming constant pressure, is the volume of a fixed mass of gas at 127°C doubled?

- A. 200 K
B. 254 K
C. 400 K
D. 800 K

1. What is the mass, in g, of one mole of hydrated copper(II) sulfate, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$, given the following relative atomic mass values?

Element	Cu	S	H	O
Relative atomic mass	64	32	1	16

- A. 160
 B. 178
 C. 186
 D. 250

2. An excess of calcium carbonate is added to a solution containing 0.10 mol of HCl (aq). What mass of calcium carbonate reacts, and what mass of carbon dioxide is formed?

Mass of one mole of $\text{CaCO}_3 = 100 \text{ g}$

Mass of one mole of $\text{CO}_2 = 44 \text{ g}$



$\text{CaCO}_3(\text{s}) / \text{g}$	$\text{CO}_2(\text{g}) / \text{g}$
A. 10	4.4
B. 10	2.2
C. 5.0	2.2
D. 5.0	4.4

3. For which compounds is the empirical formula the same as the molecular formula?

- I. Methane
 II. Ethene
 III. Ethanol
- A. I and II only
 B. I and III only
 C. II and III only
 D. I, II and III

4. Some sodium chloride is dissolved in water. Which term describes the role of sodium chloride in this process?

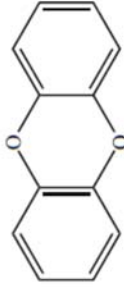
- A. Solute
 B. Solvent
 C. Solution
 D. Saturated

Topic Chem 1 Q# 9/ 1B/Paper 1/2014/s/Time Zone 1/Standard Level/

1. How many atoms are present in 0.500 mol of NH_3 ?

- A. 1.20×10^{23}
 B. 3.01×10^{23}
 C. 6.02×10^{23}
 D. 1.20×10^{24}

2. The structural formula of a dioxin is shown below.



What is its empirical formula?

- A. C_6O
- B. C_6H_4O
- C. C_6H_6O
- D. $C_{12}H_8O_2$

3. 100.0 cm^3 of a 0.50 mol dm^{-3} solution of $BaCl_2$ is added to 50.0 cm^3 of a 0.10 mol dm^{-3} solution of Na_2SO_4 . A precipitate of $BaSO_4$ is formed according to the equation below.



What is the amount, in mol, of $BaSO_4$ produced?

- A. 0.0050
- B. 0.010
- C. 0.050
- D. 0.10

4. Which volumes of gases at standard temperature and pressure have the same mass as 100 cm^3 of O_2 ?

- I. 50 cm^3 of SO_2
- II. 100 cm^3 of CH_4
- III. 100 cm^3 of SiH_4

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

Topic Chem 1 Q# 10/ IB/Paper 1/2013/w/Time Zone 0/Standard Level/

1. What is the total number of oxygen atoms in 0.200 mol of glucose, $C_6H_{12}O_6$?

- A. 1.20
- B. 6.00
- C. 1.20×10^{23}
- D. 7.22×10^{23}

2. Which represents an empirical formula?

- A. C_2H_4
- B. B_2H_6
- C. Al_2O_3
- D. C_6H_6

3. What are the coefficients of $H_2SO_4(aq)$ and $H_3PO_4(aq)$ when the following equation is balanced using the smallest possible whole numbers?



	Coefficient of $H_2SO_4(aq)$	Coefficient of $H_3PO_4(aq)$
A.	1	2
B.	2	3
C.	3	1
D.	3	2

- A.
- B.
- C.
- D.

4. What is the pressure, in Pa, if 3 mol of gas occupies 500 cm³ at 25 °C?

Given: $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$
 $10^{-3} \text{ m}^3 = 10^3 \text{ cm}^3$

- A. $\frac{3 \times 8.31 \times 298}{500}$
B. $\frac{3 \times 8.31 \times 25}{0.0005}$
C. $\frac{3 \times 8.31 \times 25}{500}$
D. $\frac{3 \times 8.31 \times 298}{0.0005}$

5. 7.102 g of Na₂SO₄ ($M = 142.04 \text{ g mol}^{-1}$) is dissolved in water to prepare 0.5000 dm³ of solution. What is the concentration of Na₂SO₄ in mol dm⁻³?

