

Chemistry
Standard level
Paper 1

Wednesday 8 November 2017 (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]**.

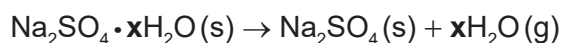
The Periodic Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1 H 1.01												5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	2 He 4.00
2	3 Li 6.94	4 Be 9.01											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	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 Uut (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. How many atoms of nitrogen are there in 0.50 mol of $(\text{NH}_4)_2\text{CO}_3$?

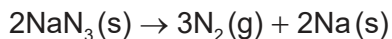
- A. 1
- B. 2
- C. 3.01×10^{23}
- D. 6.02×10^{23}

2. What is the value of x when 32.2 g of $\text{Na}_2\text{SO}_4 \cdot x\text{H}_2\text{O}$ are heated leaving 14.2 g of anhydrous Na_2SO_4 ? $M_r(\text{H}_2\text{O}) = 18$; $M_r(\text{Na}_2\text{SO}_4) = 142$.



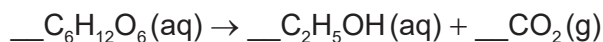
- A. 0.1
- B. 1
- C. 5
- D. 10

3. How many grams of sodium azide, NaN_3 , are needed to produce 68.1 dm^3 of $\text{N}_2(\text{g})$ at STP? Molar volume at STP = $22.7 \text{ dm}^3 \text{ mol}^{-1}$; $M_r(\text{NaN}_3) = 65.0$



- A. 32.5
- B. 65.0
- C. 130.0
- D. 195.0

4. What is the sum of the coefficients when the following equation is balanced using the smallest whole numbers?



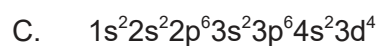
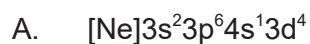
- A. 4
- B. 5
- C. 9
- D. 10

Turn over

5. What is the number of protons and the number of neutrons in ^{131}I ?

	Protons	Neutrons
A.	53	78
B.	53	131
C.	78	53
D.	131	53

6. Which is the electron configuration of a chromium atom in the ground state?



7. Which trends are correct across period 3 (from Na to Cl)?

- I. Atomic radius decreases
- II. Melting point increases
- III. First ionization energy increases

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

8. Which oxide dissolves in water to give a solution with a pH below 7?

- A. MgO
- B. Li₂O
- C. CaO
- D. P₄O₁₀

9. The electronegativity values of four elements are given.

C	N	O	F
2.6	3.0	3.4	4.0

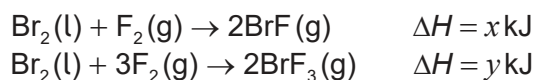
What is the order of **increasing** polarity of the **bonds** in the following compounds?

- A. CO < OF₂ < NO < CF₄
 - B. CF₄ < CO < OF₂ < NO
 - C. NO < OF₂ < CO < CF₄
 - D. CF₄ < NO < OF₂ < CO
10. Which compound has the shortest C–N bond?
- A. CH₃NH₂
 - B. (CH₃)₃CNH₂
 - C. CH₃CN
 - D. CH₃CHNH

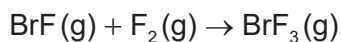
Turn over

11. Which of the following series shows increasing hydrogen bonding with water?
- A. Propane < propanal < propanol < propanoic acid
 - B. Propane < propanol < propanal < propanoic acid
 - C. Propanal < propane < propanoic acid < propanol
 - D. Propanoic acid < propanol < propanal < propane
12. Which statements are correct for metals?
- I. They conduct electricity because they have free moving ions.
 - II. They consist of a close-packed lattice of positive ions with delocalized electrons.
 - III. They are malleable because the layers of positive ions can slide over each other.
- A. I and II only
 - B. I and III only
 - C. II and III only
 - D. I, II and III
13. Which statement is correct for this reaction?
- $$\text{Fe}_2\text{O}_3(\text{s}) + 3\text{CO}(\text{g}) \rightarrow 2\text{Fe}(\text{s}) + 3\text{CO}_2(\text{g}) \quad \Delta H = -26.6 \text{ kJ}$$
- A. 13.3kJ are released for every mole of Fe produced.
 - B. 26.6kJ are absorbed for every mole of Fe produced.
 - C. 53.2kJ are released for every mole of Fe produced.
 - D. 26.6kJ are released for every mole of Fe produced.

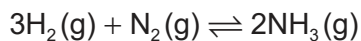
14. The enthalpy changes for two reactions are given.



What is the enthalpy change for the following reaction?



- A. $x - y$
- B. $-x + y$
- C. $\frac{1}{2}(-x + y)$
- D. $\frac{1}{2}(x - y)$
15. What is the enthalpy change, in kJ, of the following reaction?

