Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2024

Life and Health Sciences

Assessment Unit AS 3

assessing

Aspects of Physical Chemistry in Industrial Processes

[SZ031]

MONDAY 3 JUNE, 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)	(i)	A continuous process is a non-stop process [1] where products are removed at the same time as new reactants are added [1].	[2]	
		(ii)	Any **one** from: • Less down time • Automated – low(er) labour costs • Higher production rate	[1]	
	(b)	(i)	80	[1]	
		(ii)	44	[1]	
		(iii)	Moles of nitrous oxide = 143000/44 = 3250 mol [1] Mass = moles × M_r = 3250 × 80 = 260 000g = 260 kg [1]	[2]	
		(iv)	109/143 × 100 = 76.2(%)	[1]	
		(v)	Any **one** from: Side reactions Some product lost in separation from reaction mixture	[1]	
	(c)		Any **one** from: More jobs (specialist and general) Generates money for the local economy Improves infrastructure/services	[1]	10
2	(a)	(i)	x-axis labelled correctly [1] y-axis labelled correctly [1] reactants labelled (left) and products labelled (right), correct shape of reaction profile diagram [1] EA from reactants to peak of energy barrier (or equivalent) [1]	[4]	
		(ii)	(Energy level of) products is higher than reactants	[1]	
		(iii)	minimum energy [1] for a reaction to occur [1]	[2]	
	(b)	(i)	Maxwell-Boltzmann (distribution curve)	[1]	
		(ii)	Tick in fourth box down	[1]	
		(iii)	shaded area to right of E_A under the curve	[1]	
		(iv)	curve A	[1]	11

AVAILABLE MARKS

3 Indicative content

- Use a conical flask
- Add (excess volume of) acid to $CaCO_3$ (or vice versa)
- Stopper inserted/add bung/attach gas syringe
- Start timer
- Idea of being done quickly
- Note volume/amount of gas collected
- At regular time intervals/at time when reaction complete
- Plot graph (of volume v time), calculate gradient/calculate rate using volume divided by time

Level of response	Marking Criteria	Marks
Excellent	Candidate clearly articulates the process for determining the rate of reaction. There is excellent use of spelling, punctuation and grammar. Form and style are of an excellent standard using **5 or more** indicative points.	[5]–[6]
Good	Candidate provides a good description of the process for determining the rate of reaction. There is good use of spelling, punctuation and grammar. Form and style are of a good standard using **3-4** indicative points.	[3]–[4]
Basic	Candidate provides a limited description of the process for determining the rate of reaction. There is limited use of spelling, punctuation and grammar. Form and style are of basic standard. **1 or 2** indicative points used.	[1]–[2]
	This response is not worthy of credit	[0]

[6] 6

4 (a) (i) substance that speeds up a reaction, [1]
but is not used up in the reaction [1] [2]

(ii) vanadium(V) oxide / V_2O_5 [1]

(iii) raw materials / energy / fuel / electricity / catalyst / packaging / transport [1]

(b) (i) When the rates of the forward and backwards reactions are equal, [1] the amounts / concentrations of reactants and products remain constant [1] [2]

(ii) Temperature (threshold)
Effect: Decreases yield [1]
Any **one** from:
Favours reverse reaction [1] / favours endothermic reaction [1] / to reduce temperature [1] / forwards reaction is exothermic [1] / (Position of) equilibrium moves to left [1]

Pressure (threshold)
Effect: Increases yield [1]
Any **one** from:
Favours less moles [1] / moves to side with less moles [1] / favours forward reaction [1] /
molecules of gas [1] / (Position of) equilibrium moves to right [1] [4]

(iii) Any **one** from:
- higher / more energy needed
- specialist equipment / thicker pipes / (capital) cost
- (more) dangerous [1]

(c) $SO_3 + H_2O \rightarrow H_2SO_4$
LHS [1], RHS [1] [2]

AVAILABLE MARKS

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5 **(a)** Any **three** from:
- calorimeter / copper can / beaker
- thermometer
- clamp and (retort) stand
- balance [3]

(b) **(i)** 21(°C) [1]

(ii) $Q=mc\Delta T$ [1]

(iii) Q=150 × 4.2 × 21 [1]
Q= 13230/13.230 [1]
Unit = J/kJ [3]
ecf from **5(b)(i)**

(iv) Mass of ethanol burned = 62.09 – 60.94 = 1.15 (g) [1]
Moles of ethanol = mass / M_r = 1.15 / 46 = 0.0250 (mol) [1] ecf [2]

(v) −13230 / 0.0250 [1] **or** −13.23 / 0.025 [1]
−529200 / −529.2 [1]
$Jmol^{-1}$ / $kJmol^{-1}$ [1]
ecf from **(iii)** and **(iv)** [3]

(vi) Any matching statement and explanation;
(statement is threshold)

- Heat loss to surroundings
  Use a draught shield / Place lid on calorimeter / minimise distance between flame and calorimeter

- Heat loss in apparatus
  Use copper can / calorimeter instead of beaker

- Water loss by evaporation
  Use a lid on the beaker/can to minimise evaporation

- Uneven heat distribution in water
  Stir thoroughly [2]

				AVAILABLE MARKS
	(c)	**(i)** $\Delta H = -(-278) + ((2 \times -394) + (3 \times -286))$ $\Delta H = 278 - 1646$ $\Delta H = -1368$ ($kJmol^{-1}$)	[3]	
		(ii) It is an element	[1]	19
6	**(a)**	$M_r = 40$ [1] $n = m/M_r = 24/40 = 0.6\ 9$ (mol) [1] $c = n/v = 0.6/0.5 = 1.2$ ($moldm^{-3}$) [1]	[3]	
	(b)	• weigh the NaOH (into a beaker using a balance) [1] • dissolve in (a small amount of) deionised water [1] • transfer to 500cm^3 volumetric flask [1] • rinse the beaker and glass rod (with the deionised water) and add washings to volumetric flask [1] • add deionised water to the flask to the mark [1] • (insert stopper) and shake / invert [1]	[6]	
	(c)	Burette correctly labelled (above flask) Conical flask labelled (below burette) Burette labelled with NaOH and flask labelled with CH_3COOH	[3]	
	(d)	B	[1]	
	(e)	Phenolphthalein (threshold) Colour change is colourless to pink [1] for colours wrong way round	[3]	16
			Total	**75**