OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

GATEWAY SCIENCE

B742/02

CHEMISTRY B

Unit B742: Chemistry modules C4, C5, C6 (Higher Tier)

MARK SCHEME

Duration: 1 hour 30 minutes

MAXIMUM MARK 85

This document consists of 24 pages

Guidance for Examiners

Additional Guidance within any mark scheme takes precedence over the following guidance.

1. Mark strictly to the mark scheme.
2. Make no deductions for wrong work after an acceptable answer unless the mark scheme says otherwise.
3. Accept any clear, unambiguous response which is correct, eg mis-spellings if phonetically correct (but check additional guidance).
4. Abbreviations, annotations and conventions used in the detailed mark scheme:

   / = alternative and acceptable answers for the same marking point
   (1) = separates marking points
   not/reject = answers which are not worthy of credit
   ignore = statements which are irrelevant - applies to neutral answers
   allow/accept = answers that can be accepted
   (words) = words which are not essential to gain credit
   words = underlined words must be present in answer to score a mark
   ecf = error carried forward
   AW/owtte = alternative wording
   ora = or reverse argument

   eg mark scheme shows 'work done in lifting / (change in) gravitational potential energy' (1)
   work done = 0 marks
   work done lifting = 1 mark
   change in potential energy = 0 marks
   gravitational potential energy = 1 mark

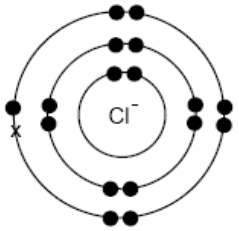
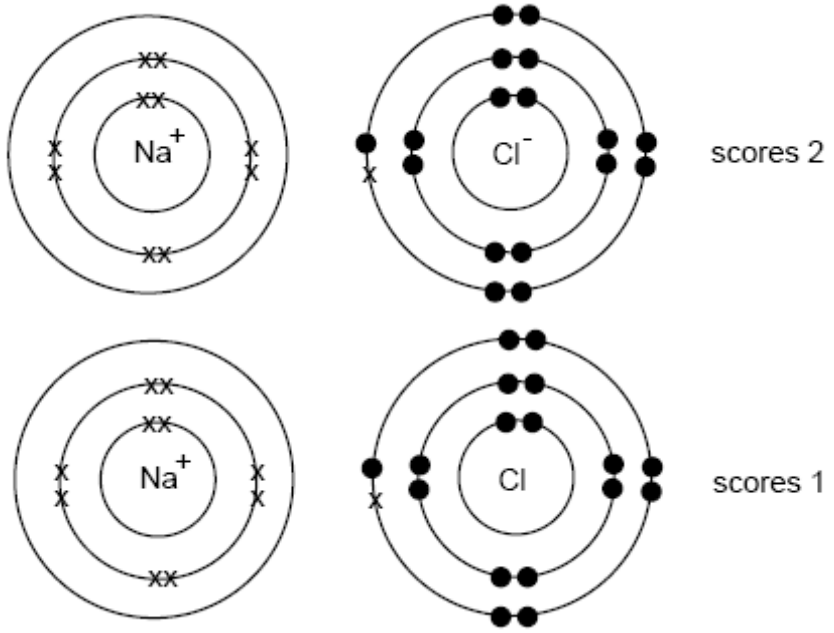
5. If a candidate alters his/her response, examiners should accept the alteration.
6. Crossed out answers should be considered only if no other response has been made. When marking crossed out responses, accept correct answers which are clear and unambiguous.