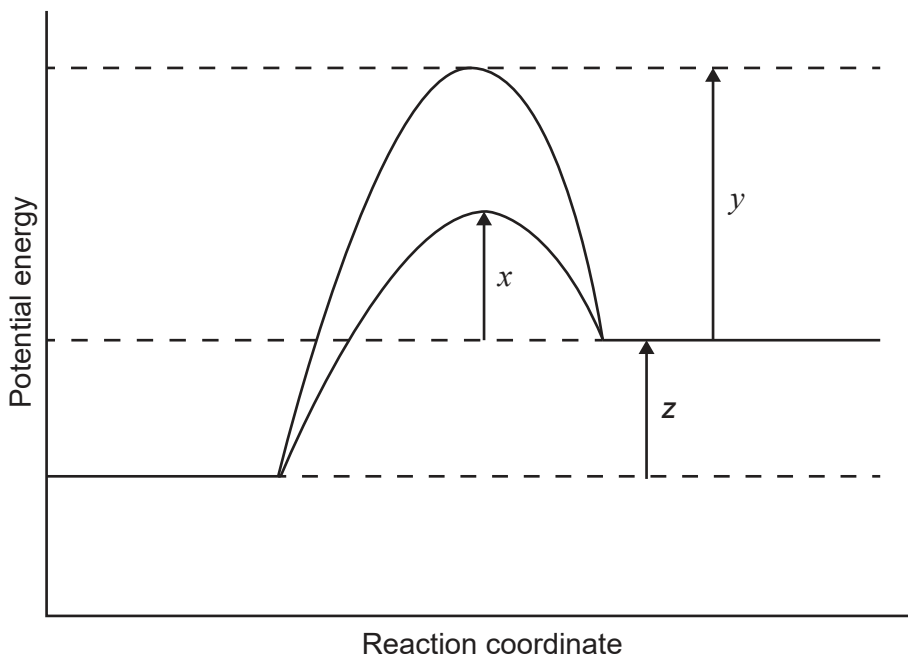


Bond	Bond enthalpy / kJ mol^{-1}
$\text{N}\equiv\text{N}$	945
$\text{H}-\text{H}$	436
$\text{N}-\text{H}$	391

- A. $(6 \times 391) - [(3 \times 436) + 945]$
- B. $(3 \times 391) - (436 + 945)$
- C. $-[(3 \times 436) + 945] + (3 \times 391)$
- D. $-(6 \times 391) + [(3 \times 436) + 945]$

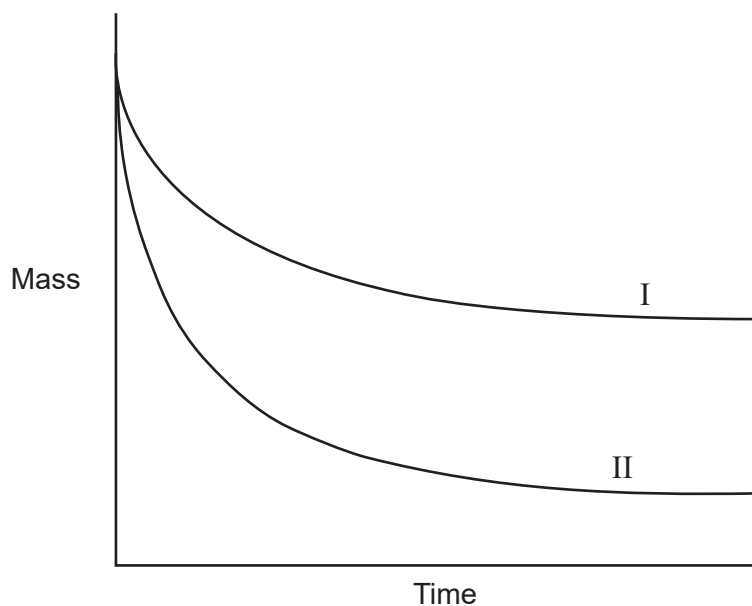
Turn over

16. The diagram shows the energy profile for a catalysed and uncatalysed reaction. Which represents the enthalpy change, ΔH , and the activation energy, E_a , for the **catalysed** reaction?



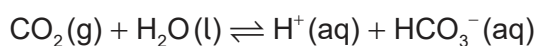
	ΔH	E_a (catalysed reaction)
A.	z	$x + z$
B.	z	$z + y$
C.	$-z$	x
D.	$z + x$	x

17. Excess magnesium powder was added to a beaker containing hydrochloric acid, HCl(aq). The mass of the beaker and its contents was recorded and plotted against time (line I).



Which change could give line II?

- A. Doubling the mass of powdered Mg
 - B. Using the same mass of Mg ribbon
 - C. Increasing the temperature
 - D. Using the same volume of more concentrated HCl
18. What will happen if the pressure is increased in the following reaction mixture at equilibrium?



- A. The equilibrium will shift to the right and pH will decrease.
- B. The equilibrium will shift to the right and pH will increase.
- C. The equilibrium will shift to the left and pH will increase.
- D. The equilibrium will shift to the left and pH will decrease.

