www.dynamicpapers.com

edexcel

Mark Scheme (Results)
January 2012

GCE Chemistry (6CH05) Paper 01
General Principles of Chemistry II
Transition Metals and Organic Nitrogen Chemistry
(including synoptic assessment)

www.dynamicpapers.com

Edexcel and BTEC Qualifications
Edexcel and BTEC qualifications come from Pearson, the world's leading learning company. We provide a wide range of qualifications including academic, vocational, occupational and specific programmes for employers. For further information, please call our GCE line on 0844 576 0025, our GCSE team on 0844 576 0027, or visit our qualifications website at www.edexcel.com.

For information about our BTEC qualifications, please call 0844 576 0026, or visit our website at www.btec.co.uk.

If you have any subject specific questions about this specification that require the help of a subject specialist, you may find our Ask The Expert email service helpful.

Ask The Expert can be accessed online at the following link:
http://www.edexcel.com/Aboutus/contact-us/

Alternatively, you can contact our Science Subject Advisor directly by sending an email to ScienceSubjectAdvisor@EdexcelExperts.co.uk .

You can also telephone 0844 576 0037 to speak to a member of our subject advisor team.

(If you are calling from outside the UK please dial + 44 1204 770 696 and state that you would like to speak to the Science subject specialist).

Pearson: helping people progress, everywhere
Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

January 2012
Publications Code UA030269

All the material in this publication is copyright
© Pearson Education Ltd 2012

www.dynamicpapers.com

General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Mark schemes will indicate within the table where, and which strands of QWC, are being assessed. Questions labelled with an **asterix (*)** are ones where the quality of your written communication will be assessed.

www.dynamicpapers.com

Using the Mark Scheme

Examiners should look for qualities to reward rather than faults to penalise. This does NOT mean giving credit for incorrect or inadequate answers, but it does mean allowing candidates to be rewarded for answers showing correct application of principles and knowledge. Examiners should therefore read carefully and consider every response: even if it is not what is expected it may be worthy of credit.

The mark scheme gives examiners:
- an idea of the types of response expected
- how individual marks are to be awarded
- the total mark for each question
- examples of responses that should NOT receive credit.

/ means that the responses are alternatives and either answer should receive full credit.
( ) means that a phrase/word is not essential for the award of the mark, but helps the examiner to get the sense of the expected answer.
Phrases/words in **bold** indicate that the meaning of the phrase or the actual word is **essential** to the answer.
ecf/TE/cq (error carried forward) means that a wrong answer given in an earlier part of a question is used correctly in answer to a later part of the same question.

Candidates must make their meaning clear to the examiner to gain the mark. Make sure that the answer makes sense. Do not give credit for correct words/phrases which are put together in a meaningless manner. Answers must be in the correct context.

Quality of Written Communication

Questions which involve the writing of continuous prose will expect candidates to:
- write legibly, with accurate use of spelling, grammar and punctuation in order to make the meaning clear
- select and use a form and style of writing appropriate to purpose and to complex subject matter
- organise information clearly and coherently, using specialist vocabulary when appropriate.

Full marks will be awarded if the candidate has demonstrated the above abilities.
Questions where QWC is likely to be particularly important are indicated (QWC) in the mark scheme, but this does not preclude others.

www.dynamicpapers.com

Section A (multiple choice)