- A. 2.500×10^{-2}
B. 1.000×10^{-1}
C. 1.000×10
D. 1.000×10^2

Topic Chem 1 Q# 11/ 1B/Paper 1/2013/s/Time Zone 2/Standard Level/

1. Which contains the largest number of ions?

- A. 1 mol of Al₂(SO₄)₃
B. 1 mol of Mg₃(PO₄)₂
C. 2 mol of K₃PO₄
D. 3 mol of NaNO₃

2. How many atoms are present in 0.10 mol of PtCl₂(NH₃)₂?

- A. 6.0×10^{22}
B. 3.0×10^{23}
C. 6.6×10^{23}
D. 6.6×10^{24}

3. Which is the best description of relative atomic mass, A_r ?

- A. The number of neutrons and protons present in the nucleus of an atom
B. The average number of neutrons and protons in all isotopes of an element
C. The weighted mean mass of naturally occurring isotopes of an element compared to the mass of an atom of carbon-12
D. The weighted mean mass of naturally occurring isotopes of an element compared to $1/12^{\text{th}}$ of the mass of an atom of carbon-12

4. What mass of carbon dioxide, CO₂(g), in g, is produced when 5.0 g of calcium carbonate, CaCO₃(s), reacts completely with hydrochloric acid, HCl(aq)?



- A. 0.050
B. 2.2
C. 4.4
D. 5.0

5. What volume of carbon dioxide, CO₂(g), in dm³, is produced when 1 dm³ of octane, C₈H₁₈(g), undergoes complete combustion?



- A. 1
B. 4
C. 8
D. 9

5. What is the pressure, in Pa, in a 100 cm^3 container containing 1.8 g of steam at a temperature of 727°C ? ($R = 8.31\text{ JK}^{-1}\text{ mol}^{-1}$)
- A. $\frac{1.8 \times 8.31 \times 727}{18 \times 100}$
 B. $\frac{18 \times 100}{1.8 \times 8.31 \times 727}$
 C. $\frac{1.8 \times 8.31 \times 1000}{18 \times 10^{-4}}$
 D. $\frac{1.8 \times 8.31}{1.8 \times 10^{-4} \times 1000}$

Topic Chem 1 Q# 13/ IB/Paper 1/2012/w/Time Zone 0/Standard Level/

1. What is the number of ions in 0.20 mol of $(\text{NH}_4)_3\text{PO}_4$?

- A. 8.0×10^{-1}
 B. 1.2×10^{23}
 C. 4.8×10^{23}
 D. 2.4×10^{24}

2. What is the molar mass, in g mol^{-1} , of washing soda crystals, $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$?

- A. 105.99
 B. 124.00
 C. 263.15
 D. 286.19

3. The equation for the reduction of iron(III) oxide is:



What mass of carbon dioxide, in g, is produced by the complete reduction of 80 g of iron(III) oxide?

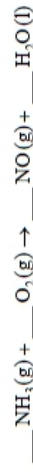
- A. 44
 B. 66
 C. 88
 D. 132

- I. Which statements are correct about Avogadro's constant?
- I. It is the number of ions in 12 g of sodium hydride, NaH.
 II. It is the number of molecules in 22.4 dm^3 of hydrogen gas at 0°C and 1 atm .
 III. It is the number of atoms in 12 g of ^{12}C .
- A. I and II only
 B. I and III only
 C. II and III only
 D. I, II and III
2. What is the molar mass, in g mol^{-1} , of a substance if 0.30 mol of the substance has a mass of 18 g ?

molar volume for gas 22.7
 dm³ (new syllabus)
 22.4 dm³ old syllabus

- A. 5.4
 B. 6.0
 C. 30
 D. 60

3. What is the whole number ratio of the coefficients of ammonia to oxygen when the following equation is balanced correctly?



