N08/4/CHEMI/SPM/ENG/TZ0/XX

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CHEMISTRY
STANDARD LEVEL
PAPER 1

Tuesday 11 November 2008 (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
1 **H** 1.01				Atomic Number **Element** Atomic Mass													2 **He** 4.00
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
11 **Na** 22.99	12 **Mg** 24.31											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
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	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
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	49 **In** 114.82	50 **Sn** 118.69	51 **Sb** 121.75	52 **Te** 127.60	53 **I** 126.90	54 **Xe** 131.30
55 **Cs** 132.91	56 **Ba** 137.34	57 † **La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.85	75 **Re** 186.21	76 **Os** 190.21	77 **Ir** 192.22	78 **Pt** 195.09	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.37	82 **Pb** 207.19	83 **Bi** 208.98	84 **Po** (210)	85 **At** (210)	86 **Rn** (222)
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)

1. Analytical chemists can detect amounts of amino acids as small as 2.0×10^{-21} mol of molecules. How many molecules does this represent?

A. 2.0×10^{-21}

B. 1.2×10^{3}

C. 6.0×10^{23}

D. 3.0×10^{44}

2. One stage in the manufacture of nitric acid is the oxidation of ammonia:

$$\_\_\ NH_3(g) + \_\_\ O_2(g) \rightarrow \_\_\ NO(g) + \_\_\ H_2O(l)$$

When the equation is balanced using the smallest possible whole numbers, what is the coefficient for NH_3?

A. 2

B. 4

C. 5

D. 6

3. What amount of solute ions, in moles, is present in 50 cm^3 of 0.10 $mol\,dm^{-3}$ sodium hydroxide solution?

A. 2.5×10^{-3}

B. 5.0×10^{-3}

C. 1.0×10^{-2}

D. 5.0×10^{-2}

4. Complete combustion of a hydrocarbon produces 0.44 g of CO_2 and 0.18 g of H_2O. What is the empirical formula of the hydrocarbon?

A. CH

B. CH_2

C. CH_3

D. CH_4

5. Which species contains the same number of electrons and neutrons?

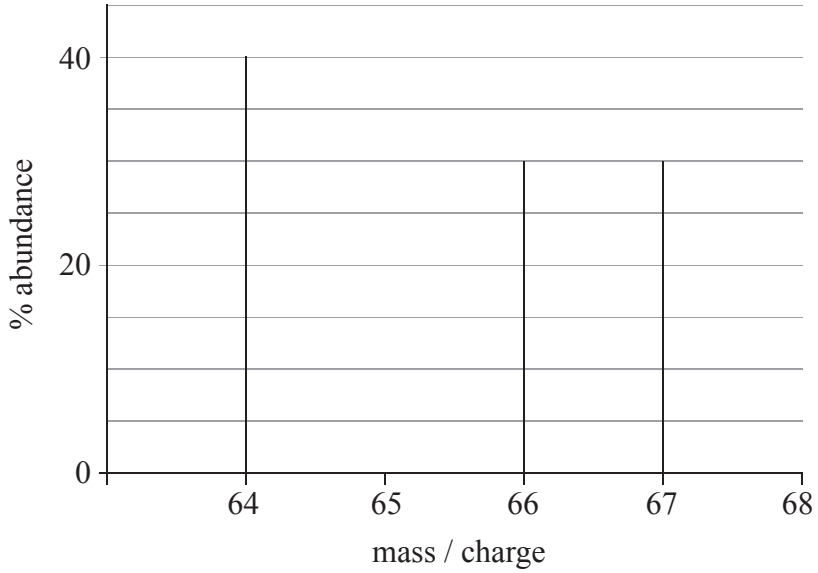
A. $^{1}_{1}H$

B. $^{2}_{1}H^{-}$

C. $^{7}_{3}Li^{+}$

D. $^{35}_{17}Cl^{-}$

6. The mass spectrum of a sample of an element is shown below.



Which value is closest to the relative atomic mass of the element?

