XPERTSTEM Chemistry Sample Test Division 5 for Grade 11 & 12

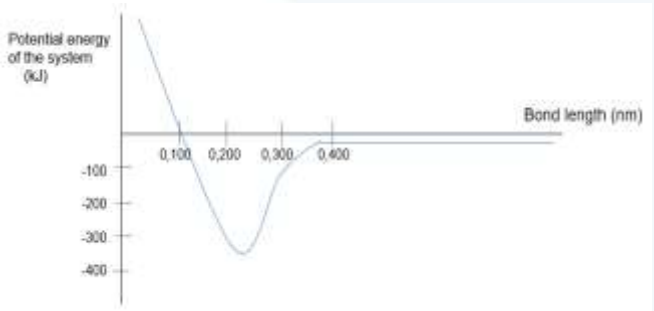
Grade 11 and 12

1. The HBr molecule forms a dipole because:

(i) The Br atom is more electronegative than the H atom
(ii) The H atom is more electronegative than the Br atom
(iii) The HBr molecule is polar

A only (i) is true
B both (i) and (iii) are true
C both (ii) and (iii) are true
D only (ii) is true

Study the energy diagram below which represents the formation of a covalent bond between two atoms. Use this diagram to answer questions 2 and 3.



2. The bond energy of the chemical bond is given by:
A 0 kJ
B 30 kJ
C 330 kJ
D 200 kJ

3. The bond length between the two atoms forming the chemical bond is given by:
A 0,200 nm
B 0,370 nm
C 0,24 nm
D 0,050 nm

4. Consider the reaction represented by the balanced equation below.
$H_3PO_4(aq) + H_2O(\ell) \rightleftharpoons H_3O^+(aq) + H_2PO_4^-(aq)$
Which ONE of the following is a conjugate acid-base pair?
A $H_3O^+(aq)$ and $H_2O(\ell)$
B $H_3PO_4(aq)$ and $H_2O(\ell)$
C $H_3PO_4(aq)$ and $H_3O^+(aq)$
D $H_3O^+(aq)$ and $H_2PO_4^-(aq)$

5. Which ONE of the following compounds will react with sodium hydroxide (NaOH) in a neutralisation reaction?
A CH_3CHO
B CH_3COOH
C CH_3COCH_3
D CH_3CH_2OH

6. Which ONE of the following represents the products formed during the hydrolysis of ammonium chloride?
A $NH_3(aq)$ and $H_3O^+(aq)$
B $NH_4^+(aq)$ and $C\ell^-(aq)$
C $HC\ell(aq)$ and $OH^-(aq)$
D $C\ell^-(aq)$ and $H_3O^+(aq)$

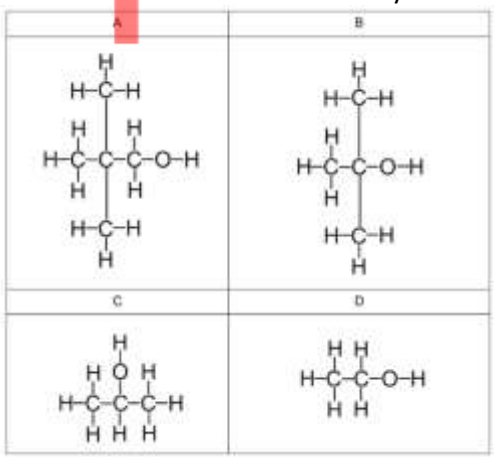
7. Which compound does not have the molecular formula $C_4H_8O_2$?

A methylpropanoic acid
B ethyl ethanoate
C butane-1,2-diol
D propyl methanoate

8. Structural isomerism only should be considered when answering this question. How many straight-chain isomers are there with molecular formula $C_4H_8Cl_2$?

A 6
B 7
C 8
D 9

9. Which alcohol cannot be dehydrated?



10. A hydrochloric acid solution, HCℓ(aq), and an acetic acid solution, $CH_3COOH(aq)$, of EQUAL CONCENTRATIONS are compared. How do the H_3O^+ (aq) concentration of HCℓ(aq) and the pH of HCℓ(aq) compare to that of $CH_3COOH(aq)$?

	$[H_3O^+]$ of HCℓ(aq)	pH of HCℓ(aq)
A	Higher than	Higher than
B	Higher than	Lower than
C	Equal to	Equal to
D	Higher than	Equal to

11. The following equilibrium exists in pure water at 25 °C.

$$2H_2O(\ell) \rightleftharpoons H_3O^+(aq) + OH^-(aq) \quad \Delta H > 0$$

At this temperature, the pH = 7 and Kw = 1×10^{-14} . The temperature of the water is now increased to 90 °C. Which ONE of the following is TRUE at the new temperature?

A pH = 7
B $[H_3O^+] = [OH^-]$
C $[H_3O^+][OH^-] = 10^{-14}$
D $[H_3O^+] = 10^{-7}$ mol·dm^{-3}

12. Gaseous hydrogen and gaseous iodine react to form gaseous hydrogen iodide.

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

In an experiment, 2.0 mol of hydrogen and 2.0 mol of iodine are placed in a sealed container of volume 1 dm^3. The Kc value for this reaction under these conditions is 9

How many moles of hydrogen iodide are present at equilibrium?