- A. 1 : 2
 B. 2 : 1
 C. 4 : 5
 D. 5 : 4

4. When 50 cm^3 of a hydrocarbon, C_xH_y , was burned in excess oxygen, 200 cm^3 of carbon dioxide and 250 cm^3 of steam were produced (all volumes were measured under the same conditions). What is the molecular formula of the hydrocarbon?

- A. C_2H_4
 B. C_3H_8
 C. C_4H_8
 D. C_4H_{10}

4. 3.0 dm^3 of ethyne, C_2H_2 , is mixed with 3.0 dm^3 of hydrogen and ignited. The equation for the reaction that occurs is shown below.



Assuming the reaction goes to completion and all gas volumes are measured at the same temperature and pressure, what volume of ethane, C_2H_6 , in dm^3 , is formed?

- A. 1.5
B. 2.0
C. 3.0
D. 6.0

Topic Chem 1 Q# 14 / IB/Paper 1/2012/s/Time Zone 2/Standard level/

1. What is the total number of atoms in 0.100 mol of $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$?

- A. 11
B. 6.02×10^{22}
C. 3.01×10^{23}
D. 6.62×10^{23}

2. Nitroglycerine, $\text{C}_3\text{H}_5\text{N}_3\text{O}_9$, can be used in the manufacture of explosives. What is the coefficient of $\text{C}_3\text{H}_5\text{N}_3\text{O}_9(\text{l})$ when the equation for its decomposition reaction is balanced using the lowest whole numbers?



- A. 2
B. 4
C. 20
D. 33

1. What is the total number of atoms in 0.100 mol of $[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$?

- A. 11
B. 6.02×10^{22}
C. 3.01×10^{23}
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- A. 2
B. 4
C. 20
D. 33

3. The volume occupied by one mole of an ideal gas at 273 K and $1.01 \times 10^5 \text{ Pa}$ is 22.4 dm^3 . What volume, in dm^3 , is occupied by $3.20 \text{ g O}_2(\text{g})$ at 273 K and $1.01 \times 10^5 \text{ Pa}$?

- A. 2.24
B. 4.48
C. 22.4
D. 71.7

4. What volume, in m^3 , is occupied by 2.00 mol of gas at 27°C and 2.00 atm pressure? Assume: $1.00 \text{ atm} = 1.01 \times 10^5 \text{ Pa}$ and $R = 8.31 \text{ J K}^{-1} \text{ mol}^{-1}$.

- A. $\frac{8.31 \times 27}{1.01 \times 10^5}$
B. $\frac{2.00 \times 8.31 \times 27}{1.01 \times 10^5}$
C. $\frac{2.00 \times 8.31 \times 300}{2.00 \times 1.01 \times 10^5}$
D. $\frac{2.00 \times 8.31 \times 300}{1.01 \times 10^5}$

5. Which statements about solutions are correct?

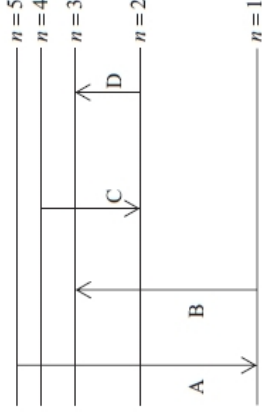
- I. A solute dissolves in a solvent to form a solution.
II. A solution is a homogeneous mixture of two or more substances.
III. Concentrations of solutions can be expressed in g dm^{-3} .

