Chemistry SL P1

2009 November

School Level 12th IB Diploma Programme

Board Exam

International Baccalaureate (IB Board)

Solved

N09/4/CHEMI/SPM/ENG/TZ0/XX+

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CHEMISTRY
STANDARD LEVEL
PAPER 1

Tuesday 3 November 2009 (afternoon)

45 minutes

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 page 2 of this examination paper.

The Periodic Table

1	2											3	4	5	6	7	0
																	2 **He** 4.00
												5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
1 **H** 1.01												13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
3 **Li** 6.94	4 **Be** 9.01											31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
11 **Na** 22.99	12 **Mg** 24.31											49 **In** 114.82	50 **Sn** 118.69	51 **Sb** 121.75	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.30
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.71	29 **Cu** 63.55	30 **Zn** 65.37	81 **Tl** 204.37	82 **Pb** 207.19	83 **Bi** 208.98	84 **Po** (210)	85 **At** (210)	86 **Rn** (222)
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** 98.91	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.40	80 **Hg** 200.59	79 **Au** 196.97	78 **Pt** 195.09	77 **Ir** 192.22	76 **Os** 190.21	75 **Re** 186.21
55 **Cs** 132.91	56 **Ba** 137.34	57 † **La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.85												
87 **Fr** (223)	88 **Ra** (226)	89 ‡ **Ac** (227)															

†	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** 146.92	62 **Sm** 150.35	63 **Eu** 151.96	64 **Gd** 157.25	65 **Tb** 158.92	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.04	71 **Lu** 174.97
‡	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** (237)	94 **Pu** (242)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (254)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)

Atomic Number

Element

Atomic Mass

8809-6104

1. Which non-metal forms an oxide XO_2 with a relative molecular mass of 60?

A. C

B. N

C. Si

D. S

2. How many oxygen atoms are there in 0.20 mol of ethanoic acid, CH_3COOH?

A. 1.2×10^{23}

B. 2.4×10^{23}

C. 3.0×10^{24}

D. 6.0×10^{24}

3. 4.00 mol of a hydrocarbon with an empirical formula of CH_2 has a mass of 280 g. What is the molecular formula of this compound?

A. C_2H_4

B. C_3H_6

C. C_4H_8

D. C_5H_{10}

4. What will be the concentration of sulfate ions in $mol\,dm^{-3}$ when 0.20 mol of $KAl(SO_4)_2$ is dissolved in water to give 100 cm^3 of aqueous solution?

A. 0.2

B. 1.0

C. 2.0

D. 4.0

5. The volume of an ideal gas at 27.0 °C is increased from 3.00 dm^3 to 6.00 dm^3. At what temperature, in °C, will the gas have the original pressure?

A. 13.5

B. 54.0

C. 327

D. 600

6. Which species have the same number of electrons?

I. S^{2-}

II. Cl^-

III. Ne

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

7. Which gives the correct order of these processes in a mass spectrometer?

A.	ionization	deflection	acceleration
B.	ionization	acceleration	deflection
C.	acceleration	ionization	deflection
D.	deflection	acceleration	ionization

8. What happens when sodium is added to water?

I. A gas is evolved

II. The temperature of the water increases

III. A clear, colourless solution is formed

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

9. An atom of an element contains 19 electrons. In which group of the periodic table does it occur?

A. 1

B. 2

C. 5

D. 7

10. What compound is formed when lithium reacts with selenium?

A. LiSe

B. Li_2Se

C. $LiSe_2$

D. Li_2Se_2

11. How many non-bonding pairs of electrons are there in a nitrogen molecule?

A. 0

B. 1

C. 2

D. 3

12. Which molecule contains a bond angle of approximately 120°?

A. CH_4

B. C_2H_2

C. C_2H_4

D. C_2H_6

13. Which compound does **not** form hydrogen bonds between its molecules?

A. CH_3NH_2

B. CH_3COCH_3

C. CH_3COOH

D. CH_3CH_2OH

14. Which substance does **not** conduct electricity?

A. Solid zinc

B. Molten zinc

C. Solid zinc chloride

D. Molten zinc chloride

15. Which is true for a chemical reaction in which the products have a higher enthalpy than the reactants?

	Reaction	ΔH
A.	endothermic	positive
B.	endothermic	negative
C.	exothermic	positive
D.	exothermic	negative

16. In a reaction that occurs in 50 g of aqueous solution, the temperature of the reaction mixture increases by 20 °C. If 0.10 mol of the limiting reagent is consumed, what is the enthalpy change (in kJ mol^{-1}) for the reaction? Assume the specific heat capacity of the solution = 4.2 kJ kg^{-1} K^{-1}.

A. $-0.10 \times 50 \times 4.2 \times 20$

B. $-0.10 \times 0.050 \times 4.2 \times 20$

C. $\dfrac{-50 \times 4.2 \times 20}{0.10}$

D. $\dfrac{-0.050 \times 4.2 \times 20}{0.10}$

17. Use the average bond enthalpies below to calculate the enthalpy change, in kJ, for the following reaction.

$$H_2(g) + I_2(g) \rightarrow 2HI(g)$$

Bond	Bond energy / kJ mol^{-1}
H–H	440
I–I	150
H–I	300

A. +290

B. +10

C. –10

D. –290

18. Hydrochloric acid is reacted with large pieces of calcium carbonate, the reaction is then repeated using calcium carbonate powder. How does this change affect the activation energy and the collision frequency?

