

**DIPLOMA PROGRAMME**

**MOCK EXAMINATION**

**2020**

**Name :**

**CHEMISTRY**

**HIGHER LEVEL**

**PAPER 1**

**1 hour**

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**INSTRUCTIONS TO CANDIDATES**

- Do not open this examination paper until instructed to do so.
- Answer all the questions.
- For each question, choose the answer you consider to be the best and indicate your choice on the answer sheet provided.
- The periodic table is provided for reference on the last page of this examination paper.
- The maximum mark for this examination paper is [40 marks].

**1. Which factors affect the molar volume of an ideal gas?**

- I. Pressure
- II. Temperature
- III. Empirical formula

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

**2. In which mixture is NaOH the limiting reagent?**

- A. 0.20mol NaOH + 0.10mol H<sub>2</sub>SO<sub>4</sub>
- B. 0.10mol NaOH + 0.10mol H<sub>2</sub>SO<sub>4</sub>
- C. 0.20mol NaOH + 0.10mol HNO<sub>3</sub>
- D. 0.10mol NaOH + 0.10mol HNO<sub>3</sub>

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

- A. 0.20 mol P<sub>2</sub>O<sub>5</sub>
- B. 0.30 mol O<sub>3</sub>
- C. 0.40 mol CH<sub>3</sub>COOH
- D. 0.80 mol H<sub>2</sub>O

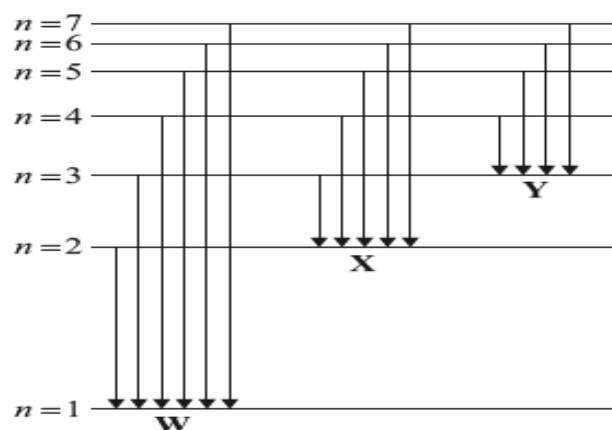
**4. Which electron transition in the hydrogen atom emission spectrum emits radiation with the longest wavelength?**

- A.  $n = 2 \rightarrow n = 1$
- B.  $n = 1 \rightarrow n = 2$
- C.  $n = 4 \rightarrow n = 1$
- D.  $n = 3 \rightarrow n = 2$

**5. Which electron configuration is correct for the Calcium ion, Ca<sup>2+</sup>?**

- A. 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> 3s<sup>2</sup> 3p<sup>4</sup> 4s<sup>2</sup>
- B. 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> 3s<sup>2</sup> 3p<sup>6</sup>
- C. 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>6</sup> 3s<sup>2</sup> 3p<sup>6</sup> 3d<sup>10</sup>
- D. 1s<sup>2</sup> 2s<sup>2</sup> 2p<sup>3</sup> 3s<sup>2</sup> 3p<sup>3</sup> 3d<sup>6</sup>

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



Which statement is correct?

- A. The arrows represent the transition of electrons to different energy levels when heat is supplied.
- B. The arrows of W represent emission in the UV region.
- C. The smallest arrow of X represents a violet line in the emission spectrum.
- D. The arrows of Y represent emission of electromagnetic waves with higher energy than those represented by X and W.

7. Which oxide, when added to water, produces the solution with the highest pH?

- A.  $\text{Na}_2\text{O}$
- B.  $\text{SO}_3$
- C.  $\text{MgO}$
- D.  $\text{CO}_2$

8. Which element is a metalloid?

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

9. Which periodic trend is described correctly?

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

10. The elements argon, potassium, and calcium are consecutive in the periodic table. Which gives the correct order of increasing first ionization energies?

