Pearson

Mark Scheme (Results)

October 2025

Pearson Edexcel International Advanced
Subsidiary Level in Chemistry
WCH11/01

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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.

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.

Section A

Question Number	Answer	Mark
1(a)	**The only correct answer is C** (84) ***A*** *is incorrect because 36 is the atomic number* ***B*** *is incorrect because 48 is the number of neutrons in the isotope* ***D*** *is incorrect because 120 is the sum of the atomic number and the mass number*	**(1)**

Question Number	Answer	Mark
1(b)	**The only correct answer is B** (P) ***A*** *is incorrect because Ga is the element using the mass number for the atomic number* ***C*** *is incorrect because Pd is the element using the sum of the atomic number and mass number* ***D*** *is incorrect because S is the element using the difference between the mass number and the atomic number*	**(1)**

Question Number	Answer	Mark
1(c)	**The only correct answer is B** (36) ***A*** *is incorrect because 34 is the number of electrons in a neutral atom* ***C*** *is incorrect because 80 is the sum of the protons and neutrons* ***D*** *is incorrect because 82 is the sum of the electrons and neutrons*	**(1)**

Question Number	Answer	Mark
2(a)	**The only correct answer is B** (electric field) ***A*** *is incorrect because the beam of electrons is used to ionise the sample* ***C*** *is incorrect because the magnetic field is used to deflect the sample* ***D*** *is incorrect because vaporisation is carried out on the sample prior to its entry to the mass spectrometer*	**(1)**

Question Number	Answer	Mark
2(b)	**The only correct answer is C** (10.79) ***A*** *is incorrect because 10.21 is the value with the percentages used for the isotopes the wrong way round* ***B*** *is incorrect because 10.50 assumes 50% of each of the two isotopes* ***D*** *is incorrect because 10.80 is the value from the periodic table*	**(1)**

Question Number	Answer	Mark
2(c)	**The only correct answer is C** (ions can form with a 2+ charge) ***A*** *is incorrect because isotopes do not form in a spectrometer* ***B*** *is incorrect because the sample used was pure* ***D*** *is incorrect because this true statement does not explain the presence of the peak with m/z = 80*	**(1)**

Question Number	Answer	Mark
3	**The only correct answer is D** (C_2H_5O) ***A*** *is incorrect because* $C_4H_{10}O$ *is the formula using the* M_r *and not the* A_r *for oxygen* ***B*** *is incorrect because* $C_4H_{10}O_2$ *is the molecular formula and not the empirical formula* ***C*** *is incorrect because* $C_4H_5O_2$ *is the formula using atomic numbers*	**(1)**

Question Number	Answer	Mark
4(a)	**The only correct answer is C** ($SrCO_3(s) + 2H^+(aq) \rightarrow Sr^{2+}(aq) + CO_2(g) + H_2O(l)$) ***A*** *is incorrect because these are the ions for the formation of strontium nitrate and not those in the ionic equation* ***B*** *is incorrect because this is the ionic equation for the reaction of a soluble carbonate, not an insoluble one* ***D*** *is incorrect because this is the reaction equation*	**(1)**

Question Number	Answer	Mark
4(b)	**The only correct answer is C** (77.3) ***A*** *is incorrect because 22.7 is the percentage of the undesired products* ***B*** *is incorrect because 70.7 is the percentage calculated for the strontium nitrate only having one nitrate* ***D*** *is incorrect because 82.8 is the percentage calculated by omitting the water product*	**(1)**

Question Number	Answer	Mark
5	**The only correct answer is D** (S^{2-}) ***A*** *is incorrect because sulfur has fewer protons than calcium* ***B*** *is incorrect because sulfur has fewer protons than chlorine* ***C*** *is incorrect because sulfur has fewer protons than potassium*	**(1)**

Question Number	Answer	Mark
6	**The only correct answer is D** (34.0) ***A*** *is incorrect because 0.034 is the concentration in g* cm^{-3} ***B*** *is incorrect because 0.400 is the concentration in mol* dm^{-3} ***C*** *is incorrect because 8.50 is just the mass dissolved in 250* cm^3 *and not the concentration per* dm^3	**(1)**