Question Number	Correct Answer	Mark
1	A	**1**

Question Number	Correct Answer	Mark
2	D	**1**

Question Number	Correct Answer	Mark
3	A	**1**

Question Number	Correct Answer	Mark
4	B	**1**

Question Number	Correct Answer	Mark
5	D	**1**

Question Number	Correct Answer	Mark
6	B	**1**

Question Number	Correct Answer	Mark
7	C	**1**

Question Number	Correct Answer	Mark
8	D	**1**

Question Number	Correct Answer	Mark
9	B	**1**

Question Number	Correct Answer	Mark
10	B	**1**

Question Number	Correct Answer	Mark
11	C	**1**

Question Number	Correct Answer	Mark
12	A	**1**

www.dynamicpapers.com

Question Number	Correct Answer	Mark
13	C	**1**

Question Number	Correct Answer	Mark
14	B	**1**

Question Number	Correct Answer	Mark
15	C	**1**

Question Number	Correct Answer	Mark
16	D	**1**

Question Number	Correct Answer	Mark
17	C	**1**

Question Number	Correct Answer	Mark
18	D	**1**

Question Number	Correct Answer	Mark
19	D	**1**

Question Number	Correct Answer	Mark
20	A	**1**

TOTAL FOR SECTION A = 20 MARKS

www.dynamicpapers.com

Section B

Question Number	Acceptable Answers	Reject	Mark
21(a)	$3d^3 4s^2$ OR $4s^2 3d^3$ $3d^5 4s^1$ OR $4s^1 3d^5$ both must be correct. ALLOW Electron numbers could be on the line or as subscripts IGNORE case of letters		**1**

Question Number	Acceptable Answers	Reject	Mark
21(b)(i)	Variable/varying/different/several/ more than one **oxidation state /number** **(1)** Complex (ion formation) **(1)** Treat Physical properties (if correct) including catalytic activity as neutral	Each metal has a different oxidation number Ligand exchange	**2**

Question Number	Acceptable Answers	Reject	Mark
21(b)(ii)	The following metals scores (2) marks with correct E value: Mg 1.96, Ce 1.92, U 1.39, Al 1.25, Mn 0.78, V 0.77, Zn 0.35 **NOTE:** Positive sign/unit not needed, but penalise negative value The following metals score (1) mark with correct E value: Li 2.62, Rb 2.52, K 2.51, Ca 2.46, Na 2.30, Cr 0.33, Fe 0.03 **NOTE:** Positive sign/unit not needed, but penalise negative value	All other metals 0/2	**2**

www.dynamicpapers.com

Question Number	Acceptable Answers	Reject	Mark
21(b)(iii)	Not a redox process Chromate and dichromate **both** the same/no change in oxidation number **(1)** contain Cr(VI) 6/6+ **(1)** Mark independently OR Not redox and **both** contain Cr(VI) 6/6+ **(2)**		**2**

www.dynamicpapers.com

Question Number	Acceptable Answers	Reject	Mark
21(b)(iv)	Forms two (dative/covalent) bonds/has two lone pairs (to the Transition Metal/ion) OR donates two pairs of electrons (to the Transition Metal/ion) **Check answer to (v) if mark not awarded here**	'…to the molecule'	**1**

Question Number	Acceptable Answers	Reject	Mark
21(b)(v)	**Any two from** Both have two nitrogen atoms with lone pairs or implied **(1)** or Far enough apart/longer chain in between in en (but not in hydrazine)/too close in hydrazine/hydrazine is too short/not as long **(1)** or Dative bonds/lone pairs too close/repel in hydrazine **(1)** OR for two marks Forms 5-membered ring (with en with no angle strain/stable) **(2)** or Bond angles too acute/too much ring strain in hydrazine **(2)** **Mark for iv can be awarded here.**	N=N, or triple bond in hydrazine max 1 or if implies **only** en has lone pairs max 1	**2**

www.dynamicpapers.com

Question Number	Acceptable Answers	Reject	Mark
21(c)(i)	- 0.41 (V) +1.33 (V) **Both** answers needed, with number and sign, for 1 mark IGNORE additional words		**1**