A. 64.5

B. 65.0

C. 65.5

D. 66.0

7. In what order are the elements listed in the periodic table?

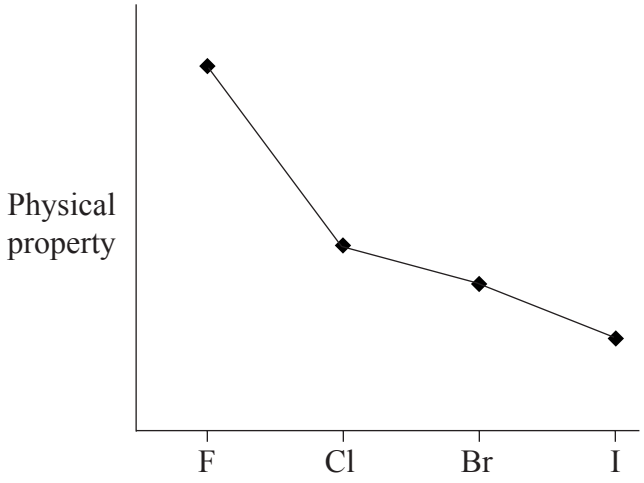
A. In order of relative atomic mass

B. In order of reactivity

C. In order of nuclear charge

D. In order of electronegativity

8. The graph shows the trend in a physical property down group 7 in the periodic table.



What is the physical property?

A. Atomic radius

B. Electronegativity

C. Density

D. Melting point

9. The table shows the boiling points of the hydrogen halides.

Compound	Boiling point / °C
HF	20
HCl	−85
HBr	−67
HI	−35

Which statement explains the higher boiling point of hydrogen fluoride?

A. The covalent bond in hydrogen fluoride is stronger than those in the other hydrogen halides.

B. There is strong hydrogen bonding between the hydrogen fluoride molecules.

C. Fluorine is the most reactive element in group 7.

D. Fluorine has the highest first ionization energy in group 7.

10. What happens when lithium and oxygen react together?

A. Each lithium atom gains one electron.

B. Each lithium atom loses one electron.

C. Each oxygen atom gains one electron.

D. Each oxygen atom loses one electron.

11. Which substance has the lowest electrical conductivity?

A. Al(s)

B. $Al_2O_3(l)$

C. KCl(aq)

D. HCl(g)

12. What is the C–C–C bond angle in CH_3COCH_3?

A. 180°

B. 120°

C. 109°

D. 90°

13. Which sample contains molecules with the greatest average kinetic energy?

A. H_2 at 100 K

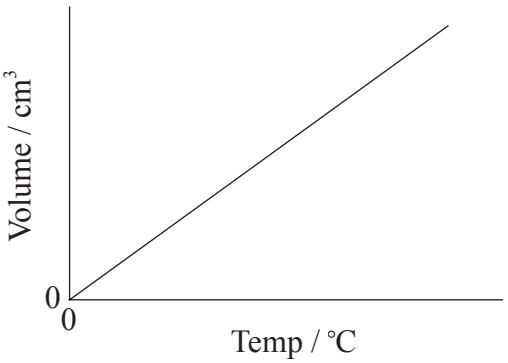
B. C_3H_8 at 273 K

C. N_2 at 273 K

D. Br_2 at 373 K

14. Which graph shows the variation in volume of a fixed mass of an ideal gas with temperature in ℃ at constant pressure?

A.



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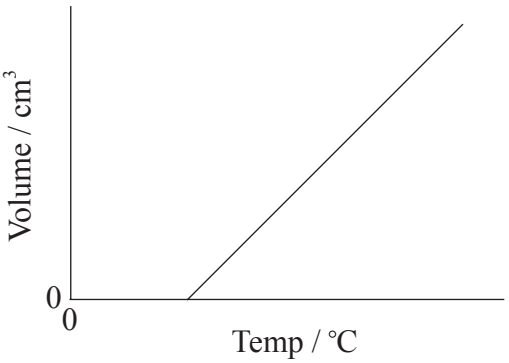

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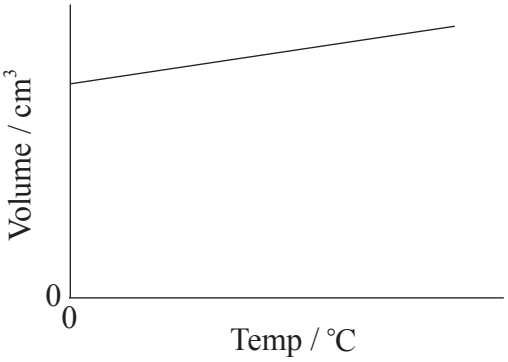
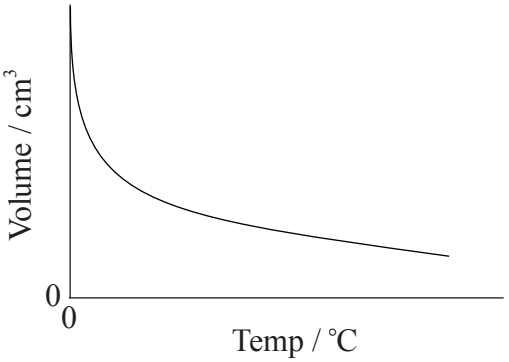


D.