	Activation energy	Collision frequency
A.	increases	increases
B.	stays constant	increases
C.	increases	stays constant
D.	stays constant	stays constant

19. Which statement is true about using sulfuric acid as a catalyst in the following reaction?

$$CH_3{-}CO{-}CH_3(aq) + I_2(aq) \xrightarrow{H^+(aq)} CH_3{-}CO{-}CH_2{-}I(aq) + HI(aq)$$

I. The catalyst increases the rate of reaction.

II. The catalyst lowers the activation energy for the reaction.

III. The catalyst has been consumed at the end of the chemical reaction.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

20. An increase in temperature increases the amount of chlorine present in the following equilibrium.

$$PCl_5(s) \rightleftharpoons PCl_3(l) + Cl_2(g)$$

What is the best explanation for this?

A. The higher temperature increases the rate of the forward reaction only.

B. The higher temperature increases the rate of the reverse reaction only.

C. The higher temperature increases the rate of both reactions but the forward reaction is affected more than the reverse.

D. The higher temperature increases the rate of both reactions but the reverse reaction is affected more than the forward.

21. What will happen when at a constant temperature, more iodide ions, I^-, are added to the equilibrium below?

$$I_2(s) + I^-(aq) \rightleftharpoons I_3^-(aq)$$

A. The amount of solid iodine decreases and the equilibrium constant increases.

B. The amount of solid iodine decreases and the equilibrium constant remains unchanged.

C. The amount of solid iodine increases and the equilibrium constant decreases.

D. The amount of solid iodine increases and the equilibrium constant remains unchanged.

22. What is the formula of the conjugate base of the hydrogenphosphate ion, HPO_4^{2-}?

A. $H_2PO_4^-$

B. H_3PO_4

C. HPO_4^-

D. PO_4^{3-}

23. Which pH value is that of an aqueous solution of carbon dioxide?

A. 2.1

B. 5.6

C. 9.8

D. 12.2

24. Which are redox reactions?

I. $2FeCl_2 + Cl_2 \rightarrow 2FeCl_3$

II. $Mg + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2$

III. $H_2O + SO_3 \rightarrow H_2SO_4$

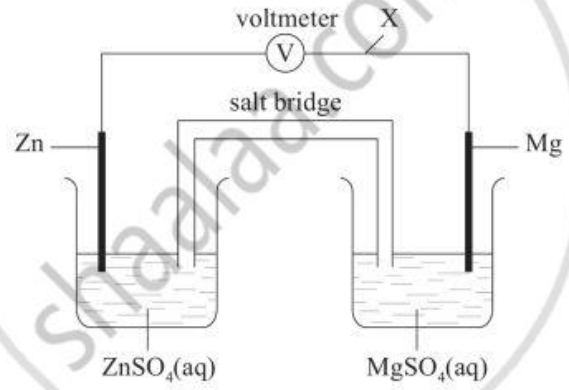
A. I and II only

B. I and III only

C. II and III only

D. I, II and III

25. Magnesium is higher in the reactivity series than zinc. In the cell shown, in which direction do the electrons flow in wire X and which metal is oxidized?



	Electron flow	Oxidized
A.	Zn to Mg	Zn
B.	Mg to Zn	Zn
C.	Zn to Mg	Mg
D.	Mg to Zn	Mg

26. How many **structural** isomers exist with the formula $C_3H_5Cl_3$?

A. 3

B. 4

C. 5

D. 6

27. Which substance is produced by the reaction of hydrogen with a vegetable oil?

A. Margarine

B. Nylon

C. Polypropene

D. Soap

28. Which substance is **not** produced during the combustion of alkanes?

A. CO_2

B. CO

C. C

D. H_2

29. Propene is converted to propanone in a two stage process.

$$\text{Propene} \rightarrow \text{X} \rightarrow \text{Propanone}$$

What is the formula of compound X?

A. $CH_3CHBrCH_3$

B. $CH_3CH_2CH_2Br$

C. $CH_3CHOHCH_3$

D. $CH_3CH_2CH_2OH$

30. Which are likely to be reduced when an experiment is repeated a number of times?

A. Random errors

B. Systematic errors

C. Both random and systematic errors

D. Neither random nor systematic errors

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MARKSCHEME

November 2009

CHEMISTRY

Standard Level

Paper 1

2 pages

1.	C	16.	D	31.	–	46.	–
2.	B	17.	C	32.	–	47.	–
3.	D	18.	B	33.	–	48.	–
4.	D	19.	A	34.	–	49.	–
5.	C	20.	C	35.	–	50.	–
6.	A	21.	B	36.	–	51.	–
7.	B	22.	D	37.	–	52.	–
8.	D	23.	B	38.	–	53.	–
9.	A	24.	A	39.	–	54.	–
10.	B	25.	D	40.	–	55.	–
11.	C	26.	C	41.	–	56.	–
12.	C	27.	A	42.	–	57.	–
13.	B	28.	D	43.	–	58.	–
14.	C	29.	C	44.	–	59.	–
15.	A	30.	A	45.	–	60.	–