www.dynamicpapers.com

Question Number	Acceptable Answers	Reject	Mark
***21(c)(ii) QWC**	Combines the equations to obtain $8Cr^{3+} + 7H_2O \rightarrow 6Cr^{2+} + Cr_2O_7^{2-} + 14H^+$ ALLOW $6Cr^{3+} + 2Cr^{3+}$ instead of $8Cr^{3+}$ IGNORE state symbols even if wrong species **(1)**, balance **(1)** $E^{\ominus}_{reaction}$ = — 1.74V **(1)** So not feasible on condition of negative value **(1)** OR $6Cr^{2+} + Cr_2O_7^{2-} + 14H^+ \rightarrow 8Cr^{3+} + 7H_2O$ If fully correct **(1)** $E^{\ominus}_{reaction}$ = + 1.74V **(1)** **Disproportionation** not feasible on condition of positive value but reject 'reaction is spontaneous' **(1)** **Other wrong equations** **IF** $Cr_2O_7^{2-}$ or Cr^{2+} on left Then + 1.74 V **(1)** **If** Cr^{3+} alone on the left Then -1.74 V **(1)** and reaction not feasible **(1)**	1 max for the equation if electrons are shown balanced or unbalanced	**4**

www.dynamicpapers.com

Question Number	Acceptable Answers	Reject	Mark
22(a)(i)	C 60/12 = 5 H 8/1 = 8 O 32/16 = 2 ALLOW 1 mol = 100 g So 60 %C = C_5, etc		**1**

Question Number	Acceptable Answers	Reject	Mark
22(a)(ii)	**C=C** **Test** : add bromine water/Br_2(aq) **(1)** **Result**: From yellow/brown/red-brown/orange to colourless/decolorises **(1)** OR **Test** : add (acidified) potassium manganate((VII)) (solution) **(1)** **Result**: goes from pink/purple to colourless/brown **(1)** **Test** : add alkaline potassium manganate((VII)) (solution) **(1)** **Result**: goes green **(1)** **COOH:** **Test** : add $NaHCO_3$ /Na_2CO_3/sodium carbpnate (solution) **(1)** **Result**: Fizzes/bubbles/large volume neutralized **(1)**	Bromine/Br_2/Br_2(l) clear for colourless clear for colourless PCl_5 /$LiAlH_4$ as test NaOH/NaOH(aq) colourless gas evolved	**4**

www.dynamicpapers.com

	ALLOW gas given off that turns limewater cloudy OR **Test** : with **blue** litmus **(1)** **Result**: turns red **(1)** The test can be with any other indicator, including universal indicator, with the correct initial and final colour ALLOW pH meter **(1)** pH 4-6 **(1)** OR **Test** : add ethanol with conc H_2SO_4 (and warm) **(1)** **Result**: gives pleasant/fruity smell of ester **(1)** OR **Test:** add magnesium **(1)** **Result:** fizzing/bubbles etc (of hydrogen) **(1)** ALLOW gas given off that burns with a squeaky pop	Add sodium colourless gas evolved	

www.dynamicpapers.com

Question Number		Reject	Mark
22(b)(i)	Explanation of precedence/priority in terms of atomic numbers/masses of the attached groups OR Highest-precedent/priority groups on each carbon are on opposite sides of the molecule **(1)** *E*-/entgegen **(1)** Mark independently	Both CH_3/methyl groups on the same side so Z (0/2)	**2**

Question Number	Acceptable Answers	Reject	Mark
22(b)(ii)	45 $COOH^+$ /CO_2H^+ **(1)** 55 $C_4H_7^+$ OR $C_3OH_3^+$ **(1)** ALLOW Structural/displayed formulae of ions Absence of + charge (1 max)		**2**

Question Number	Acceptable Answers	Reject	Mark
22(b)(iii)	If they say yes **(0)** (No) (Cleavage of the C—COOH bond in) both compounds gives fragment(s) of the same mass OR Both give the same peak(s)/fragment(s) Both give CO_2H^+/ $C_4H_7^+$ fragments The mark can be scored by referring to just one of the fragments/peaks/masses.	'No' on its own	**1**

www.dynamicpapers.com

Question Number	Acceptable Answers	Reject	Mark
***22(c)(i) QWC**	**C** is CH_3CHO (alone) **(2)** **D** is $CH_3COCOOH$ (alone) **(2)** so tiglic acid must be **B** **(1)** tiglic acid mark can only be awarded if correct structures of either **C** or **D** are given. **Any one of the following** **C** must be an aldehyde **(1)** **D** is a ketone **(1)** Mention that CH_3CO present in either/both compounds (because of formation of iodoform) **(1)** If one or both of the structures are incorrect any of the last 3 marks can be awarded max 5 If C and D are fully correct, but the wrong way round max 5	CH_3COH **1 max**	**6**

