OCR
Oxford Cambridge and RSA

OCR Level 3 Cambridge Technicals in Laboratory Skills
Unit 2 Laboratory Techniques

Sample Assessment Material

Date – Morning/Afternoon
Time Allowed: 2 hours

You must have:
- A ruler

You may use:
- A scientific calculator

Do not use:
- None

* 800000001 *

First name	
Last name	
Centre number	
Candidate number	

INSTRUCTIONS
- Use black ink.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the bar codes.
- A scientific calculator may be used.
- The Periodic Table is printed on the back page.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- This document consists of **13** pages.

Answer **all** questions.

1. Watersavvy is a company that tests boiler water for signs of boiler corrosion and tests cooling systems for harmful bacteria for its client companies. The company has recruited a new employee to test boiler water for signs of corrosion. The new employee will also test cooling systems for harmful bacteria.

(a) New employees must undertake initial health and safety training. State **two** reasons why health and safety training is important.

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……**[2]**

(b) Suggest three hazards that are likely to be encountered in the labs at Watersavvy.

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……**[3]**

(c) State what the following three Globally Harmonised System of classification and labelling of chemicals (GHS) hazard pictograms mean:

(i)

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……**[1]**

(ii)

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……**[1]**

(iii)

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……**[1]**

(d) Watersavvy must record details of the water samples received from the client companies. List the information that should be recorded.

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……**[3]**

(e) One of the technician's tasks in the laboratory is to check the temperatures on all the incubators, fridges and thermostat baths.

All the thermometers must have their calibration checked.

Explain why the thermometers must have their calibration checked and how this could be done.

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……**[4]**

2.

(a) The molar mass of anhydrous sodium carbonate is 105.9888 g mol^{-1}.

(i) Calculate the **number of moles** needed to make 250 cm^3 of a 0.05 mol dm^{-3} solution.

Show the equation and the working for the calculation.

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……..**[2]**

(ii) Calculate the **mass** of sodium carbonate needed to make 250 cm^3 of a 0.05 mol dm^{-3} solution. Show the equation and the working for the calculation.

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(b) Explain the steps that a technician would need to follow when accurately making the solution of sodium carbonate in **(a) (ii)**.

Include all the glassware and equipment that they would use.

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(c) Explain how the solution of sodium carbonate in **(a) (ii)** could be used to find the concentration of a hydrochloric acid solution by titration.

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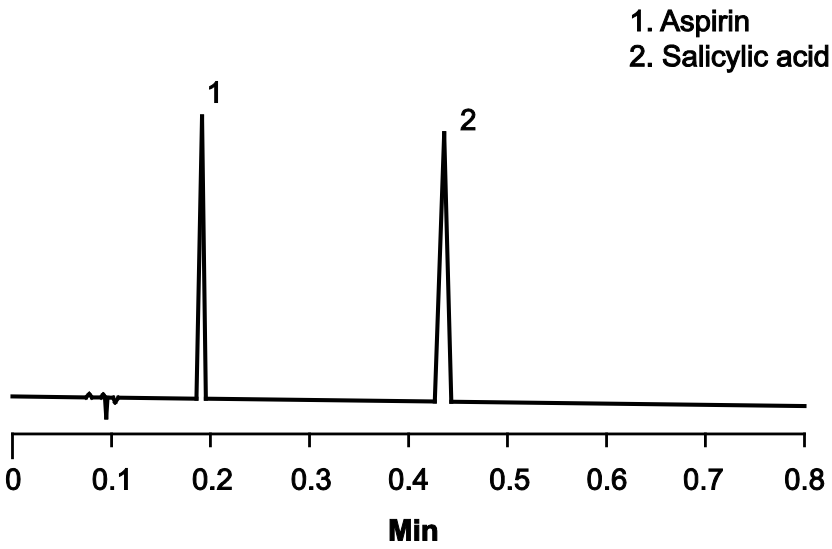
……**[4]**

3.

(a) The high performance liquid chromatography (HPLC) chromatogram for a reaction mixture containing aspirin and salicylic acid is shown below:



(i) State the retention time for component 1

……**[1]**

(ii) State the retention time for component 2

……**[1]**

(iii) Suggest how the aspirin in the reaction mixture could be quantified.

