AS Chemistry

Unit 2 Practice Exam Questions – Test 5

**1.** (a) (i) compound/molecule containing hydrogen and carbon **only** 1

(ii) C10H22 1

(iii) C5H11 {ecf from (ii)} 1

(b) (i) (a particle that) contains/has a single/unpaired electron 1

(ii) UV (light) /sunlight/high temp 1

(iii) homolytic (fission)/ homolysis 1

(iv) C12H26  C*l*  C12H25  HC*l* 1

 (the dot for the free radical does not have to be on the C)

 C12H25  C*l*2  C12H25C*l*  C*l* 1

(v) six 1

(c) (i) C12H26  2C2H4  1C8H18 2

 (1 mark for correct formula of octane or ethene)

(ii) octane/ ecf from (c) (i) 1

(d) (i)



 1 mark for correct reagent and 1 mark for correct product. 2

(ii) 1 mark for any unambiguous formula of cyclohexane 1

1 mark for 1H2 but check that formula of heptane is correct/equation
balanced.1



[16]

**2.** (i) *low volatility*, = **high** boiling point/ not easy to vapourise/owtte 1

 *intermolecular bonds*. = bonds/forces/attractions **between** molecules 1

(ii) type of intermolecular bond = hydrogen bond 1

 dipoles on both O-H bonds 1

 H-bond shown as a ‘dashed bond’ 1



(iii) (The boiling point of glycerol will be higher than ethanol because there are)

more OH groups  more H-bonds 1

[6]

**3.** (i) butan-2-ol by name or by formula  1

(ii)



curly arrow from the O of the OH- to C(δ+) 

curly arrow from C-C*l* bond to C*l* **and** correct dipoles 

correct products/ allow NaC*l* 

curly arrow from lone pair on :OH- 

 SN1 route can still score all 4 marks:

curly arrow from C-C*l* bond to C*l* **and** correct dipoles 

curly arrow from the O of the OH− to C ion 

correct products/ allow NaC*l* 

curly arrow from lone pair on :OH−  4

[5]

**4.** (i) H+  Cr2O72- 2

(ii)



 3

(iii) carboxylic acid would have an absorption between
1680 – 1750 cm-1 /1700 cm-1 or 2500 – 3300 cm-1. 1

[6]

**5.** (a) (a reaction) that releases energy/ (a reaction) that releases heat/ a reaction with a
negative H (1) 1

(b) (i) diagram to show

 upward **hump** (1)

 CO2  (2)H2O/ carbon dioxide and water below

 reactants (1) 2

(ii) Ea marked (1)

 if an arrowhead is included, it must be upwards 1

[4]

**6.** sketch distribution to show axes labelled number/ fraction of
molecules/atoms and

energy (1)

shape starting at origin, maximum, approaching but not

crossing  axis (1) for **both** graphs

explanation of distribution

2 from

no molecules with no energy

few very energetic molecules

most have average amounts of energy

area under curve is the number of molecules (2)

distribution at higher temperature shown on diagram

hump lower than original (1)

and to RHS of original (1)

*E*a marked (1)

rate increases with an increase in temperature (1) 9

since more molecules have energy > *E*a (1)

[9]

**[4]**

**7.** (a) (heat/ energy change) when 1 mole of substance is

formed (1)

from its elements (1) 2

(b) C(s)  2H2(g)  CH4(g)

balanced equation (1)

state symbols (1) 2

(c) cycle drawn/ sum of enthalpy changes products – sum

of enthalpy changes reactants (1)

-75 – 242   = -110 (1) 3

H = 207 (kJ mol-1) (1)

(d) any industrial use, examples include

manufacture of ammonia/ for Haber process 1

manufacture of margarine/ hydrogenation of alkenes

[8]

**8.** (a) to overcome activation energy (1)

reaction is endothermic (1)

to break bonds – if type of bonds stated must be ionic or covalent (1)

