

Chemistry
Standard level
Paper 1

Key

Wednesday 16 May 2018 (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]**.



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.** $\frac{6 \times 28 \times 100}{7 \times 46}$

Handwritten calculation: $7g \times \frac{28 \text{ mol}}{28g} \times \frac{1 C_2H_5OH}{1 C_2H_4} \times \frac{46g}{\text{mol}} = 11.5g$

Annotation: "flip all to make denominator" with a diagram showing the cancellation of units.

Final result: $11.5g$ (crossed out) and $6g$ written above it.

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

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

Handwritten: $31 - 15 = 16$

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. ^{shorter}
- 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, Na_2O ?

Handwritten: "gliz", "Metal oxides react w/ H_2O to give metal hydroxide", $Na_2O + H_2O \rightarrow 2NaOH$

	Bonding	Conduction of electricity (pure substance)	pH of aqueous solution
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?

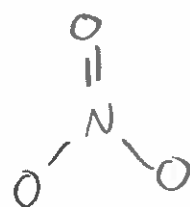
- A. $(NH_3)_3PO_4$
 - B.** $(NH_4)_3PO_4$
 - C. $(NH_4)_2PO_4$
 - D. $(NH_3)_2PO_3$
- Handwritten: NH_4^+ and PO_4^{3-}

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

- A. Graphite
- B. Graphene
- C.** Diamond covalent network
- D. Carbon nanotube

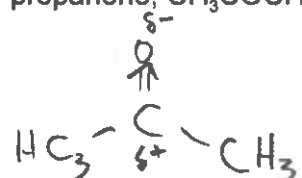
11. What is the molecular geometry and bond angle in the molecular ion NO_3^- ?

	Molecular geometry	Bond angle
A.	tetrahedral	109.5°
<input checked="" type="radio"/> B.	trigonal planar	120°
C.	trigonal pyramidal	107°
D.	trigonal planar	109.5°



12. What are the strongest intermolecular forces between molecules of propanone, CH_3COCH_3 , in the liquid phase?

- A. London (dispersion) forces ✓
 B. Covalent bonding *within*
 C. Hydrogen bonding *NO OH*
 D. Dipole-dipole forces ✓



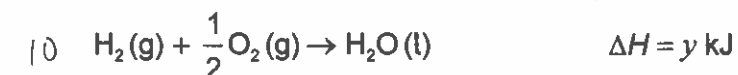
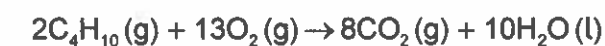
13. The enthalpy of combustion of ethanol is determined by heating a known mass of tap water in a glass beaker with a flame of burning ethanol.

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

- A. Assuming the density of tap water is 1.0 g cm^{-3} *good*
 B. Assuming all the energy from the combustion will heat the water
 C. Assuming the specific heat capacity of the tap water is $4.18 \text{ J g}^{-1} \text{ K}^{-1}$ *good*
 D. Assuming the specific heat capacity of the beaker is negligible *not negligible, but small.*

most heat is lost to air

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

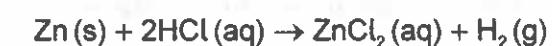


- A. $4x + 5y - z$
 B. $4x + 5y + z$
 C. $8x + 10y - 2z$ *x per mol ∴ ÷ 2*
 D. $8x + 5y + 2z$
- P-R*

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

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

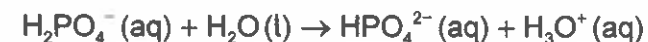
18. The equilibrium constant for $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ is K .

What is the equilibrium constant for this equation?

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

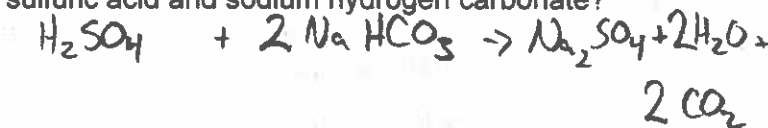
$2N_2(g) + 6H_2(g) \rightleftharpoons 4NH_3(g)$
 Technically K^2 but that's dum
 Apparently not ...
 Reduce

19. Which classification is correct for the reaction?



	Brønsted-Lowry Acid	Brønsted-Lowry Base
A.	H_2O	$H_2PO_4^-$
B.	HPO_4^{2-}	$H_2PO_4^-$
C.	$H_2PO_4^-$	H_3O^+
<input checked="" type="radio"/> D.	$H_2PO_4^-$	H_2O

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



- A. $NaSO_4 + H_2O + CO_2$ ✗
- B. $Na_2SO_4 + CO_2$
- C. $Na_2SO_4 + H_2O + CO_2$ Conservation of mass
- D. $NaSO_4 + H_2CO_3$ ✗

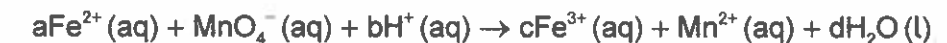
21. Which equation shows oxygen undergoing reduction?