- A. I and II only
B. I and III only
C. II and III only
D. I, II and III

1. How many atoms of hydrogen are in 0.500 mol of CH_3OH molecules?
- A. 1.20×10^{23}
 B. 3.01×10^{23}
 C. 6.02×10^{23}
 D. 1.20×10^{24}
2. 1 mol of a hydrocarbon with general formula $\text{C}_n\text{H}_{2n-2}$ reacts completely with oxygen to produce 4 mol of H_2O . What is the amount of oxygen molecules, in mol, that reacts?
- A. 4
 B. 5
 C. 6
 D. 7
3. Under which combination of conditions is 1 mol of an ideal gas present?
- | | Volume | Pressure | Temperature |
|----|----------------------|----------|-------------|
| A. | 22.4 dm ³ | 101 Pa | 273 K |
| B. | 22.4 m ³ | 101 Pa | 298 K |
| C. | 22.4 dm ³ | 101 kPa | 273 K |
| D. | 22.4 m ³ | 101 kPa | 298 K |
- molar volume = 22.7 dm³
 old syllabus (22.4 dm³)
4. A fixed mass of an ideal gas at 27.0 °C and 1.01×10^5 Pa has a volume of 100 cm³. Which change doubles the volume of the gas?
- A. Heating the gas at constant pressure to 54.0 °C.
 B. Heating the gas at constant pressure to 327 °C.
 C. Increasing the pressure on the gas to 2.02×10^5 Pa at constant temperature.
 D. Heating the gas to 54.0 °C and increasing the pressure to 2.02×10^5 Pa.
5. 10 cm³ of a solution of 1.0 mol dm⁻³ NaOH(aq) is diluted with water until the final volume is 100 cm³. What is the concentration, in mol dm⁻³, of the new solution?
- A. 0.10
 B. 1.0
 C. 10.0
 D. 0.01

Topic Chem 2 Q# 1/ IB/Paper 1/2016/Specimen Paper/Time Zone 0/Standard Level/

5. Which electronic transition would absorb the radiation of the shortest wavelength?



Topic Chem 2 Q# 2/ IB/Paper 1/2016/s/Time Zone 0/Standard Level/

5. Which is correct for the chromium isotope $^{53}_{24}\text{Cr}$?

- A. 24 neutrons and 53 nucleons
- B. 24 protons and 29 nucleons
- C. 24 protons and 29 neutrons
- D. 24 electrons and 53 neutrons

6. Which electron configuration is correct for the selenide ion, Se^{2-} ?

- A. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^{10} 4p^4$
- B. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 4d^{10} 4p^6$
- C. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^4$
- D. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^6$

Topic Chem 2 Q# 3/ IB/Paper 1/2015/w/Time Zone 0/Standard Level/

5. Which species has 16 protons and 17 electrons?

- A. S^-
- B. S
- C. Cl
- D. Cl^-

Topic Chem 2 Q# 4/ IB/Paper 1/2015/s/Time Zone 2/Standard Level/

5. Which statement is correct for the ion ${}^9_4\text{Be}^{2+}$?

- A. The ion contains 15 subatomic particles in the nucleus.
- B. The ion contains more protons than neutrons in the nucleus.
- C. The ion has an electron arrangement of 2,2. **1s²; 2s²**
- D. Most of the total volume of the ion is empty space.

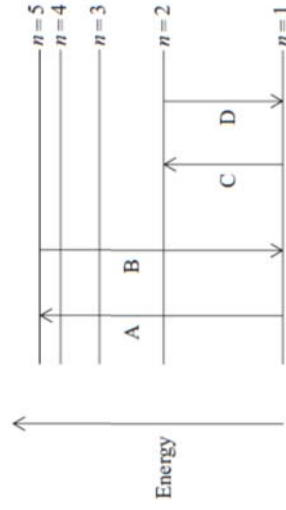
5. Which statement about the isotopes of nitrogen is correct?

	Number of electrons	Number of neutrons	Mass number
A.	same	same	same
B.	same	same	different
C.	same	different	different
D.	different	different	different

6. Ultraviolet radiation has a shorter wavelength than infrared radiation. How does the frequency and energy of ultraviolet radiation compare with infrared radiation?