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……**[2]**

Turn over

(iv) What extra information could be obtained if this technique is coupled with mass spectrometry?

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……**[1]**

(b) A thin-layer chromatography (TLC) plate, 10 cm x 4 cm, for the reaction mixture was prepared and run in a mobile phase of 50% ethyl ethanoate and 50% hexane.

When setting up the TLC experiment, the spot corresponding to the mixture was applied
1.5 cm from the bottom of the plate (in the middle of the width, 2 cm from each side).

The plate was removed from the mobile phase when the solvent front was 1 cm from the top of the plate.

R_f value aspirin = 0.291

R_f value salicylic acid = 0.945

(i) Explain how the experiment would have been carried out and how the spots would have been visualised.

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……**[6]**

(ii) Calculate the distance moved by the aspirin **and** the distance moved by the salicylic acid in the mixture. Show your working.

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……**[4]**

4. A student has been given samples of two ionic compounds in solution, X and Y, to analyse.

The cation present could be Na^+, K^+, Li^+, Ca^{2+}, Ba^{2+}, Al^{3+}, Cu^{2+}, Fe^{2+}, Fe^{3+} or Pb^{2+}.
The anion present could be Cl^-, Br^-, I^-, SO_4^{2-} or CO_3^{2-}.

(c) A few drops of sodium hydroxide solution are added to X.

There is no precipitate.

A flame test is carried out on a fresh sample of X.

The flame colour is pale lilac which then turns a dull orange.

Identify the cation in X.

……**[1]**

(d) 1 cm^3 of dilute hydrochloric acid is added to X.

There is effervescence.

Identify the anion in X.

……**[1]**

(e) Write the chemical formula of X.

……**[1]**

(f) A few drops of sodium hydroxide solution are added to Y.

A white precipitate is seen but this dissolves when more sodium hydroxide solution is added.

A drop of potassium iodide solution is added to a fresh sample of Y.

No precipitate forms.

(i) Identify the cation in Y.

……**[1]**

(ii) Write the chemical equation for the reaction between copper (II) ions in solution and hydroxide ions in solution to form a precipitate, showing state symbols.

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……**[2]**

(g) A few drops of barium chloride solution are added to a fresh sample of Y.

A dense, white precipitate forms.

(i) Identify the anion in Y.

……**[1]**

(ii) The carbonate ion reacts with barium chloride solution to form a precipitate of barium carbonate. Write a chemical equation for the reaction between the carbonate ion in solution and barium ions in solution, showing state symbols.

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……**[2]**

(h) Write the chemical formula of Y.

……**[1]**

(i) Explain whether Y is likely to be found as an anhydrous salt.

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……**[1]**

(j) The amount of the cation present in X could be found by atomic emission spectroscopy. Outline the experimental procedure.

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5.

(a) A slide of muscle tissue is viewed through a 40x objective lens. The magnification of the eyepiece lens is 10x. What is the total magnification of the observed tissue sample?

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(b) Explain how the width of a human hair may be calculated by using a graticule and a light microscope.

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(c) Evaluate the advantages and disadvantages of using an electron microscope compared to a light microscope.

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……**[5]**

(d) These images were produced using two different pieces of equipment.

Image 5a

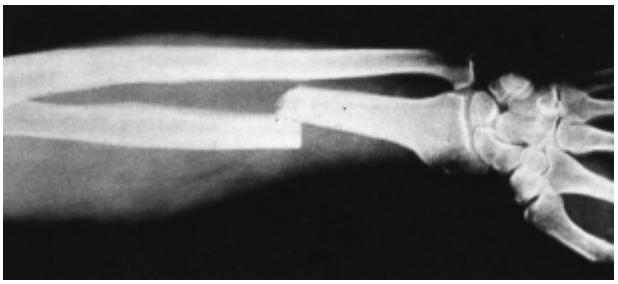

Image 5b

Identify the equipment used to produce each of the images.

State the reason for its use.