- A. $2F_2 + O_2 \rightarrow 2F_2O$ (not -2) F is more electronegative gain e^- (more neg)
- B. $Na_2O + H_2O \rightarrow 2NaOH$
- C. $H_2O_2 + 2HI \rightarrow 2H_2O + I_2$
- D. $2CrO_4^{2-} + 2H^+ \rightleftharpoons Cr_2O_7^{2-} + H_2O$

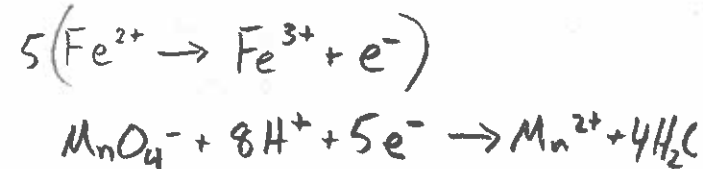
22. What are the products of electrolysis when molten calcium bromide is electrolysed using graphite electrodes?

	Product at cathode (negative electrode)	Product at anode (positive electrode)
<input checked="" type="radio"/> A.	calcium	bromine
B.	bromine	calcium
C.	calcium ions	bromide ions
D.	bromide ions	calcium ions

23. Which coefficients correctly balance this redox equation?

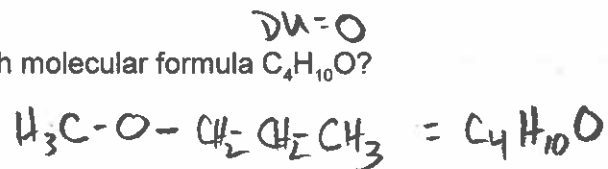


	a	b	c	d
<input checked="" type="radio"/> A.	1	8	1	4
B.	5	4	5	2
<input checked="" type="radio"/> C.	3	4	3	2
<input checked="" type="radio"/> D.	5	8 ✓	5	4



24. What are possible names of a molecule with molecular formula $C_4H_{10}O$?

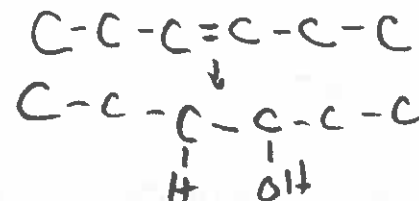
- I. 1-Methoxypropane ✓
- II. 2-Methylpropan-2-ol ✓
- III. Butanal ✗



- (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. $CH_2=CH_2 + HBr \rightarrow CH_3CH_2Br$

Halogen + Alkene

- (D) $CH_3CH_3 + Cl_2 \rightarrow CH_3CH_2Cl + HCl$

Alkane

27. Which compound could be formed when $CH_3CH_2CH_2OH$ is heated with acidified potassium dichromate(VI)?

terminal OH 1°

- I. CH_3CH_2CHO ✓
- II. CH_3CH_2COOH ✓
- III. $CH_3COCH_3 \rightarrow$ only 2°

- (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?

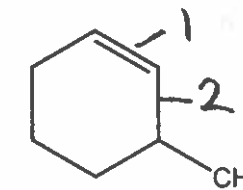
$q = mc\Delta T$
 Joules

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

- A. 6
- (B) 6.3
- C. 6.27
- D. 6.270

2

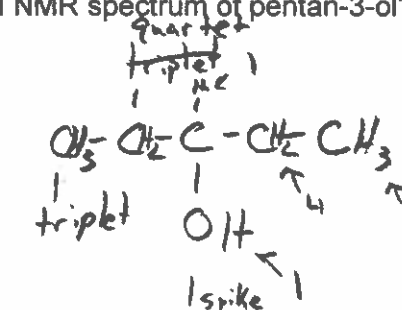
29. What is the index of hydrogen deficiency, IHD, of 3-methylcyclohexene?



- A. 0
- B. 1
- (C) 2
- D. 3

30. What is the ratio of the areas of the signals in the 1H 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



6:4