A2 answer based on polarisation of carbonate by Ca2+ is acceptable 2

(b) (i) rate forward > rate backward (1) 1

(ii) rate forward = rate backward (1) 1

(iii) equilibrium moves to RHS (1)

use of le Chatelier (1)

more CaO /product / less CaCO3 / reactant present (1) 3

[7]

**9.** (a) anywhere in range 30 - 40% (1)

if range given all values must be in this range 1

(b) (i) increases (1) 1

(ii) more moles of A and B (1)

equilibrium moves in direction of less moles (1) 2

 (c) endothermic (marks for **explanation**)

an increase in temperature converts more A (1)

equilibrium moves in direction to lower temperature/

forward reaction must tend to lower temperature/

an increase in temperature favours the endothermic 2

process (1)

(d) (i) a substance that alters/increases the rate of
reaction/lowers Ea (1)

but remains unchanged **after the reaction** /is not used **up** (1) 2

(ii) to save **energy/money**  reason eg by allowing process

to run at a lower temperature/ by lowering Ea (1)

goes faster to save **time**/ allows the process to run

continuously (1) 2

(e) not enough time was allowed for the equilibrium to

establish/ other products were formed (1) 1

(f) two important catalysts, examples include

iron in Haber process/ manufacture of ammonia

vanadium(V) oxide in Contact process/ manufacture of

sulphuric acid

nickel in hydrogenation of alkenes/ manufacture of

margarines

phosphoric acid in the conversion ethene to ethanol

enzyme/ named enzyme with corresponding function

Pt/Pd/Rh in catalytic converter (any 1 metal)

Ziegler catalyst in alkene

any named acid (except nitric) in esterification

zeolites/ platinum in catalytic cracking 2

[13]

**10.** (a) octane, 400 /- 5 1

hexadecane. 545 /- 5 1

if C penalise once.

(b) fractional distillation 1

 (c) (i)



 2

(ii) 2-methylpentane 1

(iii) **C**, **B** and **A** 1

(iv) the more branching/the shorter the chain… the lower the boiling point/
less energy needed to separate the molecules 1

 long chain have greater surface area/surface interactions/more VdW forces
or converse argument about short/branched chains. 1

 (d) (i)



 1

 (ii) C6H14  C=H12  H2 1

(iii) better fuels/more volatile/lower boiling point/reduces knocking/
increases octane rating/used as (petrol) additives 1

 (e) (i) *Mr* of (CH3)3COH = 74 1

 % oxygen = (16/74)  100 = 21.6 % 1

(ii) (CH3)3COH  6O2  4CO2  5H2O

 1 mark for CO2 and H2O only 2

[16]

**Examiners Report**

**1.** (a) This was generally very well answered with many scoring both marks. It was unfortunate that a ‘C’ was not shown in the structural formula of isoprene but the Examiners compensated candidates by crediting both C5H8 and C4H8.

(b) Most scored the mark in (i) but very many failed to score both marks in (ii). It was common to see equations for partial hydrogenation. Candidates who had misinterpreted the structural formula of isoprene in (a)(i) were also given credit in this section.

 The partial hydrogenation of limonene was reasonably well done but it was not uncommon to see isoprene rather than limonene. A surprising number indicated an extra C by drawing structures that revealed a misunderstanding of skeletal formulae such as those shown below.



**2.** (i) This was surprisingly badly answered with very many not scoring the mark.

(ii) As always the response to the mechanism was very Centre-specific and it was often three marks or none. It is important that Centres look carefully at the mark schemes to see what is required to score the marks.

**3.** Able candidates scored all four marks but weaker candidates demonstrated a variety of errors. Many candidates do not seem to be comfortable with numbers. Percentage yields exceeding 100% were seemingly not challenged.

**4.** (i) Most scored at least one mark but many failed to follow the instructions within the question and ‘put a bracket round one of the repeat units’.

(ii) This was straightforward but many lost the mark by either describing CO2 as a toxic gas or by stating that the fumes would damage the ozone layer.

(iii) This was generally well answered.

**5.** Some candidates were confused over the role of electronegativity of the halogen and others incorrectly identified C–F as the weakest bond.