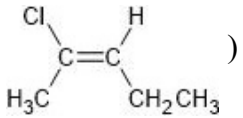
Question Number	Answer	Mark
7	**The only correct answer is D** (graphene and graphite only) ***A*** *is incorrect because diamond does not have flat hexagonal rings* ***B*** *is incorrect because graphene is not the only giant lattice of carbon atoms with flat hexagonal rings* ***C*** *is incorrect because graphite is not the only giant lattice of carbon atoms with flat hexagonal rings*	**(1)**

Question Number	Answer	Mark
8	**The only correct answer is B** (2.18×10^{-18}) ***A*** *is incorrect because* 1.09×10^{-18} *is the value if the ionisation energy value is viewed as being for the hydrogen molecule* ***C*** *is incorrect because* 1.09×10^{-21} *is the value if the ionisation energy value is viewed as being for the hydrogen molecule and is in kilojoules* ***D*** *is incorrect because* 2.18×10^{-21} *is the energy in kilojoules*	**(1)**

Question Number	Answer	Mark
9	**The only correct answer is B** (NCl_3) ***A*** *is incorrect because the linear shape results in no overall dipole moment* ***C*** *is incorrect because the tetrahedral shape results in no overall dipole moment* ***D*** *is incorrect because the trigonal bipyramidal shape results in no overall dipole moment*	**(1)**

Question Number	Answer	Mark
10	**The only correct answer is A** (12) ***B*** *is incorrect because 10 is the total number of electrons in the d orbitals* ***C*** *is incorrect because 8 is the total number of electrons in the s orbitals* ***D*** *is incorrect because 6 is the number of electrons in one p-subshell*	**(1)**

Question Number	Answer	Mark
11	**The only correct answer is C** (CeO_2) ***A*** *is incorrect because the ratio of cerium to oxygen is not 1:4* ***B*** *is incorrect because the ratio of cerium to oxygen is not 2:3* ***D*** *is incorrect because the ratio of cerium to oxygen is not 3:4*	**(1)**

Question Number	Answer	Mark
12	**The only correct answer is A** () ***B*** *is incorrect because the two hydrogen atoms are 'cis' to each other* ***C*** *is incorrect because the chlorine atoms are 'trans' to each other* ***D*** *is incorrect because the hydrogen atoms and the ethyl groups are 'trans' to each other*	**(1)**

Question Number	Answer	Mark
13(a)	**The only correct answer is A** () ***B*** *is incorrect because the curly half-arrows should originate from the bond and not end there* ***C*** *is incorrect because this is heterolytic fission with both electrons ending on one chlorine atom* ***D*** *is incorrect because both curly half-arrows should originate from the bond and go to separate chlorine atoms*	**(1)**

Question Number	Answer	Mark
13(b)	**The only correct answer is A** (CH_4 + Cl• → CH_3Cl + H•) ***B*** *is incorrect because this is the first propagation step* ***C*** *is incorrect because this is the second propagation step* ***D*** *is incorrect because this is a propagation step in the further substitution of methane*	**(1)**

Question Number	Answer	Mark
13(c)	**The only correct answer is C** (no free radicals are formed) ***A*** *is incorrect because covalent bonds are formed in both steps* ***B*** *is incorrect because heterolytic fission does not occur in either step* ***D*** *is incorrect because ultraviolet light is not needed in either step*	**(1)**

TOTAL FOR SECTION A = 20 MARKS

Section B

Question Number	Answer	Additional Guidance	Mark
14(a)	An answer that makes reference to the following points: • a region (within an atom) which can hold electrons **(1)** • (up to) **two** electrons with **opposite spin** **(1)**	Allow area, space, place Allow region where the probability of finding an electron is high Allow where electrons are Allow orbitals have electrons in them Ignore energy level Ignore any reference to s, p, d, subshells etc Allow pair of electrons with opposite spin Allow two electrons spin in opposite directions Ignore any reference to s, p, d, subshells etc	**(2)**