Question Number	Acceptable Answers	Reject	Mark
22(c)(ii)	Doesn't distinguish *E*- isomer from *Z*-isomer/geometric isomers (so no) OR Doesn't distinguish which sides of C=C functional groups are on	Just isomers/ stereoisomers/ enatiomers	**1**

www.dynamicpapers.com

Question Number	Acceptable Answers	Reject	Mark
22(d)(i)	CH_3CHO **(1)** ACCEPT displayed or skeletal **Step 1** (heat)using acidified potassium dichromate/or $H^+/Cr_2O_7^{2-}$ **(1)** distil (product as formed) conditional on dichromate **(1)** **Step 2** HCN with KCN OR KCN with H^+/acid OR KCN with (cold) NaOH(aq)/alkali **(1)** ALLOW HCN with NaOH/alkali For step 2 Ignore conditions e.g. any references to heat	CH_3COH Manganate VII/$KMnO_4$ Reflux HCN alone	**4**

Question Number	Acceptable Answers	Reject	Mark
22(d)(ii)	**Nucleo**philic addition Any recognisable spelling of 'philic' and addition, either order **Both** words needed	**Nutro**philic addition Any other or additional words	**1**

www.dynamicpapers.com

Question Number	Acceptable Answers	Reject	Mark
***22(d)(iii) QWC**	Ethanal is planar (at the reaction site) OR Ethanal is a planar molecule **(1)** Attack (from CN^- to give the cyanohydrin) is (equally likely) from either side/above or below/from both sides (of the molecule) (so a racemic mixture is formed) **(1)** Mark independently	Intermediate is planar Square planar Can attack carbocation from either side/any reference to SN1/SN2	**2**

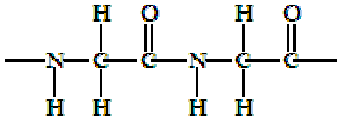
Question Number	Acceptable Answers	Reject	Mark
22(d)(iv)	Receptors for the compound in the body are often stereospecific so only one stereoisomer is pharmacologically active OR Body recognises one (stereo)isomer ALLOW Only one (stereo)isomer is active OR One/the other isomer may be toxic/dangerous/harmful OR One isomer destroys body cells OR (Different) isomers have different biological/pharmacological/biochemical properties		**1**

www.dynamicpapers.com

Question Number	Acceptable Answers	Reject	Mark
23(a)(i)	Formula showing $-NH_3^+$ and $—COO^-$ /$—CO_2^-$ Charges can be anywhere on functional group Rest of the molecule must be correct ALLOW displayed/part displayed formula		**1**

Question Number	Acceptable Answers	Reject	Mark
23(a)(ii)	**Any two from** High energy needed (to overcome) **(1)** strong ionic/electrostatic forces OR strong forces between oppositely charged ions/between positive and negative **(1)** between **different** (zwitter)ions OR between $-NH_3^+$ and $—COO^-$ OR between one molecule and another OR Chains of zwitterions/molecules **(1)**	any reference to intermolecular forces eg (strongly) polar/bond polarity if they state the ionic bond is within the same molecule	**2**

www.dynamicpapers.com

Question Number	Acceptable Answers	Reject	Mark
23(a)(iii)	 Correct peptide link **(1)** Minimum two residues and extension to the rest of the molecule **(1)** ALLOW $-NHCH_2CONHCH_2CO-$ **(2)** Drawn the other way round, i.e. starting with the carbonyl group Brackets around outside with 'n' ie $(.....)_n$ Second mark depends on first		**2**