15. Which statement about covalent bonds is correct?

A. Breaking covalent bonds is exothermic and releases energy.

B. Breaking covalent bonds is endothermic and absorbs energy.

C. Making covalent bonds is exothermic and absorbs energy.

D. Making covalent bonds is endothermic and releases energy.

16. The average bond enthalpy for the C–H bond is 412 kJ mol^{-1}. Which process has an enthalpy change closest to this value?

A. $CH_4(g) \rightarrow C(s) + 2H_2(g)$

B. $CH_4(g) \rightarrow C(g) + 2H_2(g)$

C. $CH_4(g) \rightarrow C(g) + 4H(g)$

D. $CH_4(g) \rightarrow CH_3(g) + H(g)$

17. A reaction has a positive $\Delta H^{\ominus}$ and a negative $\Delta S^{\ominus}$ value. Which statement about this reaction is correct?

A. It is not spontaneous at any temperature.

B. It is spontaneous at all temperatures.

C. It is spontaneous only at low temperatures.

D. It is spontaneous only at high temperatures.

18. When 50 cm^3 of 1.0 mol dm^{-3} nitric acid solution, $HNO_3(aq)$, is added to 50 cm^3 of 1.0 mol dm^{-3} potassium hydroxide solution, KOH(aq), the temperature of the mixture increases by 6.4 °C. What will be the temperature change when 25 cm^3 of each of these solutions are mixed together?

A. 1.6 °C

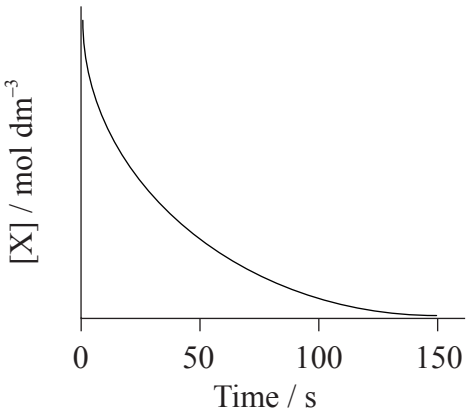
B. 3.2 °C

C. 6.4 °C

D. 12.8 °C

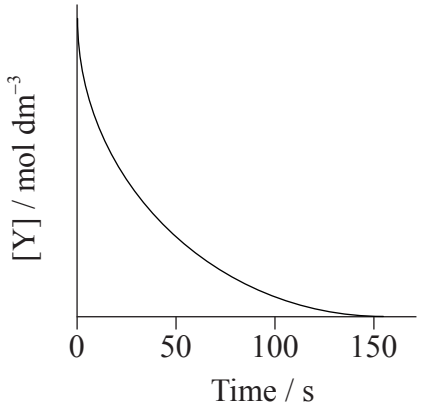
19. The graph below shows how the concentration of X changes with time during the following reaction:

$$X \rightarrow Y$$



Which graph shows the change in concentration of Y during the same time period?

A.



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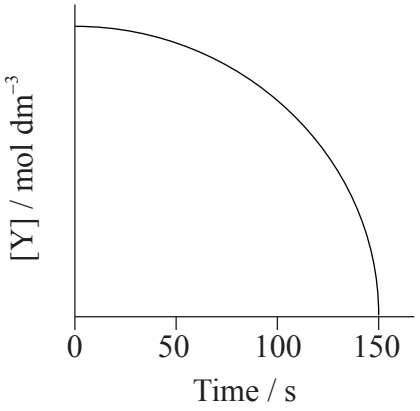