Question Number	Answer		Additional Guidance	Mark
14(b)	A description that makes reference to four of the following points: • M1 (the trend is that) first ionisation energies decrease down (Group 1) Then any 3 out of 4 • M2 (because) there is an increase in (atomic) radius • M3 (and) an increase in shielding (by inner shells of electrons)/ an increase in electron repulsion (between inner shells of electrons) • M4 (resulting in) less **attraction** between the nucleus and outer electron • M5 **despite/even though** the increasing nuclear charge / number of protons	**(1)** **(1)** **(1)** **(1)**	Standalone marks Allow more shells Allow outer electron further from the nucleus Allow electrons in a higher energy level Ignore less energy needed to remove an electron Ignore atomic number increases Ignore (ion) charge does not change Just increasing nuclear charge will not score as it has to related to the fact that ionisation energy decreases despite this. Ignore electronegativity Ignore charge density	**(4)**

Question Number	Answer	Additional Guidance	Mark
14(c)	An explanation that makes reference to the following points: • there is an increase in ionisation energies (from 1st to 4th) • the biggest jump is between the 2nd to 3rd ionisation energies • indicating 2 electrons in the outer shell	This can be implied or awarded if they mention an increase in three of the ionisation energies eg from 1st to 3rd or from 2nd to 4th Allow a big jump after the 2nd Allow group 2 Allow the 3rd electron comes from a new shell/ sub shell OWTTE All 3 points score 2 2 points score 1	**(2)**

Question Number	Answer	Additional Guidance	Mark
14(d)	• equation **(1)** • state symbols **(1)**	<u>Example of equation</u> $F^+(g) \rightarrow F^{2+}(g) + e^{(-)}$ Allow $F^+(g) - e^{(-)} \rightarrow F^{2+}(g)$ Ignore state symbols on the electron Allow TE for M2 is if the 1st or 3rd ionisation equation is shown.	**(2)**

Question Number	Answer	Additional Guidance	Mark
14(e)	An answer that makes reference to the following points: • value **(1)** (Justification) **(1)** • outermost electron of oxygen is paired in a p **orbital** • so is repelled by the other electron (resulting in a decrease in (first) ionisation energy) **(1)** Allow reverse argument for M2 and M3 • N is higher as the electron is being removed from a singly occupied orbital • there is no electron repulsion (resulting in a higher (first) ionisation energy)	Standalone marks Accept any value in the range (+)1100 – 1382 (Actual value 1314) Do not award negative values Allow electrons in orbital boxes Allow 2 electrons in $2p^x$ etc Ignore just p sub shell/shell Ignore electronic configuration but this can be evidence that it is a p electron if not stated Allow spin pair repulsion Do not award electron pairs repel Penalise 3p once only	**(3)**

Question Number	Answer	Additional Guidance	Mark
14(f)	An explanation that makes reference to the following points: • the outermost electron of aluminium is in a (3)p orbital whereas it is in a (3)s orbital for magnesium **(1)** • which is further from the nucleus/ higher energy (than the s orbital electron and so requires less energy to remove) **(1)**	Allow valence electron/electron being removed Allow (3) p subshell and (3) s subshell Ignore correct electronic configurations Accept more shielded (by inner shells) / greater repulsion (by inner shells) Do not award spin pair repulsion	**(2)**

(Total for Question 14 = 15 marks)

Question Number	Answer	Additional Guidance	Mark
15(a)	• calculation of mass of propane **(1)** • calculation of moles of propane **(1)** • rearrangement of ideal gas equation **and** conversion of pressure and temperature to appropriate units **(1)** • substitution and calculation of volume **and** units **(1)**	Example of calculation m = (d × V = 0.585 × 18.4 × 10^3 =) 10 764 (g) n = (10 764 ÷ 44 =) 244.64 (mol) $V = nRT \div p$ $p = 1.01 \times 10^5$ (Pa) $T = 298$ (K) $V = (244.64 \times 8.31 \times 298 \div 1.01 \times 10^5)$ $= 5.9982$ m^3 / 5.9982×10^3 dm^3 / 5.9982×10^6 cm^3 Correct answer with some working scores (4) TE at each stage	**(4)**

