Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2019

Life and Health Sciences

Assessment Unit AS 3

assessing

Aspects of Physical Chemistry in Industrial Processes

[SZ031]

TUESDAY 21 MAY, AFTERNOON

MARK SCHEME

General Marking Instructions

Introduction

Mark schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of students in schools and colleges.

The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes, therefore, are regarded as part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

AVAILABLE MARKS

1 **(a)** The reactants are in a different (physical) state to the catalyst [1]

(b) **(i)** Maxwell–Boltzmann [1]

(ii) Curve added that has a lower peak [1] and to the right [1]
same shape [1] [3]

(c) Activation energy: The **minimum** energy [1]
for a reaction to occur/successful collision [1] [2]

Catalyst: A chemical that speeds up a reaction [1]
Without being used up [1] remains chemically unchanged at end [2]

(d) More successful collisions (per unit time)/more collisions/particles with the activation energy (per unit time) [1]
the area under the curve past the activation energy is greater [1] [2]

(e) **(i)** The yield increases [1]
as the equilibrium moves to the RHS as there are
less molecules [1]/less molecules of gas [2]

(ii) Specialised equipment required/cost linked to equipment/
dangerous [1] 14

2 **(a)** The energy required break **one mole** of a particular bond (in gaseous state) [1]
averaged over a range of compounds [1] [2]

(b) Reactants = 3703 kJ mol^{-1} [1]
Products = 5171 kJ mol^{-1} [1]
5171 – 3703 – 240 = 2C═C or 1228 [1]
C═C = 614 [1] (kJ mol^{-1}) [4]

(c) **(i)** 1 atm [1] /100kPa
298 K/25°C [1] [2]

(ii) The enthalpy/energy change in a reaction is independent of the route taken [1]
provided the starting and finishing conditions are the same [1] [2]

(iii) –1574 [1]
–858 [1] [2]

(iv) –1574 – 858 + 2542 [1] ecf
110 [1] kJ mol^{-1} [2] 14

				AVAILABLE MARKS
3	**(a)** 1.1 g and 64° C	[1]		

(b) Q = mc∆T
Q = 150 × 4.2 × 64 } either for [1]
Q = 40320 J [1]

40.32 kJ [1] [3]

(c) **(i)** 436 [1]

(ii) 1.1/436 = 0.0025 [1]

(d) 40.32/0.0025 = –16128 kJ mol^{-1} [1]

(e) Heat loss to surroundings [1]
use a heat shield [1]
(or other suitable source of error and prevention) [2] 9

4 **(a)** **(i)** Meniscus [1]

(ii) 22.2 cm^3 [1]

(b) **(i)** A solution of known concentration [1]

(ii) RFM KOH = 56 [1]
5.6 g [1] [2]

(iii) Indicative content:
- weigh the KOH (into a beaker using a balance)
- add deionised water
- dissolve/stir
- transfer to volumetric flask (correct volume)
- rinse the beaker and glass rod (with the deionised water)
- add washings to volumetric flask
- add deionised water to the flask to the mark
- insert stopper and shake/invert

Level of response	Marking Criteria	Marks
A	Candidates articulate clearly the process for preparing a standard solution. They use good spelling, punctuation and grammar and the form and style are of an excellent standard using 5 or more of the indicative points.	[5]–[6]
B	Candidates provide a good description the process for preparing a standard solution. They use good spelling, punctuation and grammar and the form and style are of a good standard using 3–4 of the indicative points.	[3]–[4]
C	Candidates provide a limited description of the process for preparing a standard solution. They use limited spelling, punctuation and grammar and the form and style are of basic standard. Using 1–2 of the indicative points.	[1]–[2]
D	This response is not worthy of credit	[0]

[6]

AVAILABLE MARKS

(iv) Indicator: Phenolphthalein/Methyl orange [1]
Colour change: colourless [1] to pink[1]/red [1] to yellow [1] [3]

(v) 23.0 and 22.8 [1]

(vi) (23.0 + 22.8)/2 = 22.9 [2]
([1] gained if rough titre used 23.1)

(vii) $KOH + HCl \rightarrow KCl + H_2O$ [1]

(viii) Moles KOH = $\frac{22.9 \times 0.1}{1000}$ = 0.00229 [1]

$\frac{0.00229 \times 1000}{25.0}$ = 0.0916 mol dm^{-3} [1] [2] 20

(accept 0.092 mol dm^{-3})

5 (a) (i) Temperature: 450° C (accept 400–450°C/670–720K) [1]
Pressure: 1–2 atm/100 –200kPa [1]
Catalyst: vanadium(V) oxide catalyst/V_2O_5/vanadium pentoxide [1] [3]

(ii) Impurities block the active sites [1]
Prevents reactants adsorbing to surface [1] [2]

(iii) Axes labelled (y enthalpy x progress of reaction) [1]
reactants higher than products [1] [2]

(b) (i) The reactants are added as the products are removed/idea that reaction does not stop [1]

(ii) Any **two** from:
- higher yield
- faster production rate
- lower labour costs
- more easily automated [2]

(c)

	Capital cost	Direct Cost	Indirect Cost
Cost of sulfur		✓ [1]	
Building the chemical plant	✓ [1]		
Cost of electricity to maintain the process		✓ [1]	
Sales and advertising			✓ [1]

([–1] for each additional tick) [4]

(d) (i) As the pressure increases the percentage of product increases [1]
as the temperature increases the percentage of product decreases [1] (or reverse of each) [2]

(ii) 400° C and 600 kPa [1]

(iii) 55% [1] 18

Total **75**