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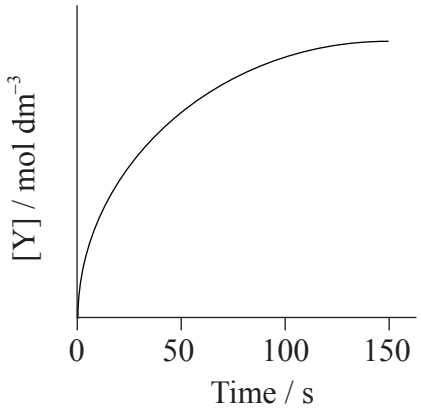

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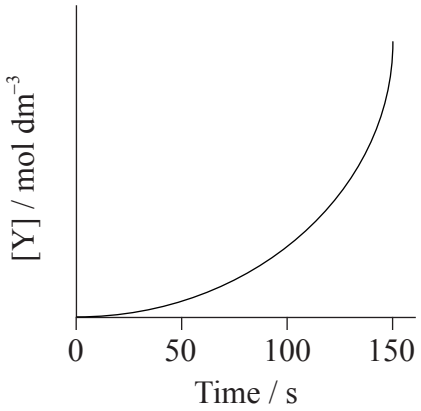

20. Which statement about the activation energy of a reaction is correct?

A. The activation energy is changed by the presence of a catalyst but not by an increase in temperature.

B. The activation energy is changed by an increase in temperature but not by the presence of a catalyst.

C. The activation energy is changed by both an increase in temperature and the presence of a catalyst.

D. The activation energy is not changed by either an increase in temperature or the presence of a catalyst.

21. The manufacture of ammonia is based on the equilibrium:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \qquad \Delta H^{\ominus} = -92 \text{ kJ mol}^{-1}$$

Which changes will increase the equilibrium concentration of ammonia?

I. Increasing the pressure

II. Decreasing the temperature

III. Adding an iron catalyst

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

22. What alters the value of the equilibrium constant, K_c , for a reversible reaction?

A. Changing the temperature

B. Changing a reactant concentration

C. Changing a product concentration

D. Adding a catalyst

23. Which statement describes a difference between strong acids and weak acids?

A. Solutions of weak acids cannot conduct an electric current but solutions of strong acids can conduct an electric current.

B. Strong acids can form concentrated solutions but weak acids cannot form concentrated solutions.

C. Weak acids are less soluble in water than strong acids.

D. Strong acids are more dissociated in aqueous solution than weak acids.

24. Which combinations form buffer solutions?

I. 50 cm^3 of 0.1 mol dm^{-3} $CH_3COOH(aq)$ + 25 cm^3 of 0.1 mol dm^{-3} $NaOH(aq)$

II. 50 cm^3 of 0.1 mol dm^{-3} $CH_3COOH(aq)$ + 50 cm^3 of 0.1 mol dm^{-3} $NaOH(aq)$

III. 50 cm^3 of 0.1 mol dm^{-3} $CH_3COOH(aq)$ + 50 cm^3 of 0.1 mol dm^{-3} $CH_3COONa(aq)$

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

25. Which statement about the electrolysis of molten sodium bromide is correct?

A. Bromide ions lose electrons at the negative electrode.

B. Bromide ions gain electrons at the positive electrode.

C. Bromide ions gain electrons at the negative electrode.

D. Bromide ions move even if there is no current.

26. In which compound does manganese have the highest oxidation number?

A. $MnCl_2$

B. MnO_2

C. Mn_2O_3

D. $MnSO_4$

27. Palladium chloride changes colour in the presence of carbon monoxide as shown below.

$$\underset{\text{orange}}{PdCl_2(s)} + CO(g) + H_2O(l) \rightarrow \underset{\text{black}}{Pd(s)} + CO_2(g) + 2HCl(aq)$$

In terms of oxidation numbers, which changes occur during the reaction?

I. Palladium is reduced.

II. Carbon is oxidized.

III. Hydrogen is reduced.

A. I and II only

B. I and III only

C. II and III only

D. I, II and III

28. Which of the following can form an addition polymer?

A. Alanine (2-aminopropanoic acid)

B. Butane

C. But-2-ene

D. 1,2-dichlorobutane

29. How many different compounds have the molecular formula C_3H_8O ?

A. 2

B. 3

C. 4

D. 5

30. Which compound, when hydrogenated, gives a product with a chiral centre?

A. $CH_2=CH_2$

B. $CH_3CBr=CH_2$

C. $CH_3CH_2CBr=CH_2$

D. $CH_3CH_2C(CH_3)=CH_2$