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6. A junior science technician has recently attended a microbiology course and has been asked to demonstrate how to prepare a streak plate of the bacterium Micrococcus luteus. The following equipment is available:

an agar plate

a culture of the bacterium

all other necessary laboratory equipment.

(a) **(i)** Describe the process in the correct order stating the equipment used. Illustrate your answer with a diagram.

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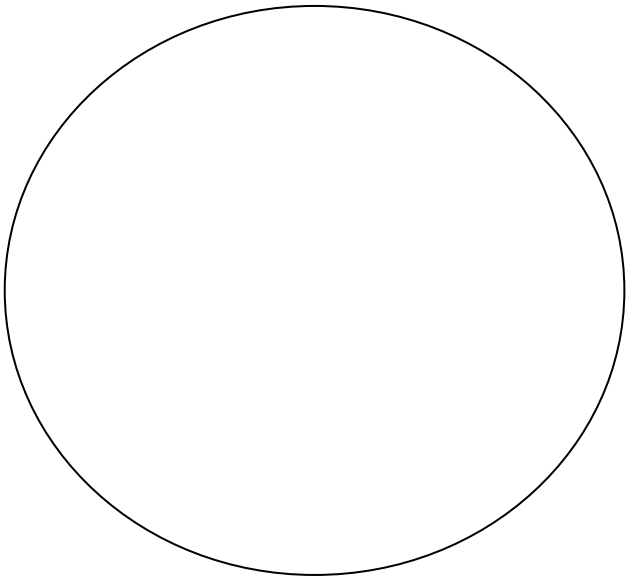

[4]

(ii) Explain the aspects of safe working during and after this procedure.

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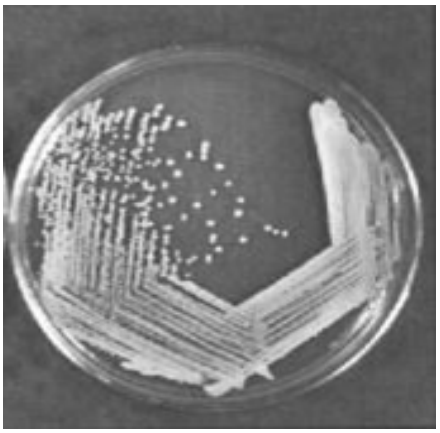
……**[3]**

(b) Once incubated, the plate looks like the one shown below.



What does this plate indicate? Explain your answer.

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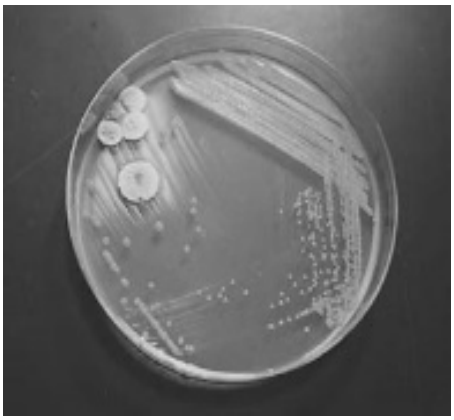
……**[2]**

(c) Another technician did the same experiment. The results are shown below.



Explain the reason for the difference between this result and those in **(b).**

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……**[1]**

Turn over

(d) Read the following procedure for making yoghurt and answer the questions that follow.

Procedure for making yoghurt

1. Put the 500 cm^3 pasteurised milk in a large beaker and place it on an electric hotplate on a medium heat. Heat the milk to 80°C. (Test with a sterile thermometer.)
2. Cover the beaker with film and leave it to cool (with the thermometer) until the milk reaches 50°C.
3. Collect a sterilised whisk and a sterilised 10 cm^3 measure.
4. Whisk in 10 cm^3 of the yoghurt starter culture (shop-bought yoghurt) to the milk.
5. Cover with film and place it in the incubator set at 50°C.
6. Leave the mixture for 6-8 hours or overnight.
7. If the yoghurt has thickened and looks set, pour it into a sterile, airtight container and put it in the fridge.

(i) Why is the pasteurised milk heated to 80°C?

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.....**[2]**

(ii) Why is the milk then cooled to 50°C?