**6.** (i), (ii) Both parts were well answered.

(iii) The propagation steps still reveal a lack of understanding by a substantial number of candidates.

**7.** (a) Many identified the catalyst but only a few deduced the correct structure of the acid.

(b) The oxidising agent was well known but the majority failed to construct a balanced equation for the oxidation.

**8.** Few if any scored full marks for this question. Most failed to structure their answer and often forgot to include either structural isomers or *cis-trans* isomers. A substantial number appear to have misunderstood the question and wrote at length firstly about isomerisation and then about cracking and reforming. The quality of written communication mark appeared more elusive than usual with many failing to correctly use specific chemical terms in the correct context.

**9.** Most candidates recognised that carbon monoxide is produced as the result of incomplete combustion of the fuel. Whilst most realised that nitrogen monoxide uses oxygen and nitrogen from the air some thought that at least one of these was in some way present in the fuel.

**10.** (i) Most candidates correctly completed the equation.

(ii) This proved challenging with a large number writing 2O3  3O2 rather than actually using the equations as given.

(iii) Most candidates recognised the function of uv light but many suggested that it was chorine itself, rather than CFCs, that was involved in the homolytic fission reaction.

(iv) Whilst a large number of answers were specific and quoted the increased risk of skin cancer on exposure to uv radiation, weaker candidates were clearly confused and effects based on global warming were not uncommon.

**11.** (i) To gain credit for this part, it was necessary to recognise that bond breaking was involved. Some candidates showed their lack of understanding when they quoted bond making or both breaking and making.

(ii) Since this is a standard definition, it was disappointing how many candidates omitted reference to 1 mole or broke the bonds in 1 mole of substance.

(iii) The calculation was generally well done with only a minority of candidates reversing the signs of the enthalpy changes needed for breaking and making the bonds. *{Numerical answer: –689 kJ mol–1}*

(iv) This is an example where candidates saw a statement about differences between enthalpy change values and related this to some sort of experimental error rather than actually considering the sources of the values being compared.

**12.** (i) The use of le Chatelier’s principle is an important concept in this unit and most candidates clearly understood it and were able to apply it to the example given. Very few examples were therefore seen when the rate of attainment of the equilibrium was confused with the equilibrium position.

(ii) Most candidates correctly related the increase in rate to an increased number of collisions with very few trying to alter activation energy.

 (iii) Apart from a few who suggested specific metals or who confused heterogeneous with heterolytic or heterozygous, this was well known.

 (iv) Most candidates were able to quote that the use of a catalyst would not alter the equilibrium position but significantly less actually explained why.

**13.** (a) Although the question required candidates to use their knowledge of the effect of temperature on particle motion, to gain full credit it was necessary to examine critically the difference between an increased rate of collision and an increased rate of reaction. Some candidates read the question carefully and gave excellent explanations but many others apparently saw the words ‘rate’ and ‘temperature’ and merely gave a standard description of activation energy. This would allow them access to four of the available five marking points.

(b) (i) Most candidates labelled the axes in a recognisable manner but some were clearly confused with enthalpy profile diagrams whilst a small number omitted the labelling completely.

(ii) On previous occasions candidates have often been required to draw the distribution at a higher temperature. A number appeared to read the question in this way. Although only a sketch was needed, so that credit was given if the curve was to the left of and higher than the original, candidates would be advised to be careful when completing their sketch. Credit was not given when their line crossed either the x axis or the line for *T1* at high energy values.

**14.** (i) As with the previous definition, a significant number of answers were seen that omitted 1 mole or that the compound was formed from its elements.

(ii) Many correct equations were given with only a few starting from formulae other than elements. This error was seen occasionally even if the definition in (i) actually stated ‘ from the elements’.

(iii) Many numerically correct answers were seen and the best candidates explained clearly the way in which they reached their answer. For some weaker candidates, even those with a correct answer or one that was only incorrect in its sign, the method of calculation was less convincing. *{Numerical answer: 123 kJ mol–1}*