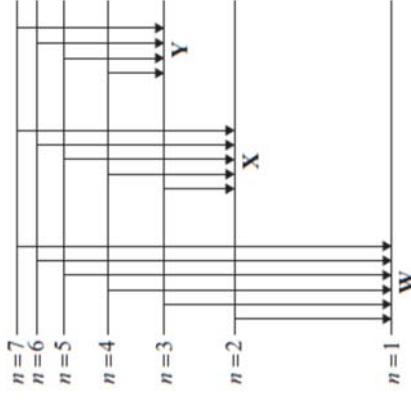
Frequency	Energy
A. higher	higher
B. higher	lower
C. lower	higher
D. lower	lower

6. Some possible electron transitions in a hydrogen atom are shown below. Which letter represents the electron transition with the highest energy in the emission spectrum?



5. What does $^{52}_{34}\text{X}$ represent?
- An isotope of Te with 24 neutrons
 - An isotope of Te with 24 electrons
 - An isotope of Cr with 28 protons
 - An isotope of Cr with 28 neutrons

5. The diagram represents the emission spectrum of hydrogen. Groups of arrows are labelled W, X and Y.



Which statement is correct?

- The arrows represent the transition of electrons to different energy levels when heat is supplied.
 - The arrows of W represent emission in the UV region.
 - The smallest arrow of X represents a violet line in the emission spectrum.
 - The arrows of Y represent emission of electromagnetic waves with higher energy than those represented by X and W.
6. Which species have the same electron arrangements?

- O^{2-} , F^- , Ne
 - Li^+ , Na^+ , K^+
 - S^{2-} , Ar , K^+
- I and II only
 - I and III only
 - II and III only
 - I, II and III

6. What are the numbers of neutrons and electrons in the iodine ion, $^{127}\text{I}^-$?

	Neutrons	Electrons
A.	53	53
B.	72	52
C.	72	53
D.	125	52

7. In the emission spectrum of the hydrogen atom, which electronic transition would produce a line in the ultraviolet region of the electromagnetic spectrum?

- A. $n = 1 \rightarrow n = 3$
 B. $n = 3 \rightarrow n = 1$
 C. $n = 3 \rightarrow n = 2$
 D. $n = 10 \rightarrow n = 2$

6. Which is an isotope of ^{24}Mg ?

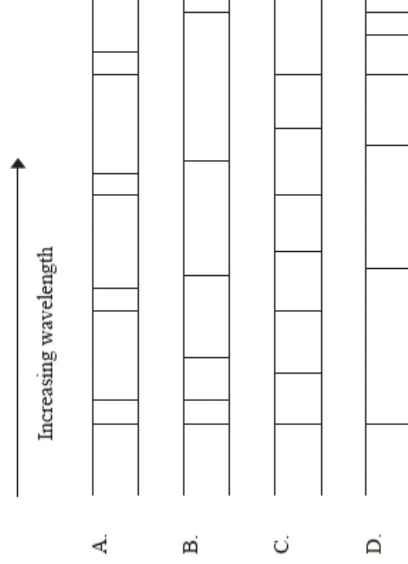
- A. $^{24}_{11}\text{Na}$
 B. $^{24}_{12}\text{Mg}^{2+}$
 C. $^{26}_{12}\text{Mg}$
 D. $^{22}_{10}\text{Ne}$

6. Which statements about the isotopes of an element are correct?

- I. They have the same chemical properties.
 II. They have different physical properties.
 III. They have the same number of protons and electrons.

- A. I and II only
 B. I and III only
 C. II and III only
 D. I, II and III

7. Which diagram shows a pattern similar to the emission spectrum of hydrogen?



5. What is the correct number of each particle in an oxygen ion, $^{18}\text{O}^{2-}$?

	Protons	Neutrons	Electrons
A.	8	8	10
B.	8	10	8
C.	8	8	6
D.	8	10	10

6. Which statement about the electromagnetic spectrum is correct?

- A. Infrared light has a shorter wavelength than ultraviolet light.
 B. Visible light has a shorter wavelength than ultraviolet light.
 C. The frequency of visible light is higher than the frequency of infrared light.
 D. The energy of infrared light is higher than the energy of visible light.