- A.  $\text{Ar} < \text{Ca} < \text{K}$
- B.  $\text{K} < \text{Ar} < \text{Ca}$
- C.  $\text{Ca} < \text{K} < \text{Ar}$
- D.  $\text{K} < \text{Ca} < \text{Ar}$

11. Which combination describes the sulfate(IV) ion,  $\text{SO}_3^{2-}$  (also known as sulfite ion)?

	Number of electron domains around S	Electron domain geometry	Molecular geometry	O-S-O angle
A.	3	trigonal planar	trigonal planar	$120^\circ$
B.	3	tetrahedral	trigonal pyramidal	$109.5^\circ$
C.	4	trigonal pyramidal	trigonal pyramidal	$107^\circ$
D.	4	tetrahedral	trigonal pyramidal	$107^\circ$

12. Which compound has resonance structures?

- A.  $\text{C}_6\text{H}_{12}$
- B.  $\text{CH}_3\text{CHO}$
- C.  $\text{NaBr}$
- D.  $\text{Na}_2\text{CO}_3$

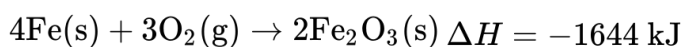
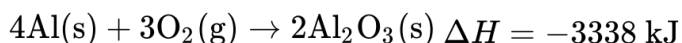
13. What describes the relationship between diamond, graphite and  $\text{C}_{60}$  fullerene?

- A. Allotropes
- B. Isomers
- C. Isotopes
- D. Polymers

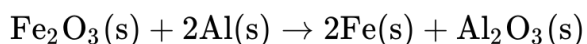
14. The formula of gallium phosphate is  $\text{GaPO}_4$ . What is the correct formula of gallium sulfate?

- A.  $\text{GaSO}_4$
- B.  $\text{GaS}$
- C.  $\text{Ga}_2(\text{SO}_4)_3$
- D.  $\text{Ga}_2\text{S}_3$

15. When four moles of aluminium and four moles of iron combine with oxygen to form their oxides, the enthalpy changes are  $-3338 \text{ kJ}$  and  $-1644 \text{ kJ}$  respectively.

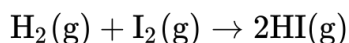


What is the enthalpy change, in  $\text{kJ}$ , for the reduction of one mole of iron(III) oxide by aluminium?



- A.  $+1694$
- B.  $+847$
- C.  $-847$
- D.  $-1694$

16. Use the average bond enthalpies below to calculate the enthalpy change, in  $\text{kJ}$ , for the following reaction.