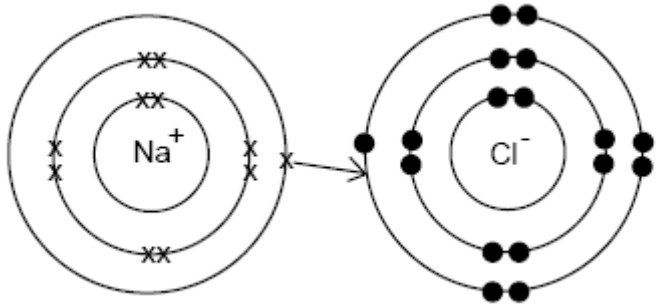
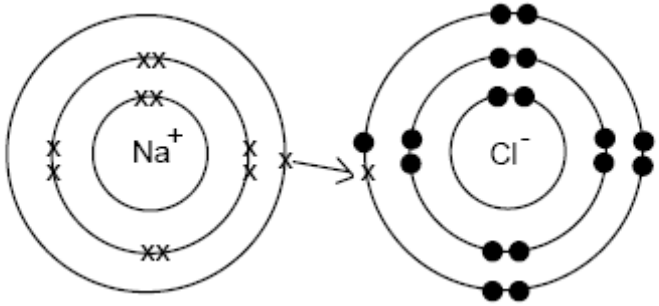
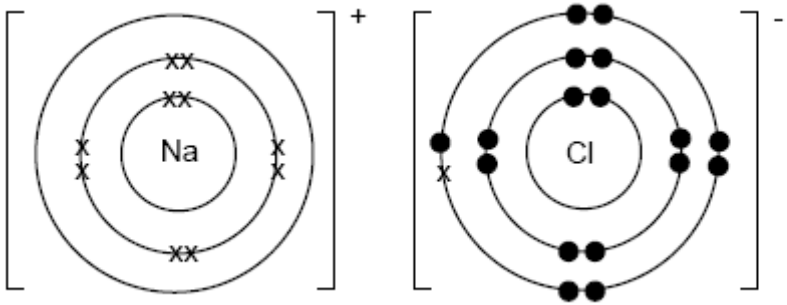
Question			Expected answers	Marks	Additional guidance
1	(a)		iodine (1)	1	
	(b)		nitrogen (1)	1	**allow** Mg
	(c)		calcium (1)	1	**allow** Ca
			Total	**3**	

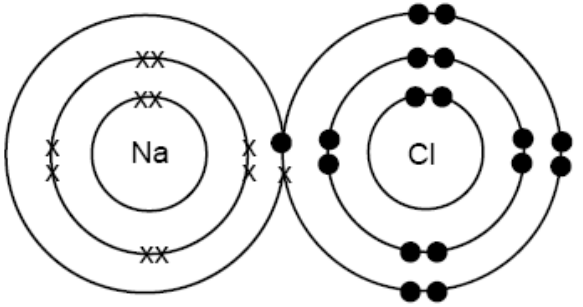
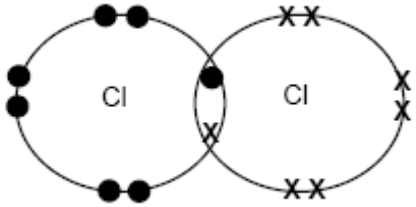
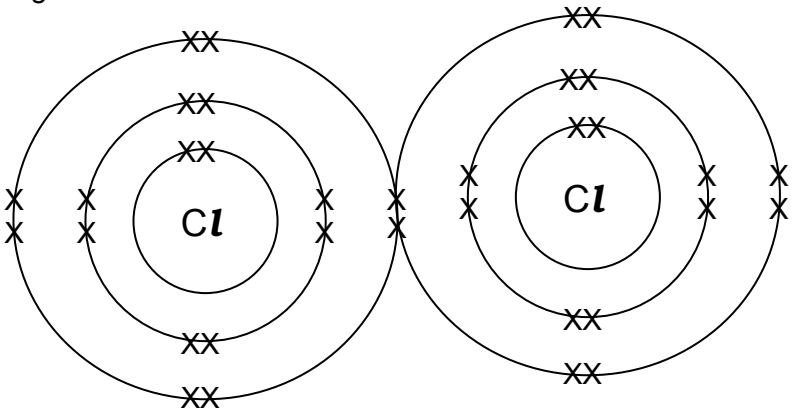
Question			Expected answers	Marks	Additional guidance
2	(a)		because in the nucleus the protons are positive and the neutrons are neutral (1)	1	**allow** because there are no negatively charged electrons in the nucleus only positive protons and neutral neutrons (1)
	(b)		they told others through: use of conferences / use of books / use of journals (1) telling others allowed: peer review by other scientists / evaluation / checking of their work / repeating of their experiments by other scientists / other scientists to develop their work (1)	2	**allow** they publish their results (1) **ignore** telephone / internet / television / video
	(c)		a diagram with 5 protons and any number other than 6 neutrons (1)	1	**allow** writing in the nucleus rather than circles eg 5 protons and 5 neutrons
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
3	(a)		$2Na + 2H_2O \rightarrow 2NaOH + H_2$ correct formulae (1) correct balancing (1)	2	**allow** = sign for arrow **not** and or & for +
	(b)		it is easier for rubidium to lose electrons when it reacts than for sodium to lose electrons because rubidium has a larger atomic radius (2) **OR** idea that both lose electrons when they react (1)	2	**electron loss must be linked to larger atomic radius in order to gain 2 marks**