6. Which subatomic particles are located in the nucleus of an atom?

- A. Protons and electrons
 B. Neutrons and electrons
 C. Protons and neutrons
 D. Protons, neutrons and electrons

7. What is the name of the type of spectrum consisting only of specific wavelengths?

- A. Electromagnetic
- B. Continuous
- C. Line
- D. Mass

8. Which statements are correct for silicon?

- I. Its electron arrangement is 2,8,4. **1s2; 2s2; 2p6; 3s2; 3p2**
- II. It has four electrons in its highest occupied energy level.
- III. In the solid state, each silicon atom is covalently bonded to four other silicon atoms in a tetrahedral arrangement. **covered in topic 4**

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

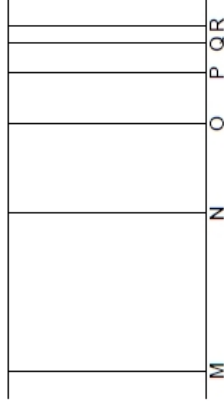
Topic Chem 2 **Q# 14** / IB/Paper 1/2012/s/Time Zone 1/Standard level/

6. Which isotope has an atomic number of 9 and a mass number of 19?

- A. ${}^9\text{F}$
- B. ${}^{19}\text{K}$
- C. ${}^{19}\text{F}$
- D. ${}^{28}\text{Si}$

Topic Chem 3 Q# 1/ 1B/Paper 1/2016/w/Time Zone 0/Standard Level/

5. Which is correct for the line emission spectrum for hydrogen?



- A. Line M has a higher energy than line N.
 B. Line N has a lower frequency than line M.
 C. Line M has a longer wavelength than line N.
 D. Lines converge at lower energy.
6. What is the condensed electron configuration of the Fe^{2+} ion?
- A. $[\text{Ar}]3d^6$
 B. $[\text{Ar}]3d^44s^2$
 C. $[\text{Ar}]3d^54s^1$
 D. $[\text{Ar}]3d^54s^2$
7. Which equation represents the first electron affinity of chlorine?

- A. $\text{Cl}(\text{g}) + \text{e}^- \rightarrow \text{Cl}^-(\text{g})$
 B. $\frac{1}{2} \text{Cl}_2(\text{g}) + \text{e}^- \rightarrow \text{Cl}^-(\text{g})$
 C. $\text{Cl}^+(\text{g}) + \text{e}^- \rightarrow \text{Cl}(\text{g})$
 D. $\text{Cl}(\text{g}) \rightarrow \text{Cl}^+(\text{g}) + \text{e}^-$

8. Which solution forms when phosphorus(V) oxide, P_4O_{10} , reacts with water?

Product	pH of solution
H_3PO_3	< 7
H_3PO_4	> 7
H_3PO_4	< 7
H_3PO_4	> 7

- A.
 B.
 C.
 D.

Topic Chem 3 Q# 2/ 1B/Paper 1/2016/Specimen Paper/Time Zone 0/Standard Level/

6. What are the numbers of protons, neutrons and electrons in the ion ${}^{238}_{92}\text{X}^{2+}$?

	Protons	Neutrons	Electrons
A.	146	92	144
B.	92	146	90
C.	92	146	94
D.	92	238	90

- A.
 B.
 C.
 D.

7. Which element is in the f-block of the periodic table?

- A. Be
 B. Ce
 C. Ge
 D. Re

8. Which property increases down group 1 of the periodic table?

- A. Melting point
 B. First ionization energy
 C. Atomic radius
 D. Electronegativity

Topic Chem 3 Q# 3/ 1B/Paper 1/2016/s/Time Zone 0/Standard Level/

7. Which element is a metalloid?

- A. Co
 B. As
 C. Cs
 D. Es

8. Which periodic trend is described correctly?

Trend in	Down the group (top to bottom)	Across the period (left to right)
atomic radius	increases	increases
ionic radius	decreases	increases
first ionization energy	decreases	decreases
electronegativity	decreases	increases

- A.
 B.
 C.
 D.