A 0.57 mol
B 1.2 mol
C 1.5 mol
D 2.4 mol

13. Which one of the following gas samples will have the largest volume at STP?

A 48 g of oxygen
B 6 g of hydrogen
C 16 g of helium
D 28 g of nitrogen

14. In this question you may assume that nitrogen behaves as an ideal gas. One atmosphere pressure = 101 kPa. Which volume does 1.0 g of nitrogen occupy at 50°C and a pressure of 2.0 atmospheres?

A 70 cm^3
B 150 cm^3
C 470 cm^3
D 950 cm^3

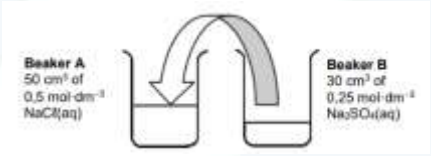
15. All the reactants and products of an exothermic reaction are gaseous. Which statement about this reaction is correct?

A The total bond energy of the products is less than the total bond energy of the reactants, and ΔH for the reaction is negative.
B The total bond energy of the products is less than the total bond energy of the reactants, and ΔH for the reaction is positive.
C The total bond energy of the products is more than the total bond energy of the reactants, and ΔH for the reaction is negative.
D The total bond energy of the products is more than the total bond energy of the reactants, and ΔH for the reaction is positive.

16. Bromophenol blue is an acid-base indicator that has a colour change from yellow to blue between pH 3,0 and 4,6. A NaOH solution is titrated with an acetic (ethanoic) acid solution, using bromophenol blue indicator. Which one of the following statements about this titration is true?

A The end point and the equivalence point occur at the same time.
B The end point occurs after the equivalence point.
C The end point occurs before the equivalence point.
D The indicator will be yellow at the equivalence point of the titration.

17. Beakers A and B contain aqueous solutions of two different sodium salts, the concentrations and volumes of which are indicated in the diagram. All of the solution in beaker B is poured into beaker A.



The new concentration of sodium ions in beaker A is given by:

A (0,025 + 0,0075) / 0,050

B (0,025 + 0,015) / 0,050

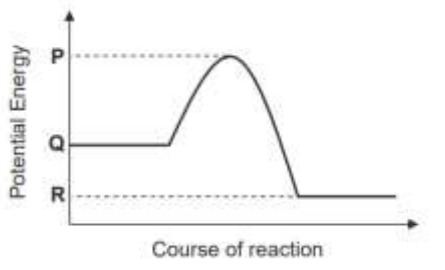
C (0,025 + 0,0075) / 0,080

D (0,025 + 0,015) / 0,080

18. X is an impure sample of a Group 2 metal carbonate, MCO3. X contains 57% by mass of MCO3. The impurities in X do not react with hydrochloric acid. 7.4 g of X is reacted with an excess of dilute hydrochloric acid. 0.050 mol of the Group 2 metal chloride is produced. What is the identity of the Group 2 metal?

A Mg
B Ca
C Sr
D Ba

19. Consider the energy profile graph for a reversible reaction shown below.
Which statement(s) is/are CORRECT?



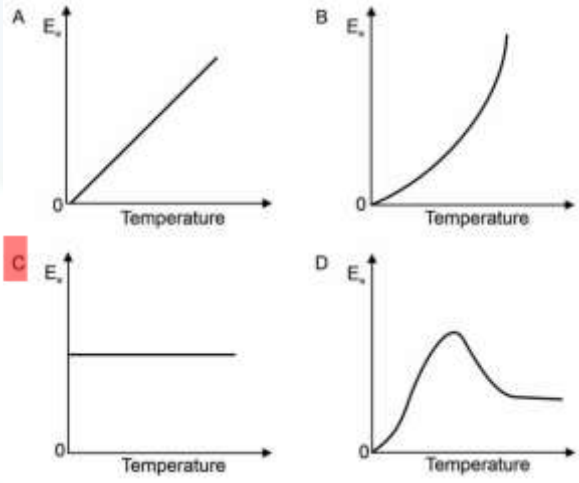
I P represents the activation energy for the forward reaction.

II ΔH for the forward reaction is equal to R–Q.

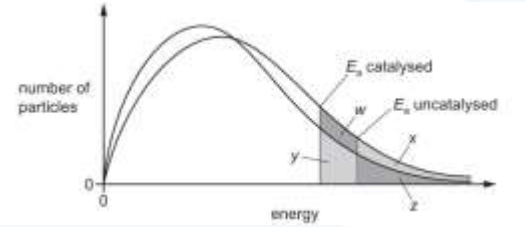
III A catalyst lowers both Q and R equally and therefore does not affect ΔH.

A All are correct.
B None are correct.
C Only II is correct.
D Only II and III are correct.

20. Which one of the following graphs shows the relationship between the activation energy (Ea) for a reaction and temperature?



21. The Boltzmann distribution for a mixture of gases capable of reaction is shown. The two curves represent the mixture of gases at 25 °C and at 35 °C. The activation energies for the catalysed and uncatalysed reactions are shown.