Question	Expected answers	Marks	Additional guidance
(c)	**Level 3** Description of relationships and comprehensive explanation about how atomic radii, the strength of the metallic bonding and the melting point are related. Predictions made based on evidence in table are accurate. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** Relationship described and explanation applies understanding that melting point depends on the strength of the metallic bond. Correct predictions made based on evidence in the table. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** Limited description of the link between atomic radii and melting point and two predictions made. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** • melting point decreases as atomic radius increases • melting point decreases because it is easier to overcome the metallic bond • because strength of metallic bond decreases as atomic radius increases • idea that metallic bond is the attraction between delocalised electrons and (closely packed) metal ions • idea that atoms lose electrons more easily down Group 1 because the attraction is weaker • melting point of rubidium is any value between 30 to 50 ^{o}C • atomic radius of rubidium 272 to 295 pm **allow** at lower levels answers that just refer to bonds between particles in a metal **ignore** anything related to the reactivity of the metals including loss of electrons and electronic structure **not** reference to covalent, ionic bonds or intermolecular forces
	Total	**10**	

Question			Expected answers	Marks	Additional guidance
4	(a)		potassium + astatine → potassium astatide (1)	1	**allow** K + At_2 → KAt
	(b)	(i)	correct charges on ions Na^+ and C*l* (1) correct electronic structures 2,8 for sodium ion and 2.8.8. for chloride ion (1)  $[Na]^+$	2	alternatively mark sodium ion for charge and electronic structure (1) and chloride ion and electronic structure (1) whichever gives most marks **allow** just $[Na]^+$ for sodium ion and its electronic structure. **not** covalent NaC*l* extra advice is shown on the next page. 

Question	Expected answers	Marks	Additional guidance
			 scores 2
			 scores 1
			 scores 2

Question			Expected answers	Marks	Additional guidance
					 scores 0
4	(b)	(ii)	correct structure for chlorine (1) 	1	diagram shown is complete answer but can **ignore** missing inner shells, or atomic symbols. as in diagram **allow** all crosses or all dots 
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
5	(a)	(i)	% = 0.000522 (1)	1	**allow** 5.22 x 10^{-4} %
		(ii)	purification methods do not remove soluble impurities and the lead ions may be in solution / lead ions may come from old lead pipes (1)	1	
	(b)		white precipitate (1) because barium sulfate is produced which is insoluble / due to presence of sulfate ions (1)	2	
			Total	**4**	

