Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2017

Life and Health Sciences

Assessment Unit AS 3

assessing

Aspects of Physical Chemistry in Industrial Processes

[SZ031]

FRIDAY 19 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 enthalpy change when one mole of a substance [1] is completely burnt in oxygen [1] [2]

(b) **(i)** Any three from:
- copper/steel can or calorimeter
- thermometer
- (fixed volume of) water/measuring cylinder/pipette/burette
- balance [3]

(ii) Any two from:
- heat loss to air/surroundings
- heat gained by copper can/calorimeter
- incomplete combustion [2]

(c) **(i)** Bonds broken: (413 × 10) + (347 × 3) + (495 × 6.5) = 8388.5 [1]
bonds made: (799 × 8) + (467 × 10) = 11062 [1]
enthalpy change = bonds broken – bonds made = 8388.5 – 11062 [1] (ecf)
enthalpy change = – 2673.5 [1] kJ mol^{-1} [4]

(ii) Fewer bonds being made **and** broken [1]

(d) **(i)** Energy cannot be created or destroyed [1]
it can only change from one form to another [1] [2]

(ii) $4C + 5H_2 \rightarrow C_4H_{10}$ [1]

(iii) (393.5 × 4) + (285.8 × 5) = 3003 [1]
– 3003 + 2877.5 = [1]
– 125.5 [1] kJ mol^{-1} [3]

ECF options for wrong equation on part **(ii)**

18

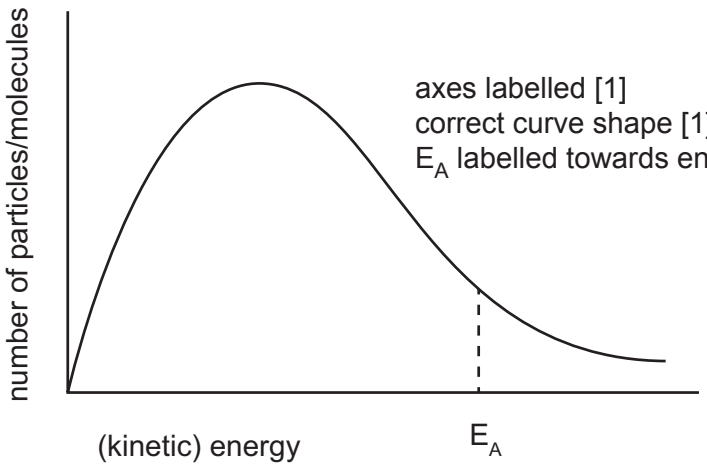
2 **(a)** $2SO_2 + O_2 \rightleftharpoons 2SO_3$

all formula correct [1], correct balancing [1] [2]

(b) A substance that increases the speed of a reaction [1] without being used up [1] it is in a different physical state to the reactants [1] [3]

(c) **(i)** The minimum amount of energy [1]
required for a reaction to occur/successful collision [1] [2]

(ii)



axes labelled [1]
correct curve shape [1]
E_A labelled towards end of x-axis [1]

[3]

AVAILABLE MARKS

(iii) A catalyst will provide an alternative pathway with a [1]
lower activation energy [1]
more particles will have the energy to successfully collide/react [1] [3]

(iv) Peak of curve moves to the right [1]
peak of curve is lower [1] [2]

15

3 **(a)** **(i)** A standard solution is one whose concentration is known [1]

(ii) Indicative points
- use pipette and filler
- rinse pipette with sulfuric acid
- fill the pipette to bottom of meniscus
- touch on the top of the solution
- rinse burette with NaOH solution
- fill burette with NaOH
- no bubbles/jet filled
- add a few drops of indicator to the conical flask
- titrate/add NaOH until colour change/end point reached
- swirl
- repeat until titres are concordant/within 0.1 cm^3
- take initial and final readings/titre

Bond	Level of response	Marking Criteria	Marks
A	Excellent	Candidates articulate clearly the process of obtaining an accurate titre. They use good spelling, punctuation and grammar and the form and style are of an excellent standard using at least 8 of the indicative points.	[6]–[8]
B	Good	Candidates provide a good description of the process of obtaining an accurate titre. They use good spelling, punctuation and grammar and the form and style are of a good standard using at least 4 of the indicative points.	[3]–[5]
C	Basic	Candidates provide a limited description of the process of obtaining an accurate titre. They use limited spelling, punctuation and grammar and the form and style are of basic standard. Using at least 2 of the indicative points.	[1]–[2]
D		This response is not worthy of credit	[0]

[8]

(b) **(i)** The titration involves a (strong acid and a) strong base/colour change happens at equivalence point/end point [1]

(ii) colourless [1] to pink [1] (reverse order allow [1]) [2]

(c) **(i)** 23.40 and 23.30 [1]

(ii) 23.35 (23.4) [2] (23.7 [1]) [2]

(d) **(i)** $n = \frac{23.35 \times 0.1}{1000}$ [1] (Allow ecf)

n = 0.002335 [1] [2]

					AVAILABLE MARKS
		(ii)	Molar ratio 2:1 therefore $\frac{0.002335}{2}$ = 0.0011675 moles H_2SO_4 [1] $\frac{0.001675 \times 1000}{25.0}$ = 0.0467 mol dm^{-3} [1] allow ecf	[2]	19
4	**(a)**		Capital – one time expenses/costs of start-up/initial costs [1] direct – (ongoing) production costs (continuous) [1]	[2]	
	(b)		Any **three** from: • eyesore • noise pollution • global warming • acid rain • destruction of natural habitats/flora/fauna/land pollution • water pollution/thermal pollution • air pollution	[3]	5
5	**(a)**	**(i)**	As the pressure increases so does the percentage of ammonia at equilibrium [1] as the temperature increases, the percentage of ammonia at equilibrium decreases [1] accept converse	[2]	
		(ii)	38	[1]	
		(iii)	Temperature – position of equilibrium moves to the left [1] – moves in endothermic direction (to remove heat)/forward reaction is exothermic [1] Pressure – position of equilibrium moves to the right [1] – fewer molecules on the right [1] (accept converse)	[4]	
	(b)	**(i)**	53.5 (ignore units)	[1]	
		(ii)	HCl: moles = 912.5/36.5 = 25 [1] ratio 1:1 [1] NH_4Cl: mass = 25 × 53.5 [1] allow ecf 1337.5 g = 1.338 kg [1]	[4]	
		(iii)	(1.15/1.3375) × 100 [1] (Allow ecf) 85.98% [1] (penalise if not to 2 decimal points)	[2]	
	(c)	**(i)**	**6**NO + **4**NH_3 → **5**N_2 + **6**H_2O (or other correct stoichiometry)	[1]	
		(ii)	22 (allow ecf with correct working out)	[1]	
		(iii)	A substance (which is not part of the reaction) adsorbs to the catalyst's surface/active sites [1] preventing reactants adsorbing (and reacting)/deactivating the catalyst/blocks active sites/does not desorb [1]	[2]	18
				Total	**75**