Question Number	Answer	Additional Guidance	Mark
15(b)	An explanation that makes reference to the following points: • metallic bonding is the **strong** (electrostatic) **attraction** **(1)** • between (metal) cations/ positive ions and the ('sea' of) delocalised electrons **(1)**	Any reference to intermolecular bonding/covalent bonding/ molecule score (0) Allow answers that refer to the **giant** lattice of metal ions and the **attraction** to the (sea of) delocalised electrons Allow e− for electrons	**(2)**

Question Number	Answer	Additional Guidance	Mark
15(c)(i)	• equation	Example of equation $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ Accept multiples Ignore state symbols even if incorrect	**(1)**

Question Number	Answer	Additional Guidance	Mark
15(c)(ii)	An answer that makes reference to the following point: • 24 (dm^3)	Ignore any working	**(1)**

Question Number	Answer	Additional Guidance	Mark
15(c)(iii)	An answer that makes reference to the following point: • climate change/global warming	Accept examples of such as rise in sea levels Allow (carbon dioxide is a)greenhouse gas Allow toxic nature of carbon monoxide (due to incomplete combustion) Ignore just more CO_2 in the atmosphere Do not award references to the ozone layer Do not award CO_2 is toxic	**(1)**

Question Number	Answer	Additional Guidance	Mark
15(d)(i)	• (maximum) volume of carbon monoxide allowed in the room **(1)** • (maximum) moles of carbon monoxide allowed **(1)** • calculation of number of molecules **(1)**	Example of calculation $V = (20 \times 10^{-6} \times 50.2 =) 1.004 \times 10^{-3}$ / 0.001004 (m^3) / 1.004 (dm^3) $n = (1.004 \div 24) = 4.1833 \times 10^{-2}$ / 0.041833 (mol) $N = (0.041833 \times 6.02 \times 10^{23})$ $= 2.5184 \times 10^{22}$ Correct answer with no working scores (3) TE at each stage Ignore SF except 1	**(3)**

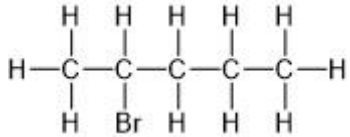
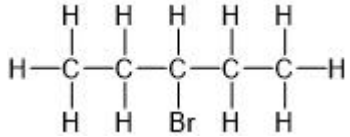
Question Number	Answer	Additional Guidance	Mark
15(d)(ii)	An answer that makes reference to two of the following points: • use of a fume cupboard **(1)** • open window/door **(1)** • wear a respirator/ oxygen mask **(1)** • avoid continuous 8 hours by taking breaks (and leaving the room) **(1)**	 Allow fume hood Allow to improve ventilation Ignore reference to wearing a mask/ Ignore fitting a CO detector Ignore gas mask/ face mask	**(2)**

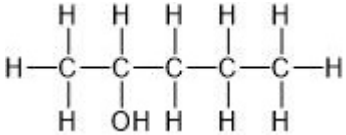
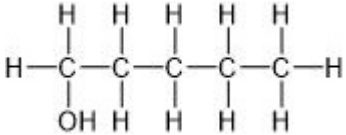
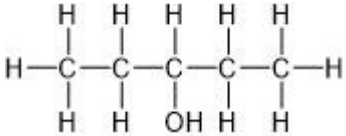
(Total for Question 15 = 14 marks)

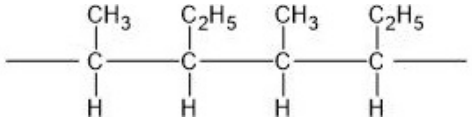
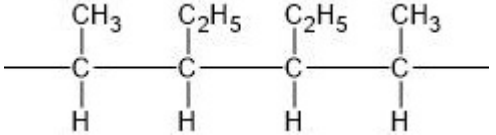
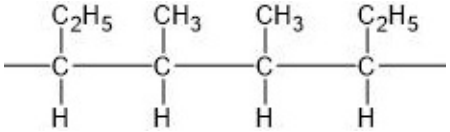
Question Number	Answer	Additional Guidance	Mark
16(a)(i)	An answer that makes reference to the following point: • same molecular formula / C_5H_{10} but different structural formulae	Allow same molecular formula but with the double bond in a different position/atoms in different positions Allow same molecular formula but with different displayed formula Allow same number of each type of atom but different structural formula	**(1)**