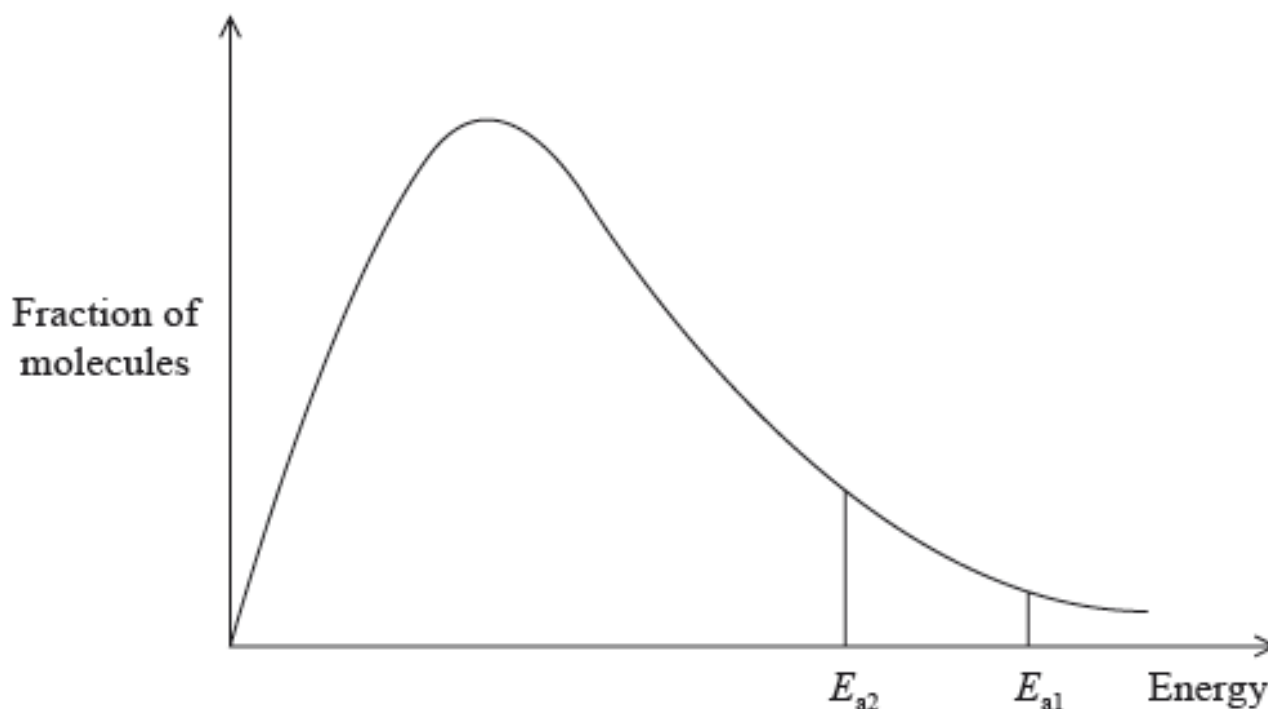
Bond	Bond energy / $\text{kJ mol}^{-1}$
H-H	440
I-I	150
H-I	300

- A.  $+290$
- B.  $+10$
- C.  $-10$
- D.  $-290$

17. Which change does not increase the initial rate of reaction when  $\text{CaCO}_3(\text{s})$  is added to excess  $\text{HCl}(\text{aq})$ ?

- A. Decrease in the size of the  $\text{CaCO}_3(\text{s})$  particles
- B. Increase in the temperature of the reaction mixture
- C. Increase in the concentration of  $\text{HCl}(\text{aq})$ , keeping the same volume
- D. Increase in the volume of  $\text{HCl}(\text{aq})$ , keeping the same concentration

18. The diagram represents the Maxwell–Boltzmann energy distribution curve of the reactants for a chemical reaction with different activation energies,  $E_{\text{a1}}$  and  $E_{\text{a2}}$ .



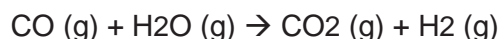
What is the reason why the rate of the reaction with activation energy  $E_{\text{a2}}$  is greater?

- A. More frequent collisions between the particles occur.
- B. More energetic collisions between the particles occur.
- C. A catalyst has been added.
- D. The temperature is higher.

19. Which are appropriate units for the rate of a reaction?

- A.  $\text{mol dm}^{-3} \text{s}^{-1}$
- B.  $\text{mol dm}^{-3} \text{s}$
- C.  $\text{mol dm}^{-3}$
- D. s

**20. Carbon monoxide and water react together in the industrial production of hydrogen gas.**



What is the impact of decreasing the volume of the equilibrium mixture at a constant temperature?

