

**Chemistry**  
**Standard level**  
**Paper 1**

Wednesday 16 May 2018 (afternoon)

45 minutes

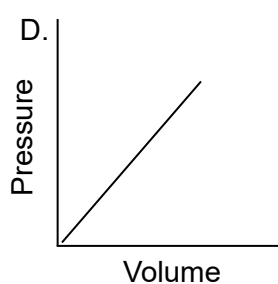
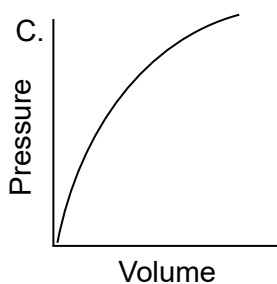
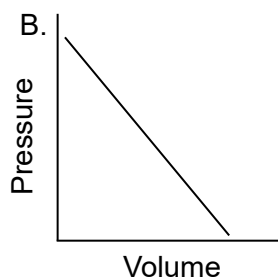
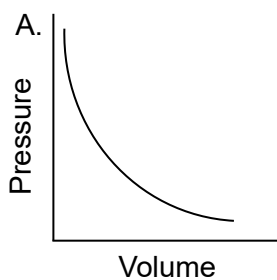
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**Instructions to candidates**

- 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 page 2 of this examination paper.
- The maximum mark for this examination paper is **[30 marks]**.

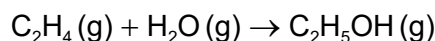


1. Which is a homogeneous mixture?
- A. Oil and water
  - B. Sand and water
  - C. Ethanol and water
  - D. Chalk and sand
2. What is the molecular formula of a hydrocarbon containing 84.6% carbon by mass with a molar mass of  $142.3 \text{ g mol}^{-1}$ ?
- A.  $\text{C}_{20}\text{H}_{44}$
  - B.  $\text{C}_{11}\text{H}_{10}$
  - C.  $\text{C}_{10}\text{H}_{22}$
  - D.  $\text{C}_5\text{H}_{11}$
3. Which graph shows the relationship between the volume and pressure of a fixed mass of an ideal gas?

**Turn over**

4. What is the percentage yield when 7 g of ethene produces 6 g of ethanol?

$M_r$  (ethene) = 28 and  $M_r$  (ethanol) = 46



- A.  $\frac{6 \times 7 \times 100}{28 \times 46}$
- B.  $\frac{6 \times 46 \times 100}{7 \times 28}$
- C.  $\frac{6 \times 28}{7 \times 46 \times 100}$
- D.  $\frac{6 \times 28 \times 100}{7 \times 46}$

5. Which shows the number of subatomic particles in  $^{31}\text{P}^{3-}$ ?

	Protons	Neutrons	Electrons
A.	15	16	18
B.	15	16	12
C.	16	31	15
D.	31	31	15

6. Which are correct statements about the emission spectrum of hydrogen in the visible region?

- I. The red line has a lower energy than the blue line.
- II. The lines converge at longer wavelength.
- III. The frequency of the blue line is greater than the frequency of the red line.

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

7. Which describes the oxide of sodium,  $\text{Na}_2\text{O}$ ?

	<b>Bonding</b>	<b>Conduction of electricity (pure substance)</b>	<b>pH of aqueous solution</b>
A.	covalent	as a solid and liquid	low
B.	covalent	as a solid only	high
C.	ionic	as a solid and liquid	low
D.	ionic	as a liquid only	high

8. Which statement is correct?

- A. Atomic radius decreases down group 17.
- B. First ionization energy decreases down group 1.
- C. Atomic radius increases across period 3 from Na to Cl.
- D. First ionization energy decreases across period 3 from Na to Cl.