Topic Chem 3 **Q# 4** / IB/Paper 1/2015/w/Time Zone 0/Standard Level/

7. Which element has the greatest first ionization energy?

- A. Al
- B. Ar
- C. Cl
- D. Cs

8. Which element produces hydrogen gas at the greatest rate when added to water?

- A. Ca
- B. Cs
- C. Li
- D. Rb

9. Which element forms more than one stable positive ion?

- A. Ca
- B. Cr
- C. Zn
- D. Ba

Topic Chem 3 **Q# 5** / IB/Paper 1/2015/s/Time Zone 2/Standard Level/

7. Which statement is correct for the halogens ($F \rightarrow I$)?

- A. Electronegativity decreases from fluorine to iodine.
- B. Atomic radius decreases from fluorine to iodine.
- C. First ionization energy increases from fluorine to iodine.
- D. Reactivity of the element with sodium increases from fluorine to iodine.

Topic Chem 3 **Q# 6** / IB/Paper 1/2015/s/Time Zone 1/Standard Level/

8. What is the definition of the term *first ionization energy*?

- A. The energy released when one mole of electrons is removed from one mole of gaseous atoms.
- B. The energy required to remove one mole of electrons from one mole of gaseous atoms.
- C. The energy released when one mole of gaseous atoms gains one mole of electrons.
- D. The energy required to add one mole of electrons to one mole of gaseous atoms.

Topic Chem 3 **Q# 7** / IB/Paper 1/2014/w/Time Zone 0/Standard Level/

7. Which properties decrease down both group 1 and group 7?

- I. Melting point
- II. First ionization energy
- III. Electronegativity

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

8. Which period 3 oxide, when added to water, forms an acidic solution?

- A. SO_3
- B. MgO
- C. Na_2O
- D. Al_2O_3

Topic Chem 3 **Q# 8** / IB/Paper 1/2014/s/Time Zone 2/Standard Level/

7. Which properties decrease down group 1?

- I. Melting point
- II. Atomic radius
- III. First ionization energy

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

8. Which pair of elements shows the greatest difference in electronegativity?

- A. Mg and O
- B. Li and F
- C. K and F
- D. Li and I

9. What is the formula of calcium phosphide?

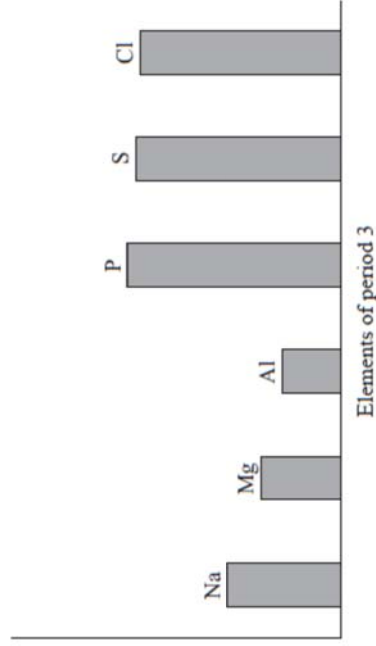
- A. $\text{Ca}_3(\text{PO}_3)_3$
- B. Ca_2P_3
- C. $\text{Ca}_3(\text{PO}_4)_2$
- D. Ca_3P_2

Topic Chem 3 Q# 9 / IB/Paper 1/2014/s/Time Zone 1/Standard Level/

7. Which statement about the periodic table is correct?

- A. The elements with atomic numbers 8, 16 and 34 have the same number of main energy levels.
- B. The elements with atomic numbers 8, 9 and 10 have similar chemical properties.
- C. The elements with atomic numbers 20, 21 and 22 are in the same group.
- D. The elements with atomic numbers 20, 38 and 56 have the same number of electrons in their outer energy level.

8. The horizontal axis of the bar chart represents the elements of period 3 from sodium to chlorine (excluding silicon). What could the vertical axis represent?



- A. Melting point of the element
- B. Electronegativity of the bonded atom
- C. Ionic radius of the most common ion
- D. First ionization energy in the gaseous state

9. The electronegativities of four elements are given in the table.

Element	W	X	Y	Z
Electronegativity	0.9	1.1	3.4	4.0

Which statement is correct?