www.dynamicpapers.com

Question Number	Acceptable Answer	Reject	Mark
***23(b) QWC**	**Key Points** **KP1** Spot (of hydrolysate) on paper/tlc/thin layer chromatogram **(1)** **KP2** Marker spots of known amino-acids/measure R_f **(1)** **KP3** Run in (suitable) solvent/discussion of comparative solubilities in phases **(1)** **KP4** (Spray with) ninhydrin (and heat) [Stand alone mark] **(1)** **KP 5** Marker spots and the unknown spots correspond ALLOW Compare R_f values of marker spots with hydrolysate spots **(1)** OR If 2-d chromatography used (2 different solvents run in two directions at right angles): **KP1** Spot (of hydrolysate) on paper/tlc/thin layer chromatogram **(1)** **KP2** Run in (suitable) solvent in one direction **(1)** **KP3** Develop in suitable/different solvent at right angles OR discussion of comparative solubilities in phases **(1)** **KP4** Spray with ninhydrin (andheat) **(1)** **KP5** Compare hydrolysate spots with same experiment for known amino acids **(1)** OR	Spot one amino acid/protein Water alone as solvent Spot one amino acid	**5**

www.dynamicpapers.com

	if column/GLC/GC used **KP1** Put amino acid mixture **(**Hydrolysate) into column **(1)** **KP2** Separately known amino-acids into column **(1)** **KP3** Detect amino acids in effluent with Ninhydrin/mass spectrometry **(1)** **KP4** Measure retention times/ discussion of comparative solubilities in phases **(1)** **KP 5** Compare retention times **(1)**	Spot one amino acid	

TOTAL FOR SECTION B = 50 MARKS

www.dynamicpapers.com

Section C

Question Number	Acceptable Answers	Reject	Mark
24(a)(i)	Not knowing the structure of the molecule (means that the reactions/reagents/reactants needed to make it are also unknown) ALLOW Structure not known		**1**

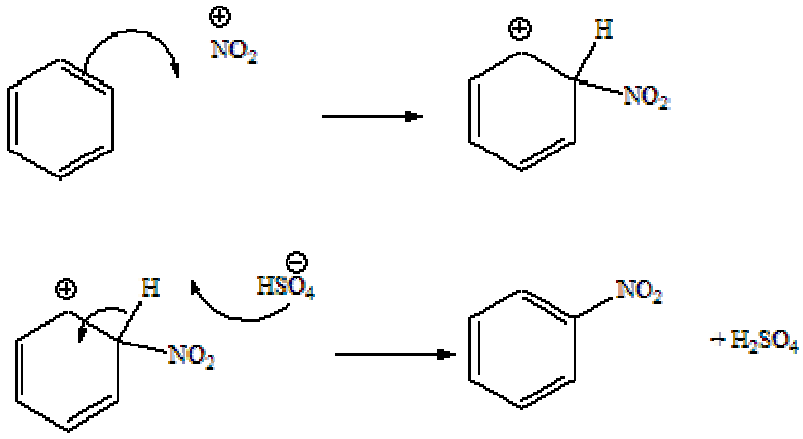
Question Number	Acceptable Answers	Reject	Mark
24(a)(ii)	Credit any reasonable arguments for example: **First mark** No longer any demand for madder/indigo OR Cheaper alternatives available **(1)** **Second mark** So the growing industries collapsed OR no market for crops OR farmers had to grow alternative crops OR decreased employment OR economic damage OR decreased GDP OR Loss of export **(1)**		**2**

www.dynamicpapers.com

Question Number	Acceptable Answers	Reject	Mark
24(b)(i)	**First mark** Double bonds expected to react with bromine water turning it colourless OR Bromine water remained yellow/orange/red/brown **(1)** **Second mark** So benzene does not contain double bonds OR Double bonds not normal/not simply double bonds/any indication that double bonds are different OR His representation incorrect **(1)**		**2**