9. What is the formula of ammonium phosphate?

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

10. Which form of carbon is the poorest electrical conductor?

- A. Graphite
- B. Graphene
- C. Diamond
- D. Carbon nanotube

**Turn over**

11. What is the molecular geometry and bond angle in the molecular ion  $\text{NO}_3^-$ ?

	<b>Molecular geometry</b>	<b>Bond angle</b>
A.	tetrahedral	$109.5^\circ$
B.	trigonal planar	$120^\circ$
C.	trigonal pyramidal	$107^\circ$
D.	trigonal planar	$109.5^\circ$

12. What are the strongest intermolecular forces between molecules of propanone,  $\text{CH}_3\text{COCH}_3$ , in the liquid phase?

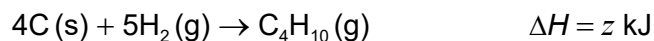
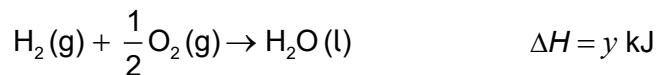
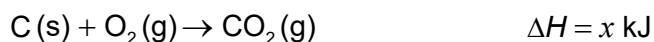
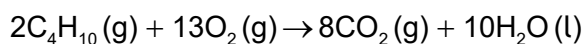
- A. London (dispersion) forces
- B. Covalent bonding
- C. Hydrogen bonding
- D. Dipole-dipole forces

13. The enthalpy of combustion of ethanol is determined by heating a known mass of tap water in a glass beaker with a flame of burning ethanol.

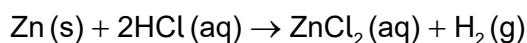
Which will lead to the greatest error in the final result?

- A. Assuming the density of tap water is  $1.0 \text{ g cm}^{-3}$
- B. Assuming all the energy from the combustion will heat the water
- C. Assuming the specific heat capacity of the tap water is  $4.18 \text{ J g}^{-1} \text{ K}^{-1}$
- D. Assuming the specific heat capacity of the beaker is negligible

14. What is the enthalpy of combustion of butane in  $\text{kJ mol}^{-1}$ ?



- A.  $4x + 5y - z$
- B.  $4x + 5y + z$
- C.  $8x + 10y - 2z$
- D.  $8x + 5y + 2z$
15. Which statement is correct?
- A. In an exothermic reaction, the products have more energy than the reactants.
- B. In an exothermic reversible reaction, the activation energy of the forward reaction is greater than that of the reverse reaction.
- C. In an endothermic reaction, the products are more stable than the reactants.
- D. In an endothermic reversible reaction, the activation energy of the forward reaction is greater than that of the reverse reaction.
16. Which change increases the rate of formation of hydrogen when zinc reacts with excess hydrochloric acid, assuming all other conditions remain the same?



- A. Adding water to the hydrochloric acid
- B. Decreasing the temperature
- C. Increasing the volume of hydrochloric acid
- D. Decreasing the size of the zinc particles while keeping the total mass of zinc the same

Turn over

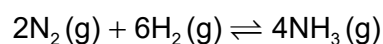
17. Which statements are correct?

- I. The activation energy of a reaction is not affected by temperature.
- II. A catalyst reduces the enthalpy change of a reaction.
- III. Catalysts provide alternative reaction pathways.

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

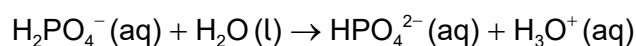
18. The equilibrium constant for  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$  is  $K$ .

What is the equilibrium constant for this equation?



- A.  $K$
- B.  $2K$
- C.  $K^2$
- D.  $2K^2$

19. Which classification is correct for the reaction?



	<b>Brønsted–Lowry Acid</b>	<b>Brønsted–Lowry Base</b>
A.	$\text{H}_2\text{O}$	$\text{H}_2\text{PO}_4^-$
B.	$\text{HPO}_4^{2-}$	$\text{H}_2\text{PO}_4^-$
C.	$\text{H}_2\text{PO}_4^-$	$\text{H}_3\text{O}^+$
D.	$\text{H}_2\text{PO}_4^-$	$\text{H}_2\text{O}$