- A. The amount of  $\text{H}_2 \text{ (g)}$  remains the same but its concentration decreases.
- B. The forward reaction is favoured.
- C. The reverse reaction is favoured.
- D. The value of  $K_c$  remains unchanged

**21. Which of the following will shift the position of equilibrium to the right in the Haber process?**



**I. Decreasing the concentration of  $\text{NH}_3(\text{g})$**

**II. Decreasing the temperature**

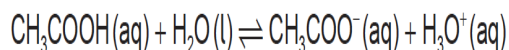
**III. Increasing the pressure**

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

**22. The following are  $K_c$  values for a reaction, with the same starting conditions carried out at different temperatures. Which equilibrium mixture has the highest concentration of products?**

- A.  $1 \times 10^{-2}$
- B. 1
- C.  $1 \times 10^1$
- D.  $1 \times 10^2$

23. Which is a conjugate Brønsted–Lowry acid-base pair?



- A.  $\text{CH}_3\text{COO}^- / \text{H}_3\text{O}^+$
- B.  $\text{H}_2\text{O} / \text{CH}_3\text{COO}^-$
- C.  $\text{H}_2\text{O} / \text{H}_3\text{O}^+$
- D.  $\text{CH}_3\text{COOH} / \text{H}_2\text{O}$

24. Which conditions must be met for a reaction to take place?

- I. Reactants collide with sufficient energy.
- II. Reactants collide with correct orientation.
- III. Reactants must be in the same state.

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

25. A student carried out a titration to determine the concentration of an acid and found that his value had good precision but poor accuracy. Which process explains this outcome?

- A. Consistently overshooting the volume of solution from the burette into the flask.
- B. Collection of insufficient titration data.
- C. Reading the meniscus in the burette at a different angle each time.
- D. Forgetting to rinse the flask after one of the titrations.

26. The pH of a solution changes from  $\text{pH} = 2$  to  $\text{pH} = 5$ . What happens to the concentration of the hydrogen ions during this pH change?

- A. It decreases by a factor of 1000
- B. It increases by a factor of 1000
- C. It decreases by a factor of 100
- D. It increases by a factor of 100



27. Which list contains only strong bases?

- A. ammonia, sodium hydroxide, ethylamine
- B. potassium hydroxide, ammonia, sodium hydroxide
- C. lithium hydroxide, potassium hydroxide, barium hydroxide
- D. ammonia, ethylamine, barium hydroxide

28. Which of the following gases does not result in acid deposition?

- A.  $\text{CO}_2$
- B.  $\text{NO}_2$
- C.  $\text{NO}$
- D.  $\text{SO}_2$

29. Applying IUPAC rules, what is the name of  $\text{MnO}_2$ ?

- A. Magnesium(II) oxide
- B. Manganese(II) oxide
- C. Magnesium(IV) oxide
- D. Manganese(IV) oxide

30. Which species are produced at each electrode during the electrolysis of molten lead(II) bromide,  $\text{PbBr}_2(\text{l})$ ?

	Negative electrode (cathode)	Positive electrode (anode)
A.	$\text{Br}^-(\text{l})$	$\text{Pb}^{2+}(\text{l})$
B.	$\text{Pb}^{2+}(\text{l})$	$\text{Br}^-(\text{l})$
C.	$\text{Br}_2(\text{g})$	$\text{Pb}(\text{l})$
D.	$\text{Pb}(\text{l})$	$\text{Br}_2(\text{g})$

31. Which statement is correct for a voltaic but not for an electrolytic cell?

- A. An electrolyte is required.
- B. The anode is where oxidation occurs.
- C. Ions move in the electrolyte.
- D. Electrons flow from the negative electrode to the positive electrode.

32. Two half-cells are connected via a salt bridge to make a voltaic cell. Which statement about this cell is correct?

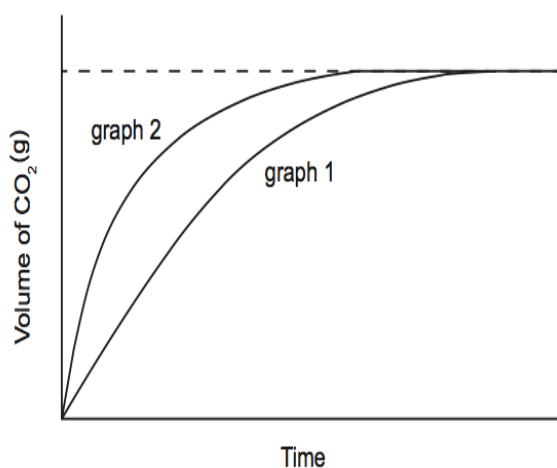
- A. Oxidation occurs at the positive electrode (cathode).
- B. It is also known as an electrolytic cell.
- C. Ions flow through the salt bridge.
- D. It requires a power supply to operate.