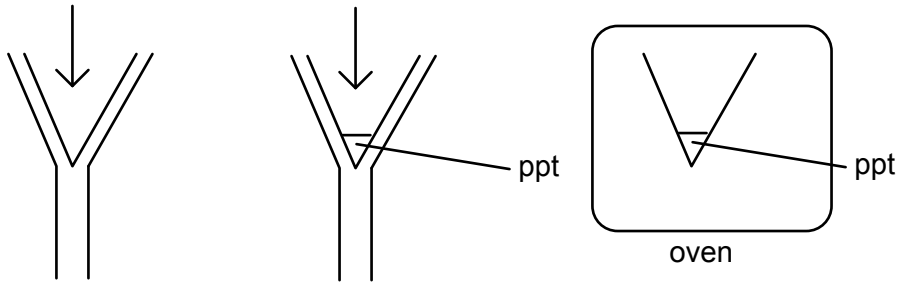
Question			Expected answers	Marks	Additional guidance
6			**use of %** % Na in NaCl is 39.3 / 39% (1) and working to show that 0.7 is 39% of 1.8 / working to show that 39.3% of 1.8 is 0.7 (1) **or** use of moles moles of sodium chloride = 1.8/58.5 (1) so mass of sodium = (1.8/58.5) X 23 = 0.7 (1) **or** ratios Na Cl NaCl 23 35.5 58.5 1 35.5/23 58.5/23 (1) 0.7 (35.5/23) X 0.7 = 1.1 (58.5/23) X 0.7 = 1.8 (1)	2	there are three main ways in which candidates may express their answer use of % of sodium use of moles of sodium use of ratios
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
7			**Level 3** Applies understanding of equilibria to give a detailed explanation of all the conditions chosen in terms of the rate and position of equilibrium. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** Applies understanding of equilibria to show that the conditions chosen give both a high rate of reaction and force position of equilibrium to the right with one condition explained. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** Idea that the presence of the catalyst, temperature chosen and/or pressure chosen will increase the rate of reaction. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include** • high temperature forces position of equilibrium to the left since the reaction is exothermic • so a relatively low temperature is used but it is high enough to increase rate of reaction • high pressure to make position of equilibrium move to the right because there are fewer gas molecules on the right • high pressure will also increase rate of reaction • if too high a pressure it will increase safety risks to workers and the plant costs will be too high • catalyst does not change the position of equilibrium (1) • catalyst increases the rate of reaction
			Total	**6**	

Question			Expected answers	Marks	Additional guidance
8	(a)		results **1** and **2** are inconsistent / 1.1 cm^3 apart so she needed to do a third experiment (1) however, results **2** and **3** are consistent / within 0.2 cm^3 so she doesn't need to do any more (1)	2	**evidence from table must be linked to the need for repeats to gain credit for each marking point** **allow** cannot tell which titration was wrong so needed to do a third experiment (1) **not** to get a better mean titre marking points in either order can gain credit
	(b)		(with universal indicator) there is a continuous colour change / no sudden change / no sharp end-point / AW (1)	1	**allow** (universal indicator) has many colours
	(c)		mean titre is 20 (cm^3) or 0.020 dm^3 (1) moles of KOH = 0.0025 (1) moles of HNO_3 = 0.0025 (1) concentration = 0.125 (mol/dm^3) (1)	4	mean titre must be from readings **2** and **3** **allow** answers in standard form ie 2.5×10^{-3} **allow** ecf from moles of KOH ie moles of KOH = moles of HNO_3 **allow** ecf from moles of HNO_3 and from mean titre answer must be to three significant figures
			Total	**7**	

Question			Expected answers	Marks	Additional guidance
9	(a)		107 (1)	1	
	(b)		C_2H_2 and C_6H_6 (1)	1	**both** needed
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
10	(a)		correct apparatus to collect gas eg gas syringe / measuring cylinder / upturned burette (1) will it work – is it gas tight? / is there water to be displaced? (1)	2	**allow** all marks from a diagram **allow** apparatus if not labelled providing it has clear graduations or is obviously a gas syringe **allow** 'solid' bungs / 'solid' ends of tubes if gas is not collected eg lime-water test is shown award no marks
	(b)		0.002 (1)	1	
	(c)		strong acid has more hydrogen ions / strong acid has a greater concentration of hydrogen ions this results in more collisions with hydrogen ions per second (2) **OR** strong acid has more hydrogen ions / strong acid has a greater concentration of hydrogen ions / there are more collisions in strong acid (1)	2	**more collisions must be linked to more/greater concentration of hydrogen ions to gain 2 marks** **allow** strong acid has more crowded hydrogen ions
			Total	**5**	