20. What are the products of the reaction between sulfuric acid and sodium hydrogen carbonate?

- A.  $\text{NaSO}_4 + \text{H}_2\text{O} + \text{CO}_2$
- B.  $\text{Na}_2\text{SO}_4 + \text{CO}_2$
- C.  $\text{Na}_2\text{SO}_4 + \text{H}_2\text{O} + \text{CO}_2$
- D.  $\text{NaSO}_4 + \text{H}_2\text{CO}_3$

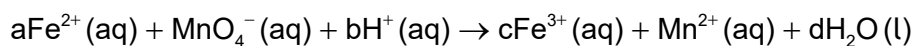
21. Which equation shows oxygen undergoing reduction?

- A.  $2\text{F}_2 + \text{O}_2 \rightarrow 2\text{F}_2\text{O}$
- B.  $\text{Na}_2\text{O} + \text{H}_2\text{O} \rightarrow 2\text{NaOH}$
- C.  $\text{H}_2\text{O}_2 + 2\text{HI} \rightarrow 2\text{H}_2\text{O} + \text{I}_2$
- D.  $2\text{CrO}_4^{2-} + 2\text{H}^+ \rightleftharpoons \text{Cr}_2\text{O}_7^{2-} + \text{H}_2\text{O}$

22. What are the products of electrolysis when molten calcium bromide is electrolysed using graphite electrodes?

	Product at cathode (negative electrode)	Product at anode (positive electrode)
A.	calcium	bromine
B.	bromine	calcium
C.	calcium ions	bromide ions
D.	bromide ions	calcium ions

23. Which coefficients correctly balance this redox equation?



	a	b	c	d
A.	1	8	1	4
B.	5	4	5	2
C.	3	4	3	2
D.	5	8	5	4

Turn over

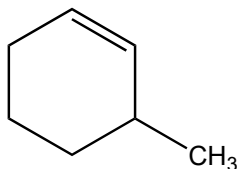
24. What are possible names of a molecule with molecular formula  $C_4H_{10}O$ ?
- 1-Methoxypropane
  - 2-Methylpropan-2-ol
  - Butanal
- A. I and II only  
B. I and III only  
C. II and III only  
D. I, II and III
25. What is the product of the reaction between hex-3-ene and steam?
- A. Hexan-1-ol  
B. Hexan-2-ol  
C. Hexan-3-ol  
D. Hexan-4-ol
26. Which of these reactions proceeds by a free radical mechanism in the presence of UV light?
- A.  $C_6H_6 + Cl_2 \rightarrow C_6H_5Cl + HCl$   
B.  $C_6H_6 + 3H_2 \rightarrow C_6H_{12}$   
C.  $CH_2CH_2 + HBr \rightarrow CH_3CH_2Br$   
D.  $CH_3CH_3 + Cl_2 \rightarrow CH_3CH_2Cl + HCl$
27. Which compound could be formed when  $CH_3CH_2CH_2OH$  is heated with acidified potassium dichromate(VI)?
- $CH_3CH_2CHO$
  - $CH_3CH_2COOH$
  - $CH_3COCH_3$
- A. I and II only  
B. I and III only  
C. II and III only  
D. I, II and III

28. Which value of  $q$ , in J, has the correct number of significant figures?

$$q = mc\Delta T$$

where  $m = 2.500\text{ g}$ ,  $c = 4.18\text{ J g}^{-1}\text{ K}^{-1}$  and  $\Delta T = 0.60\text{ K}$ .

- A. 6  
B. 6.3  
C. 6.27  
D. 6.270
29. What is the index of hydrogen deficiency, IHD, of 3-methylcyclohexene?



- A. 0  
B. 1  
C. 2  
D. 3
30. What is the ratio of the areas of the signals in the  $^1\text{H}$  NMR spectrum of pentan-3-ol?
- A. 6:4:1:1  
B. 6:2:2:2  
C. 5:5:1:1  
D. 3:3:2:2:1:1
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