Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2018

Life and Health Sciences

Assessment Unit AS 3

assessing

Aspects of Physical Chemistry in
Industrial Processes

[SZ031]

FRIDAY 18 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)** A substance that alters the speed of a reaction [1] without being used up [1] [2]	
(b) **(i)** Number of molecules/particles [1]	
(ii) The minimum amount of energy [1] required for a reaction to occur [1] [2]	
(iii) The **area** past the activation energy, under the curve is small [1]	
(iv) Curve drawn: maximum to the right of T_1 [1] peak lower than T_1 [1] distribution the same shape [1] [3]	
(v) **Area** under the **curve** above E_A is greater [1] indicating that **more particles have energy** greater than E_A [1] (and so more successful collisions) [2]	11
2 **(a)** **(i)** Any **two** from: • low **set-up** costs • easily adjusted/simpler set-up • used to produce small amounts • or other suitable (2 x [1]) [2]	
(ii) Any **two** from: • faster rate of production • larger amounts • lower labour costs/easy to automate (do not allow: unqualified costs/never stops) (2 x [1]) [2]	
(b) Any **two** from: • drainage/waste water treatment/sewage treatment • air pollution measures • major accident/chemical spillages/hazard regulations • storage or disposal of waste (2 x [1]) [2]	6

AVAILABLE MARKS

3 (a) The enthalpy **change** when one mole of a substance [1] is completely burnt in oxygen [1] [2]

(b) (i) **Indicative content**

- measure 100 cm^3 of cold water into a calorimeter/beaker/conical flask
- weigh the spirit burner (and cap) containing the ethanol
- record the initial temperature of the water (in the calorimeter)
- place the spirit burner under the calorimeter and light the wick
- allow the alcohol to heat the water (so the temperature rises by a fixed amount (e.g. 40°C)/fixed time)
- (replace the cap to) extinguish the flame
- stir
- re-weigh the spirit burner (and cap)
- (using a fresh 100 cm^3 of cold water) repeat the experiment
- record final temperature

Level of response	Marking Criteria	Marks
Excellent	Candidates articulate clearly the process for finding the enthalpy of combustion of ethanol. They use good spelling, punctuation and grammar and the form and style are of an excellent standard using more than 7 of the indicative points.	[7]–[8]
Good	Candidates provide a good description of the process for finding the enthalpy of combustion of ethanol. They use good spelling, punctuation and grammar and the form and style are of a good standard using 4–6 of the indicative points.	[4]–[6]
Basic	Candidates provide a limited description of the process for finding the enthalpy of combustion of ethanol. They use limited spelling, punctuation and grammar and the form and style are of basic standard. Using 1–3 of the indicative points.	[1]–[3]
	This response is not worthy of credit	[0]

[8]

(ii) m is the mass **of water**; c is the **specific** heat capacity and ΔT is the change in temperature [3]

(iii) Energy loss to the environment/energy not completely transferred to water [1]

(iv) Bonds broken:
(413 × 5) + (358 × 1) + (467 × 1) + (495 × 3) + (347 × 1) = 4722 [1]

bonds made: (799 × 4) + (467 × 6) = 5998 [1]

enthalpy change = bonds broken – bonds made = 4722 – 5998 [1] ecf

enthalpy change = –1276 kJ mol^{-1} [1] [4]

(v) Average **bond** enthalpy are calculated using the average of the bond enthalpies for a range of compounds/not specific to the compounds used in the reaction [1] 19

					AVAILABLE MARKS
4	(a)	(i)	Vanadium pentoxide/vanadium(V)oxide	[1]	
		(ii)	(The catalyst is) in a different (physical) state to the reactants	[1]	
		(iii)	Chemisorption [1] Any **three** from: • reactants adsorb to the surface/the catalyst • bonds weaken or break • reactants react/form products • products desorb from surface (of the catalyst) (3 × [1])	[4]	
	(b)		Both forwards and backwards reactions at same rate/speed [1] reactants and products in constant concentration [1]	[2]	
	(c)	(i)	ΔH is negative	[1]	
		(ii)	Energy profile drawn reactants higher than products [1] axes labelled (Enthalpy and progress of reaction) or other suitable [2]	[3]	
	(d)		**Temperature** Increasing the temperature decreases the yield [1] 400 °C used as a compromise because lower temperatures would be too slow [1] **Pressure** Changing/increasing the pressure has little effect on the percentage conversion [1] a pressure of 2 atm would be safer/cheaper/easier to achieve [1]	[4]	16
5	(a)	(i)	A solution of known concentration	[1]	
		(ii)	RFM = 106 [1] 106 × 0.1 = 10.6 g [1]	[2]	
	(b)	(i)	moles Na_2CO_3 = 0.1 × 0.025 = 0.0025 ratio Na_2CO_3 : HCl is 1:2 so moles HCl = 0.0025 × 2 = 0.005 concentration HCl = 0.005/0.035 = 0.143 mol dm^{-3}	[3]	
		(ii)	Any **two** from: • Wash pipette/burette before use with base/acid before titration • read volumes at eye-level/bottom of meniscus • add dropwise at end point • swirl • pH probe (2 x [1])	[2]	
		(iii)	Repeat the titration/carry out a rough and then two accurate titrations/ensure concordant results	[1]	

(c)

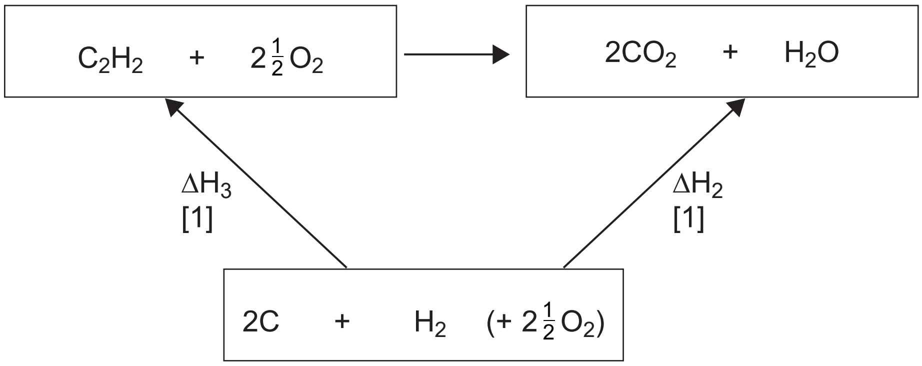
Indicators	Colour in acid	Colour in alkali
Phenolphthalein	Colourless	Pink
Methyl orange	Red	Yellow

[4] 13

AVAILABLE MARKS

6 **(a)** **(i)** The enthalpy **change** of a reaction is independent of the route taken [1] provided the initial and final conditions remain constant [1] [2]

(b) **(i)**



[2]

(ii) $\Delta Hc = -\Delta H_3 + 2\ \Delta H_1 + \Delta H_2$
$= -226 + 2(-394) - 286$ [1]
$= -1300$ [1] kJ mol^{-1} [1] ecf [3]

(c) $CaC_2 + 2H_2O \rightarrow Ca(OH)_2 + C_2H_2$
LHS [1] RHS [1] correct balancing [1] [3] 10

Total **75**