Question			Expected answers	Marks	Additional guidance
11			add two solutions and filter (1) wash the residue with water (1) dry the residue in an oven / leave in air to evaporate (1)	3	**ignore** sieving filtering stage must be before the washing and drying stage washing stage must be before the drying stage drying stage must be the last stage **allow** let it dry in air **ignore** dry it / let it dry **ignore** heat it **not** use of a Bunsen burner to dry the residue **allow** marks from a diagram reaction mixture water 
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
12	(a)		oxygen (1)	1	**allow** O_2
	(b)		$2H^+ + 2e^- \rightarrow H_2$	1	**allow** any correct multiple including fractions **allow** = for arrow **not** and or & for +
	(c)		prediction of 20 (seconds) (1) because temperature not relevant and time inversely proportional to the current used / temperature not important factor and current x 3 from 1 so time ÷3 (1)	2	
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
13	(a)		glucose → ethanol + carbon dioxide (1)	1	**not** sugar **not** alcohol
	(b)		because the reaction is catalysed by enzymes (1) if the temperature is too low the yeast is inactive and if too high the enzymes are denatured / and at these temperatures the enzyme is most effective (1)	2	answers must link change in temperature to the presence of enzymes to gain full credit just optimum temperature is not sufficient **allow** enzyme molecule loses shape **allow** if temperature is below 20°C yeast inactive and if above 50°C the yeast will die (1) **not** enzyme is killed
	(c)		C_2H_5OH / C_2H_6O (1)	1	**allow** any order of atoms **not** C^2H^5OH / C^2H^6O / C2H5OH / C2H6O
			Total	**4**	

Question			Expected answers	Marks	Additional guidance
14	(a)		iron + oxygen + water → hydrated iron (III) oxide (1)	1	**allow** mix of formulae and names Fe + O_2 + H_2O → $Fe_2O_3.H_2O$ **allow** = sign for arrow **not** and / & for +
	(b)		Fe loses electrons and O_2 or H_2O gains electrons / electrons are transferred from iron to oxygen or water (1)	1	**not** electrons are lost and electrons are gained / electrons are transferred **but** 'electrons are lost from the first equation and gained in the second equation' is sufficient
	(c)		galvanising is the only method if scratched that will still prevent rusting as zinc corrodes instead of the iron car body (1)	1	
			Total	**3**	

Question			Expected answers	Marks	Additional guidance
15			because boiled tap water needs less soap than un-boiled tap water it must contain temporary hardness (1) however, because boiled tap water still needs more soap than distilled water it still has hardness in it, so also contains permanent hardness (1)	2	**both marking points needed, in either order, for 2 marks, however either of the marking points alone scores 1 mark**
			Total	**2**	

Question			Expected answers	Marks	Additional guidance
16	(a)	(i)	any year between 1988 and 1993 (1)	1	
		(ii)	scientists had to have their work peer reviewed / there were other alternative theories to consider (1)	1	**allow** there were social or economic pressures on the government to oppose the ban **allow** there was not enough evidence to make the theory convincing
		(iii)	level in 2010 is in range 12.3-12.7 so it will take 91 to 94 years (1) so by 2101 to 2104 it should be zero (1)	2	**allow** starting from any value from 1990 onwards and so will have to apply appropriate ecf – read off graph, then divide by 0.135 to get number of years (1) and then add this to the original year (1) **allow** ecf from wrong number of years
	(b)	(i)	$O_3 \rightarrow O + O_2$ (1)	1	**allow** any correct multiple
		(ii)	the breakdown of a CFC needs UV light and at ground level most UV light has been removed (by the ozone layer) (1)	1	CFCs are inert is **not sufficient**
			Total	**6**	