Which row is correct?

	number of particles with enough energy to react at 25 °C in the catalysed reaction	number of particles with enough energy to react at 35 °C in the uncatalysed reaction
A	$w + x + y + z$	z
B	$w + x + y + z$	$x + z$
C	$y + z$	z
D	$y + z$	$x + z$

22. A galvanic cell is set up using the following half-reactions and a suitable salt-bridge.

$2H_2O + O_2 + 4e^- \rightleftharpoons 4OH^-$ $E^\theta = +0{,}40$ V

$Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$ $E^\theta = +0{,}77$ V

When this cell operates under standard conditions, the pH,

A at the anode will increase.
B at the anode will decrease.
C at the cathode will increase.
D at the cathode will decrease

23. The following characteristics may be used to describe an electrochemical cell (electrolytic or galvanic):
I The chemical reaction is self-sustaining.
II The reaction requires energy from an electrical source.
III The anode is the positive electrode of the cell.

Which of these characteristics are specific to an electrolytic cell?

A Only I
B Only II
C I and III
D II and III

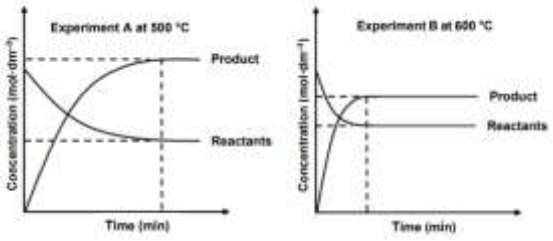
24. Which ONE of the following half-reactions occurs at the cathode during the electrolysis of an aqueous $CuC\ell_2$ solution?

A $C\ell_2 + 2e^- \rightarrow 2C\ell^-$
B $Cu+ + e^- \rightarrow Cu$
C $2C\ell^- \rightarrow C\ell_2 + 2e^-$
D $Cu^{2+} + 2e^- \rightarrow Cu$

25. A certain amount of $IC\ell(g)$ is sealed in an empty flask at a fixed temperature. The equation for the reaction that takes place is: $2IC\ell(g) \rightleftharpoons I_2(g) + C\ell_2(g)$
Which of the following statements describe(s) the change(s) that occur(s) as the system proceeds towards equilibrium?
(i) The rate of the reverse reaction increases.
(ii) The concentrations of $IC\ell$, I_2 and $C\ell_2$ change at the same rate.
(iii) The concentration of $C\ell_2$ increases.

A (i) only
B (ii) only
C (i) and (iii) only
D (ii) and (iii) only

26. Two experiments were conducted using the reversible reaction shown below.
$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
An equal number of moles of H_2 and I_2 were added to the container each time before it was sealed. Experiment A was conducted at 500 °C and Experiment B at 600 °C. The graphs of concentration vs time for each experiment were plotted using the same scale.



Deduce whether the forward reaction is exothermic or endothermic and how the value of the equilibrium constant Kc differs for the two experiments. The forward reaction is … Kc in Experiment B is …

A	Exothermic	Greater
B	Exothermic	Less
C	Endothermic	Greater
D	Endothermic	Less

27. When some solid $Ca_5(PO_4)_3OH$ is added to a beaker of water, an equilibrium is set up.

$$Ca_5(PO_4)_3OH(s) \rightleftharpoons 5Ca^{2+}(aq) + 3PO_4^{3-}(aq) + OH^-(aq)$$

Which compound, when added to the equilibrium mixture, increases the amount of $Ca_5(PO_4)_3OH(s)$ present?

A NH_3
B NH_4Cl
C CH_3CO_2H
D NaCl

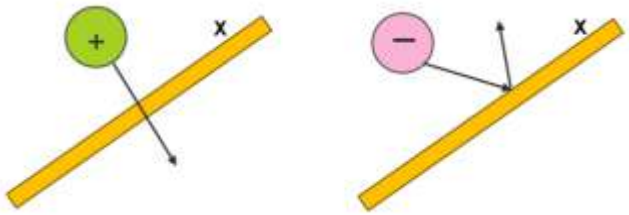
28. When the equilibrium constant of a reversible reaction has a value much greater than 1 (Kc > 1), it indicates that:

A a higher concentration of products than reactants will be formed.
B a lower concentration of products than reactants will be formed.
C the reaction will reach equilibrium quickly.
D the reaction will take a long time to reach equilibrium.

29. When copper is extracted from its ores, the impure copper, which contains small amounts of silver and gold, is purified by electrolysis. During this process, a "sludge" forms beneath the anode which is found to contain silver and traces of gold. Why is silver found in this sludge?

A Silver is a weaker oxidising agent than copper.
B Silver is an inert metal, so will not dissolve during the electrolysis.
C Silver reacts with the electrolyte to form an insoluble salt.
D Silver is more dense than copper and falls off the cathode.

30. Cations can pass through component X, while anions cannot.



Which of the following might component X represent?

A The diaphragm of an electrolytic cell used in the chlor-alkali process
B The membrane of an electrolytic cell used in the chlor-alkali process
C The wire in a galvanic cell
D The salt bridge in a galvanic cell