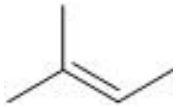
Question Number	Answer	Additional Guidance	Mark
16(a)(ii)	An explanation that makes reference to the following points: • pent-2-ene has restricted rotation/lack of free rotation about the C=C **(1)** • pent-2-ene has **two** different substituents on **each carbon** of the double bond (giving geometric isomers) **(1)**	Accept points made in annotated structures Allow restricted rotation about the double bond Allow cannot rotate/no rotation about the double bond Allow different groups Allow different alkyl groups on each carbon Allow CH_3 and H on one C and C_2H_5 and H on the other Ignore references to different sides (of the double bond)	**(2)**

Question Number	Answer	Additional Guidance	Mark
16(b)	• nickel / Ni	Accept Pd / Palladium / Pt / Platinum/ Allow nikel/ nickle Allow Rh/rhodium Ignore references to heat Do not award if given with other substances	**(1)**

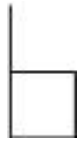
Question Number	Answer	Additional Guidance	Mark
16(c)	An answer that makes reference to the following points: • product 1 **(1)** • product 2 **(1)**	Structures can be given in either order   Allow (1) for any two correct non-displayed / semi-displayed / skeletal formulae Ignore bond length and orientation of Br Penalise missing Hs once If 6 carbons are used allow (1) for Br on C2 and C3	**(2)**

Question Number	Answer	Additional Guidance	Mark
16(d)	An explanation that makes reference to the following points: • the water molecule / H/ OH can add to the double bond either way round/to different carbons **(1)** • structure of the alcohol made from both pent-1-ene and pent-2-ene **(1)** • structure of other alcohol (made from pent-1-ene) **(1)** • structure of other alcohol (made from pent-2-ene) **(1)** • all three alcohol names linked to correct structures **(1)**	Accept any correct type of formulae, displayed / structural / skeletal or any combination thereof Allow just the OH and / or H add to the double bond  pentan-2-ol To score this structure mark it must be clear it can be formed from both alcohols  pentan-1-ol  pentan-3-ol	**(5)**

Question Number	Answer	Additional Guidance	Mark
16(e)	• two repeat units	<u>Example of structure</u>  Accept methyl / ethyl groups on alternating / either sides or joined randomly so both ethyl groups adjacent or both methyl groups adjacent as shown  or  Allow CH_3CH_2 for ethyl group Allow skeletal formula if in brackets to show extension Ignore connectivity of alkyl groups There must be extension shown Ignore brackets and ‘n’	**(1)**

Question Number	Answer	Additional Guidance	Mark
16(f)	• skeletal formula	<u>Example of structure</u>  Ignore bond angles bond lengths and the orientation of the structure Do not award non-skeletal formula	**(1)**

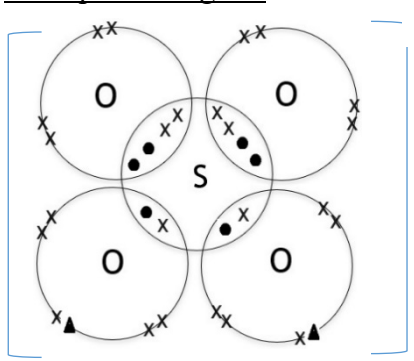
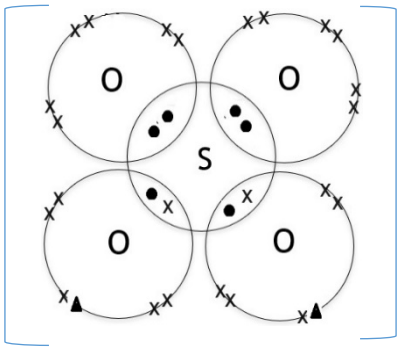
Question Number	Answer	Additional Guidance	Mark
16(g)(i)	A description that makes reference to the following point: • no change / stays brown	 Accept 'no decolorisation' Allow stays red / orange / yellow Allow no reaction Allow stays the same Ignore shades Do not award any indication of a colour change	**(1)**

