Diploma Programme
Programme du diplôme
Programa del Diploma

Chemistry
Standard level
Paper 1

Wednesday 22 May 2019 (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 maximum mark for this examination paper is **[30 marks]**.

2219–6110

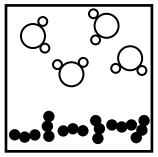
11 pages

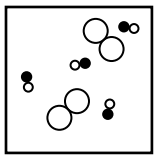
The Periodic Table

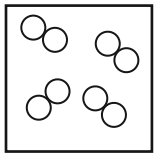
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 **H** 1.01			Atomic number **Element** Relative atomic mass														2 **He** 4.00
2	3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
3	11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.07	17 **Cl** 35.45	18 **Ar** 39.95
4	19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.87	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.38	31 **Ga** 69.72	32 **Ge** 72.63	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.90
5	37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.96	43 **Tc** (98)	44 **Ru** 101.07	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.76	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.29
6	55 **Cs** 132.91	56 **Ba** 137.33	57 † **La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.84	75 **Re** 186.21	76 **Os** 190.23	77 **Ir** 192.22	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
7	87 **Fr** (223)	88 **Ra** (226)	89 ‡ **Ac** (227)	104 **Rf** (267)	105 **Db** (268)	106 **Sg** (269)	107 **Bh** (270)	108 **Hs** (269)	109 **Mt** (278)	110 **Ds** (281)	111 **Rg** (281)	112 **Cn** (285)	113 **Unt** (286)	114 **Uug** (289)	115 **Uup** (288)	116 **Uuh** (293)	117 **Uus** (294)	118 **Uuo** (294)

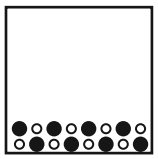
†	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.36	63 **Eu** 151.96	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.05	71 **Lu** 174.97
‡	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (262)

1. Which diagram represents a heterogeneous mixture?

A. 

B. 

C. 

D. 

2. What is the sum of the coefficients when the equation is balanced with the smallest whole numbers?

$$\_\_BaCl_2(aq) + \_\_Fe_2(SO_4)_3(aq) \rightarrow \_\_FeCl_3(aq) + \_\_BaSO_4(s)$$

A. 4

B. 6

C. 8

D. 9

3. What is the empirical formula of a hydrocarbon with 75 % carbon and 25 % hydrogen by mass?

A. C_3H

B. CH_2

C. C_2H_6

D. CH_4

4. Which graph would **not** show a linear relationship for a fixed mass of an ideal gas with all other variables constant?

A. P against V

B. P against $\frac{1}{V}$

C. P against T

D. V against T

5. Bromine consists of two stable isotopes that exist in approximately a 1 : 1 ratio. The relative atomic mass, A_r, of bromine is 79.90. Which are the stable isotopes of bromine?

A. ^{79}Br and ^{81}Br

B. ^{80}Br and ^{81}Br

C. ^{78}Br and ^{80}Br

D. ^{79}Br and ^{80}Br

6. What is the ground state electron configuration of an atom of chromium, Cr (Z = 24)?

A. $[Ar]3d^6$

B. $[Ar]4s^2 3d^4$

C. $[Ar]4s^1 3d^5$

D. $[Ar]4s^2 4p^4$

7. Which describes an atom of bismuth, Bi (Z = 83)?

	Principal energy level number	**Number of valence electrons**
A.	5	3
B.	5	5
C.	6	5
D.	6	15

8. What are typical characteristics of metals?

	Ionization energy	Electron affinity
A.	low	low
B.	high	high
C.	high	low
D.	low	high

9. What is the order of increasing boiling point?

A. $CH_3CH_2CH_2CH_3 < CH_3CH(OH)CH_3 < CH_3COCH_3 < CH_3CO_2H$

B. $CH_3CH_2CH_2CH_3 < CH_3COCH_3 < CH_3CH(OH)CH_3 < CH_3CO_2H$

C. $CH_3CO_2H < CH_3COCH_3 < CH_3CH(OH)CH_3 < CH_3CH_2CH_2CH_3$

D. $CH_3CH_2CH_2CH_3 < CH_3COCH_3 < CH_3CO_2H < CH_3CH(OH)CH_3$

10. Which species does **not** have resonance structures?

A. C_6H_6

B. NH_4^+

C. CO_3^{2-}

D. O_3

11. Which describes an ionic compound?

	Melting point	Electrical conductivity of solid
A.	high	high
B.	high	low
C.	low	high
D.	low	low

12. Which combination corresponds to a strong metallic bond?

	Charge on the metal ion	Radius of ion
A.	large	large
B.	large	small
C.	small	small
D.	small	large

13. When equal masses of X and Y absorb the same amount of energy, their temperatures rise by 5 °C and 10 °C respectively. Which is correct?

A. The specific heat capacity of X is twice that of Y.

B. The specific heat capacity of X is half that of Y.

C. The specific heat capacity of X is one fifth that of Y.

D. The specific heat capacity of X is the same as Y.

14. What is the enthalpy change of reaction for the following equation?

$$C_2H_4(g) + H_2(g) \rightarrow C_2H_6(g)$$

$$C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l) \qquad \Delta H = x$$

$$C_2H_6(g) + \frac{7}{2}O_2(g) \rightarrow 2CO_2(g) + 3H_2O(l) \qquad \Delta H = y$$

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l) \qquad \Delta H = z$$

A. $x + y + z$

B. $-x - y + z$

C. $x - y - z$

D. $x - y + z$

15. Which is correct for the reaction?

$$2Al(s) + 6HCl(aq) \rightarrow 2AlCl_3(aq) + 3H_2(g) \qquad \Delta H = -1049\,kJ$$