- A. W and X form an ionic compound.
- B. W and X form a covalent compound.
- C. Y and Z form an ionic compound.
- D. Y and Z form a covalent compound.

Topic Chem 3 Q# 10 / IB/Paper 1/2013/w/Time Zone 0/Standard Level/

8. Which statements are correct for magnesium?

- I. The electron arrangement of the atom is 2,8,2.
- II. The atom has two electrons in its outermost (valence) energy level.
- III. Its oxide is basic.

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

9. Which series is arranged in order of increasing radius?

- A. $\text{F} < \text{Cl}^- < \text{Cl}$
- B. $\text{Rb} < \text{K} < \text{Na}$
- C. $\text{Al}^{3+} < \text{Mg}^{2+} < \text{Na}^+$
- D. $\text{I}^- < \text{Br}^- < \text{Cl}^-$

10. What is the formula of calcium nitride?

- A. Ca_3N_2
- B. Ca_2N_3
- C. $\text{Ca}(\text{NO}_2)_2$
- D. $\text{Ca}(\text{NO}_3)_2$

Topic Chem 3 Q# 11/ IB/Paper 1/2013/s/Time Zone 2/Standard Level/

8. Element X is in group 5 and period 4 of the periodic table. Which statement is correct?

- A. X has 5 occupied energy levels.
- B. X can form ions with 3- charge.
- C. X is a transition element.
- D. X has 4 valence electrons.

9. Which statements are correct for the halogens F to I?

- I. Melting point increases
- II. First ionization energy increases
- III. Ionic radius increases

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

Topic Chem 3 Q# 12/ IB/Paper 1/2013/s/Time Zone 1/Standard level/

8. Which statement concerning electronegativity is correct?

- A. Electronegativity increases from left to right across a period.
- B. Metals generally have higher electronegativity values than non-metals.
- C. Electronegativity increases on descending a group.
- D. Noble gases have the highest electronegativity values.

9. Which statements are correct?

- I. Fluorine will react with potassium chloride solution to produce chlorine.
 - II. Iodine will react with sodium chloride solution to produce chlorine.
 - III. Bromine will react with lithium iodide solution to produce iodine.
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III

Topic Chem 3 Q# 13/ IB/Paper 1/2012/w/Time Zone 0/Standard Level/

7. Which statements about atomic structure and the periodic table are correct?

- I. An element in group 2 has 2 electrons in its valence (outer) energy level.
- II. An element in period 3 has electrons in 3 energy levels.
- III. The element in group 2 and period 3 has an atomic number of 12.

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

8. Which combination is correct for the properties of the alkali metals from Li to Cs?

	Atomic radius	Melting point	First ionization energy
A.	increases	increases	increases
B.	increases	decreases	decreases
C.	increases	increases	decreases
D.	decreases	decreases	increases

9. Which oxides are acidic?

- I. P_4O_{10}
- II. SO_3
- III. Na_2O

- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III

Topic Chem 3 **Q# 14**/ IB/Paper 1/2012/s/Time Zone 2/Standard Level/

9. Which series is correctly arranged in order of decreasing radius?

- A. $Al^{3+} > Mg^{2+} > Na^+ > F^-$
- B. $F^- > Na^+ > Mg^{2+} > Al^{3+}$
- C. $F^- > Al^{3+} > Mg^{2+} > Na^+$
- D. $Na^+ > Mg^{2+} > Al^{3+} > F^-$

Topic Chem 3 **Q# 15**/ IB/Paper 1/2012/s/Time Zone 1/Standard Level/

8. Which sequence of elements is in order of increasing electronegativity?

- A. $Li < Na < Rb$
- B. $O < N < C$
- C. $F < Cl < Br$
- D. $Si < P < S$

9. Which combination of descriptions is correct for the oxides of period 3 elements?

	Chlorine	Magnesium	Silicon	Sodium
A.	basic	acidic	basic	acidic
B.	acidic	basic	basic	basic
C.	basic	acidic	acidic	acidic
D.	acidic	basic	acidic	basic