Question	Expected answers	Marks	Additional guidance
17	**Level 3** Accurate electrode equations included for both electrodes and a detailed explanation of the advantages and disadvantages focussing on at least two different areas eg energy transfer, pollution, availability etc. All information in answer is relevant, clear, organised and presented in a structured and coherent format. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5-6 marks) **Level 2** An attempt at electrode equations for both electrodes and a limited explanation of the advantages and advantages of fuel cells focusing on at least one area eg energy transfer or pollution etc. For the most part the information is relevant and presented in a structured and coherent format. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3-4 marks) **Level 1** Some relevant equations included and gives only a simplistic explanation of the advantages and disadvantages. Answer may be simplistic. There may be limited use of specialist terms. Errors of grammar, punctuation and spelling prevent communication of the science. (1-2 marks) **Level 0** Insufficient or irrelevant science. Answer not worthy of credit. (0 marks)	6	**relevant points include:** **electrode equations**: • positive (+ve) electrode: $O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$ • negative (-ve) electrode: $H_2 + 2OH^- \rightarrow 2H_2O + 2e^-$ • $2H_2 + O_2 \rightarrow 2H_2O$ **advantages** • energy released as electricity rather than as heat • fuel cell produces electricity more efficiently / more direct energy transfer • uses hydrogen a renewable resource • does not produce carbon dioxide , a greenhouse gas, when generating electricity • produces water which is not polluting **disadvantages** • construction involves use of poisonous or toxic materials • disposal problems when fuel cells are finished in terms of the poisonous nature of some chemicals used • need to use energy to make hydrogen • potential difficulties of storing hydrogen • overcoming the general public concern over the use of hydrogen **allow** less polluting as a low level response / has a lower carbon footprint **ignore** fuel cell is environmentally friendly / is greener / references to cost unless qualified / can run for ever
	Total	**6**	

Question			Expected answers	Marks	Additional guidance
18	(a)		(proportion of) energy lost / wasted / used in manufacture and growth is less / biodiesel is more efficient / bio-ethanol uses 40% of the energy produced in manufacture and growth(1)	1	
	(b)		hemp and 1500 (1)	1	**both needed for mark**
	(c)	(i)	**any two from** idea that the trend is difficult to work out because there has been such a sudden rise (1) idea that it can be affected by other factors eg economics (1) availability of other fuels (1) changes in weather (1) or changes in government policies (1) better extraction techniques may be developed (1)	2	
		(ii)	food shortage / not enough food crops are grown (1)	1	**allow** over production and cannot sell the bio-diesel **allow** food prices increase **allow** less fossil fuels burnt / less carbon dioxide produced

Question	Expected answers	Marks	Additional guidance
(d)	**max 5 from:**	5	**reasoning for both sides of the argument must be used to score max 5** **reasoning must be linked to evidence in the section**
	reasoning for type of bio-fuel and plant (1)		eg she should grow hemp for bio-diesel because it is more efficiently produced and gets the biggest yield (1)
	reasoning based on environmental /social issues (max 3)		eg she should grow crops for bio-fuels because burning bio-fuels will reduce carbon dioxide emissions / will reduce global warming / reduce greenhouse effect (1) she should grow crops for bio-fuels because bio-fuels could be used instead of petrol in cars / can be burnt instead of fossil fuels (1) bio-fuels are carbon-neutral due to plants taking in energy for photosynthesis unlike other fossil fuels (1) eg she should not grow crops for bio-fuels because she may use lots of fertiliser / pesticide / cause eutrophication (1) she should not grow crops from bio-fuels because she should be growing food / people are in the world are starving / food is a better use of the land (1) idea of the production of bio-fuels is not that efficient and a lot of energy is needed (1)
	reasoning based on technology required (1)		eg she should not grow crops for bio-fuels because the technology is not ready yet / there are not enough cars that can use bio-fuels (1)
	reasoning based on lack of information (max 2)		eg she cannot make a decision because she doesn't know about cost (1) she cannot make a decision about plants because it depends on the conditions (on her farm) (1)
	Total	**10**	