A. Reactants are less stable than products and the reaction is endothermic.

B. Reactants are more stable than products and the reaction is endothermic.

C. Reactants are more stable than products and the reaction is exothermic.

D. Reactants are less stable than products and the reaction is exothermic.

16. Which properties can be monitored to determine the rate of the reaction?

$$Fe(s) + CuSO_4(aq) \rightarrow Cu(s) + FeSO_4(aq)$$

I. change in volume
II. change in temperature
III. change in colour

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

17. Which will increase the rate of reaction between calcium carbonate and hydrochloric acid?

I. an increase in temperature
II. an increase in concentration of hydrochloric acid
III. an increase in particle size of calcium carbonate

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

18. K_c for $2N_2O(g) \rightleftharpoons 2N_2(g) + O_2(g)$ is 7.3×10^{34}.

What is K_c for the following reaction, at the same temperature?

$$N_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons N_2O(g)$$

A. 7.3×10^{34}

B. $\frac{1}{\sqrt{7.3 \times 10^{34}}}$

C. $\frac{2}{7.3 \times 10^{34}}$

D. $\frac{1}{2 \times 7.3 \times 10^{34}}$

19. Which solution is basic at 25 °C?

$$K_w = 1.0 \times 10^{-14}$$

A. $[H^+] = 1.0 \times 10^{-3}\,\text{mol dm}^{-3}$

B. $[OH^-] = 1.0 \times 10^{-13}\,\text{mol dm}^{-3}$

C. solution of $pH = 4.00$

D. $[H_3O^+] = 1.0 \times 10^{-13}\,\text{mol dm}^{-3}$

20. Which is **not** a source of oxides of sulfur and nitrogen?

A. burning coal

B. internal combustion engines

C. burning methane

D. volcanic eruptions

21. Where does oxidation occur in a voltaic cell?

A. positive electrode and anode

B. negative electrode and anode

C. positive electrode and cathode

D. negative electrode and cathode

22. Which is the species oxidized and the oxidizing agent in the reaction?

$$MnO_2(s) + 4HCl(aq) \rightarrow MnCl_2(aq) + Cl_2(g) + 2H_2O(l)$$

	Species oxidized	Oxidizing agent
A.	Cl^-	HCl
B.	MnO_2	MnO_2
C.	MnO_2	HCl
D.	Cl^-	MnO_2

23. Which product will be obtained at the anode (positive electrode) when molten NaCl is electrolysed?

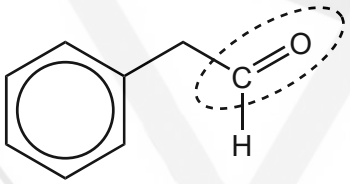
A. $Na(l)$

B. $Cl(g)$

C. $Cl_2(g)$

D. $Na(s)$

24. Which functional group is surrounded in the molecule?



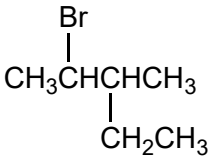
A. hydroxyl

B. carboxyl

C. carbonyl

D. ether

25. What is the IUPAC name of the following molecule?



A. 2-bromo-3-ethylbutane

B. 3-methyl-4-bromopentane

C. 2-ethyl-3-bromobutane

D. 2-bromo-3-methylpentane

26. What is the mechanism of the reaction between alkenes and halogens in the absence of light?

A. radical substitution

B. electrophilic substitution

C. electrophilic addition

D. nucleophilic substitution

27. Which alcohol would produce a carboxylic acid when heated with acidified potassium dichromate(VI)?

A. propan-2-ol

B. butan-1-ol

C. 2-methylpropan-2-ol

D. pentan-3-ol

28. How should a measurement of 5.00 g from a balance be recorded?

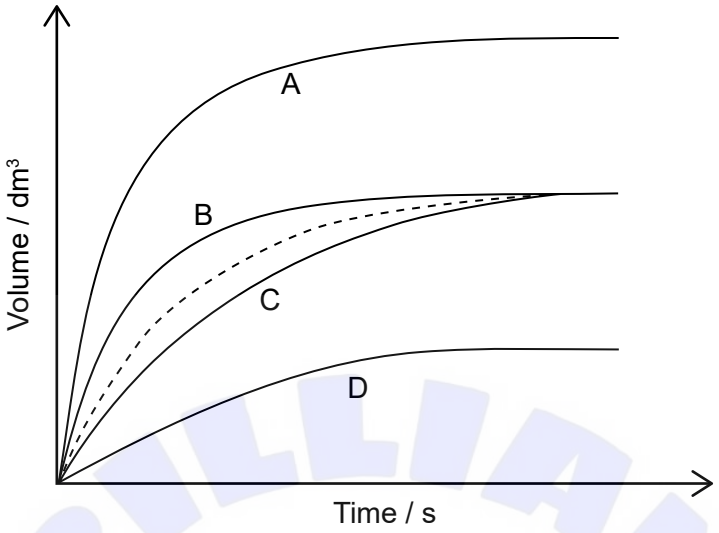
A. 5.00 ± 0.1 g

B. 5.00 ± 0.01 g

C. 5.00 ± 1 g

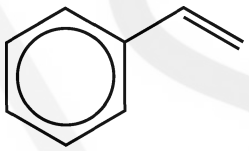
D. 5.00 ± 0.001 g

29. The dotted line represents the formation of oxygen, $O_2(g)$, from the uncatalysed complete decomposition of hydrogen peroxide, $H_2O_2(aq)$.



Which curve represents a catalysed reaction under the same conditions?

30. What is the degree of unsaturation (index of hydrogen deficiency) for the molecule?



A. 1

B. 2

C. 4

D. 5