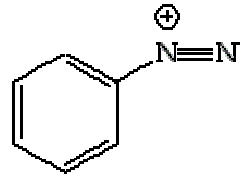
Question Number	Acceptable Answers	Reject	Mark
24(b)(ii)	The p/pi-/π/6 electrons (of carbon) OR π system **(1)** Electrons are delocalised around the ring **(1)** Which gives the molecule greater stability/need more energy to break the bonds in benzene (and hence a less exothermic hydrogenation enthalpy) Allow it is more stable **(1)**	Harder to break/disrupt [alone]	**3**

www.dynamicpapers.com

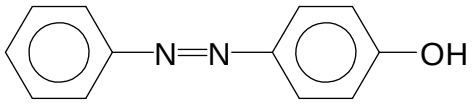
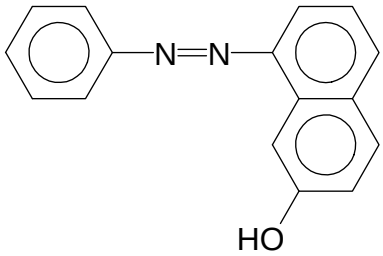
Question Number	Acceptable Answers	Reject	Mark
24(c)	$2H_2SO_4 + HNO_3 \rightarrow NO_2^+ + H_3O^+ + 2HSO_4^-$ **(1)** OR $H_2SO_4 + HNO_3 \rightarrow NO_2^+ + H_2O + HSO_4^-$ OR $H_2SO_4 + HNO_3 \rightarrow H_2NO_3^+ + HSO_4^-$ **and** $H_2NO_3^+ \rightarrow NO_2^+ + H_2O$ **Charges are needed for first mark**  Attack on nitronium ion arrow must start on or in the benzene **(1)** Wheland intermediate Can be a part, but not complete circle, in correct place inside ring BUT part circle must cover minimum of 3 carbon atoms AND must not include where nitro group is attached and must positive charge somewhere **(1)** **Either but only one of first two marks can be lost if bond is clearly to oxygen** Arrow from H bond into the ring to produce either H^+ or H_2SO_4 and return to aromaticity **(1)**		**4**

www.dynamicpapers.com

Question Number	Acceptable Answers	Reject	Mark
24(d)(i)	< 0° C/temperature too low: reaction too slow/insufficient energy to overcome activation energy **(1)** > 10° C/temperature too high: diazonium ion decomposes/produces phenol **(1)**	Will not take place	**2**

Question Number	Acceptable Answers	Reject	Mark
24(d)(ii)	 Positive charge can be on either N Cl^- may be given as well ALLOW circle in benzene ring and hydrogens/carbons displayed OR ---N=N $^+$ Is acceptable providing charge is on the end N	 Positive charge on wrong N	**1**

www.dynamicpapers.com

Question Number	Acceptable Answers	Reject	Mark
24 (d)(iii)	Adds phenol in sodium hydroxide/OH^-/alkali ALLOW 2-naphthol in sodium hydroxide/OH^- /alkali **(1)** Correct structure for the -N=N- bond between 2 benzene rings **(1)** Remainder of molecule **(1)** which is either:  ALLOW anionic form of —OH OR if 2-naphthol is used it is:  	Ignore position of –OH group on the ring	**3**

www.dynamicpapers.com

Question Number	Acceptable Answers	Reject	Mark
24 (e)	**First mark** $—SO_3^-$ are solvated / hydrated Can be drawn with polar H of water OR Negative ion bonds with/attracted to water **(1)** **Second mark** **Nitrogen/oxygen** atoms **hydrogen-bonded** (to water) Can be drawn **(1)**	Just sodium ions attracted to water	**2**

TOTAL FOR SECTION C = 20 MARKS

TOTAL FOR PAPER = 90 MARKS

www.dynamicpapers.com

Further copies of this publication are available from
International Regional Offices at www.edexcel.com/international

For more information on Edexcel qualifications, please visit
www.edexcel.com

Alternatively, you can contact Customer Services at
www.edexcel.com/ask or on + 44 1204 770 696

Pearson Education Limited. Registered company number 872828
with its registered office at Edinburgh Gate, Harlow, Essex CM20 2JE

Ofqual

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

Rewarding Learning