Turn over

19. 10.0 cm^3 of an aqueous solution of sodium hydroxide of $\text{pH} = 10$ is mixed with 990.0 cm^3 of distilled water. What is the pH of the resulting solution?
- A. 8
 B. 9
 C. 11
 D. 12

20. Which statement is **incorrect** for a 0.10 mol dm^{-3} HCOOH solution?
- A. $\text{pH} = 1$
 B. $[\text{H}^+] \ll 0.10\text{ mol dm}^{-3}$
 C. $[\text{HCOO}^-]$ is approximately equal to $[\text{H}^+]$
 D. HCOOH is partially ionized

21. What are the oxidation states of chromium in $(\text{NH}_4)_2\text{Cr}_2\text{O}_7(\text{s})$ and $\text{Cr}_2\text{O}_3(\text{s})$?

	$(\text{NH}_4)_2\text{Cr}_2\text{O}_7(\text{s})$	$\text{Cr}_2\text{O}_3(\text{s})$
A.	+7	+3
B.	+6	+3
C.	+6	+6
D.	+7	+6

22. Which of the following is a redox reaction?
- A. $3\text{Mg}(\text{s}) + 2\text{AlCl}_3(\text{aq}) \rightarrow 2\text{Al}(\text{s}) + 3\text{MgCl}_2(\text{aq})$
 B. $\text{SiO}_2(\text{s}) + 2\text{NaOH}(\text{aq}) \rightarrow \text{Na}_2\text{SiO}_3(\text{aq}) + \text{H}_2\text{O}(\text{l})$
 C. $\text{KCl}(\text{aq}) + \text{AgNO}_3(\text{aq}) \rightarrow \text{AgCl}(\text{s}) + \text{KNO}_3(\text{aq})$
 D. $2\text{NaHCO}_3(\text{aq}) \rightarrow \text{Na}_2\text{CO}_3(\text{aq}) + \text{CO}_2(\text{g}) + \text{H}_2\text{O}(\text{l})$

23. What is the reaction type and major product at the **anode** (positive electrode) when molten sodium chloride is electrolysed using platinum electrodes?

	Reaction type	Product
A.	reduction	Cl_2
B.	oxidation	Cl_2
C.	reduction	Na
D.	oxidation	Na

24. What is the major product of the reaction between HCl and but-2-ene?

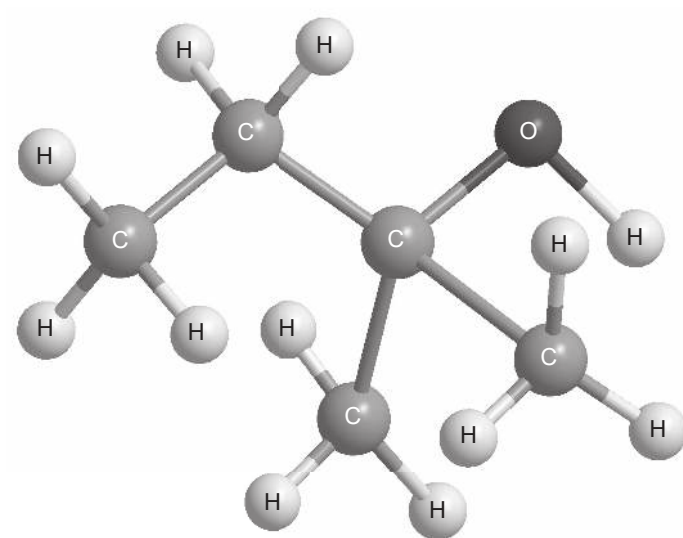
- A. 1,2-dichlorobutane
- B. 2,3-dichlorobutane
- C. 1-chlorobutane
- D. 2-chlorobutane

25. Which compound can be oxidized when heated with an acidified solution of potassium dichromate(VI)?

- A. $\text{CH}_3\text{C}(\text{O})\text{CH}_2\text{CH}_3$
- B. $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$
- C. $(\text{CH}_3)_3\text{COH}$
- D. $\text{CH}_3(\text{CH}_2)_2\text{COOH}$

Turn over

26. What is the name of this compound, using IUPAC rules?



- A. 3-methylbutan-3-ol
 - B. 2-ethylpropan-2-ol
 - C. 2-methylbutan-2-ol
 - D. 3-methylbutan-2-ol
27. Which type of reaction occurs between an alcohol and a carboxylic acid?
- A. Addition
 - B. Oxidation
 - C. Esterification
 - D. Polymerization
28. How many structural isomers of C_6H_{14} exist?
- A. 4
 - B. 5
 - C. 6
 - D. 7

29. What information is provided by ^1H NMR, MS and IR for an organic compound?
- I. ^1H NMR: chemical environment(s) of protons
 - II. MS: fragmentation pattern
 - III. IR: types of functional group
- A. I and II only
- B. I and III only
- C. II and III only
- D. I, II and III
30. A student performs an acid-base titration using a pH meter, but forgets to calibrate it. Which type of error will occur and how will it affect the quality of the measurements?
- A. Random error and lower precision
- B. Systematic error and lower accuracy
- C. Systematic error and lower precision
- D. Random error and lower accuracy
-