Question Number	Answer	Additional Guidance	Mark
16(g)(ii)	An answer that makes reference to three of the following points: • structure of methylcyclobutane **(1)** • structure of ethylcyclopropane **(1)** • structure of 1,1-dimethylcyclopropane **(1)** • structure of 1,2-dimethylcyclopropane **(1)** Comment Ignore cyclopentane and duplicate structures	Accept skeletal / displayed / structural or any combination thereof     Three correct structures scores 2 One correct structure scores 1 Ignore names even if incorrect Penalise missing Hs once only in displayed/ structural formulae	**(2)**

(Total for Question 16 = 16 marks)

Question Number	Answer	Additional Guidance	Mark
17(a)	An explanation that makes reference to the following points: • bond angles **(1)** • shapes **(1)** • ammonia has three bonded pairs (of electrons) plus one lone pair and ammonium has four bonded pairs **(1)** • lone pairs repel more (than bonded pairs and so the bond angle is smaller in ammonia / the shape changes) **(1)**	Accept labelled diagrams for marking points 107(°) in ammonia and 109.5(°) in ammonium ion pyramidal for ammonia and tetrahedral for ammonium ion Do not award by-pyramidal Allow bp and lp	**(4)**

Question Number	Answer	Additional Guidance	Mark
17(b)(i)	A description that makes reference to the following points: • carry out **electrolysis** of copper(II) sulfate solution **(1)** • by placing a solution / crystal of copper(II) sulfate on a damp piece of filter paper (on a microscope slide) **(1)** • there will be migration of the **blue** copper(II) ions to the negative electrode/cathode **(1)**	Accept marking points in a labelled diagram Allow a description such as placing eletrodes connected to a battery into a solution of copper sulfate Allow place the copper(II) sulfate solution in a U-shaped tube Allow copper metal being deposited on the cathode Allow copper chromate	**(3)**

Question Number	Answer	Additional Guidance	Mark
17(b)(ii)	• electrons around the central sulfur **(1)** • electrons around each oxygen **(1)**	Example of diagram  or  M2 depends on two electrons shown as triangles on two different oxygen atoms Note the order of the oxygens round the S may differ	**(2)**

Question Number	Answer	Additional Guidance	Mark
17(c)(i)	• calculation of moles of one salt **(1)** • calculation of moles of other salt **(1)** • statement which is in excess **(1)**	<u>Example of calculation</u> n(ammonium sufate) = 3.35 ÷ 132.1 = 0.025360 (mol) Allow 132 n(copper(II) sulfate) = 3.96 ÷ 159.6 = 0.024812 (mol) Allow 159.5 so ammonium salt is in excess/ sulfate is limiting For M3, allow TE for incorrect moles in M1 and M2. In no other marks are awarded score (1) for the formula mases of both salts ammonium sulfate = 132.1 copper(II) sulfate) = 159.6	**(3)**

Question Number	Answer	Additional Guidance	Mark
17(c)(ii)	• calculation of relative formula mass of double salt **(1)** • calculation of moles of double salt **(1)** • calculation of percentage yield **(1)** Alterative for M2 and M3 • maximum mass of double salt **(1)** • calculation of percentage yield **(1)**	<u>Example of calculation</u> $(18 \times 2) + 63.5 + (32.1 \times 2) + (16 \times 8) + (6 \times 18) = 399.7$ n(double salt) = 9.52 ÷ 399.7 = 0.023818 (mol) % yield = (0.023818 ÷ 0.024812) × 100 = 95.993 / 96.0 (%) 0.0248 × 399.7 = 9.9125 (g) % yield = (9.52 ÷ 9.9125) × 100 = 96.039 (%) Allow M3 for a TE on an incorrect mol from (c)(i) Allow TE from M2 unless the answer is over 100% Ignore SF except 1SF at any step and in the final answer	**(3)**

(Total for Question 17 = 15 marks)

TOTAL FOR SECTION B = 60 MARKS
TOTAL FOR PAPER = 80 MARKS