33. The molar mass of a gas, determined experimentally, is  $32 \text{ g mol}^{-1}$ . Its literature molar mass is  $40 \text{ g mol}^{-1}$ . What is the percentage error?

- A. 80%
- B. 25%
- C. 20%
- D. 8%

34. Graph 1 shows a plot of volume of  $\text{CO}_2(\text{g})$  against time for the reaction of  $\text{CaCO}_3(\text{s})$  with  $1.00 \text{ mol dm}^{-3} \text{HCl}(\text{aq})$ . The acid is the limiting reagent and entirely covers the lumps of  $\text{CaCO}_3(\text{s})$ .

Which set of conditions is most likely to give the data plotted in graph 2 when the same mass of  $\text{CaCO}_3(\text{s})$  is reacted with the same volume of  $\text{HCl}(\text{aq})$  at the same temperature?



	Size of lumps	Concentration of acid / $\text{mol dm}^{-3}$
A.	larger	1.00
B.	smaller	0.05
C.	smaller	1.00
D.	larger	0.05

35. Which mixture will form a buffer in aqueous solution?

- A. 0.10 mol  $\text{NH}_3$  + 0.20 mol  $\text{HCl}$
- B. 0.10 mol  $\text{NH}_3$  + 0.20 mol  $\text{NaOH}$
- C. 0.10 mol  $\text{NaOH}$  + 0.20 mol  $\text{KCl}$
- D. 0.20 mol  $\text{NH}_3$  + 0.10 mol  $\text{HCl}$

36. Which statements are correct about hydrogen bonding?

I. It is an electrostatic attraction between molecules.

II. It is present in liquid ammonia.

III. It is a permanent dipole-permanent dipole attraction.

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

37. Four identical sealed containers are prepared each containing  $10 \text{ cm}^3$  of an organic compound and at the temperature shown below. Which container will have the highest vapour pressure?

	Substance	Temperature / $^{\circ}\text{C}$
A.	$\text{C}_2\text{H}_5\text{OH}$	15
B.	$\text{C}_2\text{H}_5\text{OH}$	30
C.	$\text{CH}_3\text{OCH}_3$	15
D.	$\text{CH}_3\text{OCH}_3$	30

38. Which combination of the characteristics of element X, a metal, and element Y, a non metal, is most likely to lead to ionic bonding?

	X	Y
A.	low ionization energy	high electronegativity value
B.	low ionization energy	low electronegativity value
C.	high ionization energy	high electronegativity value
D.	high ionization energy	low electronegativity value

39. What are the correct formulas of the following ions?

	Ammonium	Hydrogencarbonate	Phosphate
A.	$\text{NH}_4^+$	$\text{HCO}_3^{2-}$	$\text{PO}_4^-$
B.	$\text{NH}_3^+$	$\text{HCO}_3^-$	$\text{PO}_4^{3-}$
C.	$\text{NH}_4^+$	$\text{HCO}_3^{2-}$	$\text{PO}_4^{2-}$
D.	$\text{NH}_4^+$	$\text{HCO}_3^-$	$\text{PO}_4^{3-}$

40. Which electron configurations do not follow the Hund's rule?

	1s	2s	2p		
I.	$\uparrow \downarrow$	$\uparrow \downarrow$	$\uparrow$	$\uparrow$	$\uparrow$
II.	$\uparrow \downarrow$	$\uparrow \downarrow$	$\uparrow \downarrow$	$\uparrow$	
III.	$\uparrow \downarrow$	$\uparrow \downarrow$	$\uparrow$	$\downarrow$	$\uparrow$

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