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.....**[2]**

(iii) Why is the milk incubated at 50°C rather than at a lower temperature, say 37°C?

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.....**[2]**

END OF QUESTION PAPER

OCR
Oxford Cambridge and RSA

SPECIMEN

Sample Assessment Material

OCR LEVEL 3 CAMBRIDGE TECHNICALS IN LABORATORY SKILLS

Unit 2 Laboratory Techniques

MARK SCHEME

Duration: 2 hours

MAXIMUM MARK 90

SPECIMEN

Version: 1.1 **Date:** 19/11/2015

This document consists of 9 pages

Question			Answer	Marks	Guidance
1	**(a)**		Any two from: Training will help to keep employees safe- employees have a right to be safe; Training will help employees to identify hazards; Training will make employees aware of safety measures; that the employer has put in place;	2	Two points like the ones suggested should be made – one mark for each
	(b)		Any three from: Harmful chemicals; Harmful bacteria; Flames; Broken glass;	3	
	(c)	**(i)**	Corrosive	1	
		(ii)	Toxic	1	
		(iii)	Toxic by inhalation	1	
	(d)		Any three from: Customer name; Date; Where the sample was taken (sampling point); Name of person taking the sample; Any special notes for the analyst);	3	
	(e)		Importance- maintain accurate standard reading; Reading can be repeated; Use a standard, calibrated and certified thermometer and compare the readings; Use processes with known temperatures (e.g. boiling point of water/freezing point of water);	4	2 marks for reason 2 marks for correct explanation
2	**(a)**	**(i)**	Correct equation selected n =c x V; Correct calculation n = 0.0125 mol;	2	Correct number of significant figures to be used. 2 marks may be awarded for the correct answer even if the working is not shown

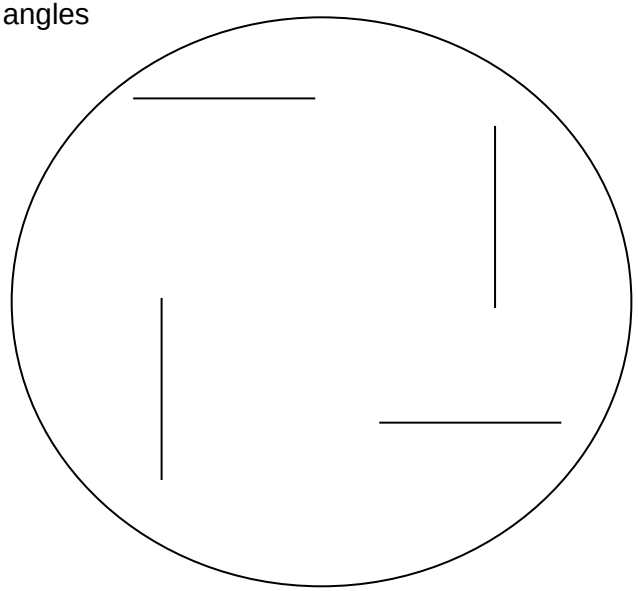
Question			Answer	Marks	Guidance
		(ii)	Correct equation selected $m = n \times M_r$ Correct substitution of variables $m = 0.0125 \times 105.9888$ Correct calculation and units $m = 1.3249$ g	3	Correct number of significant figures to be used- M_r not to be rounded up to 106 g mol^{-1} Units must be correct (1.32486 g may be accepted even though a four figure analytical balance is likely to be used) The full 3 marks may be awarded for the correct answer even if the working is not shown
	(b)		Level 3 A comprehensive explanation which accurately provides a detailed method that could be replicated. (5-6 marks) Level 2 Explanation of most of the steps required but not all in the correct sequence. (3-4 marks) Level 1 Brief outline of method. No mention of how accuracy is achieved. (1-2 marks) Level 0 Insufficient or incorrect science. (0 marks)	6	Relevant points include: **Equipment** Weighing bottle/boat Volumetric flask Funnel Teat pipette Beaker Stirring rod Top pan balance reading to 0.01g Sodium carbonate Distilled water **Method** Weigh the bottle/boat accurately Tip out the solid through a glass funnel into a 250 cm^3 volumetric flask Reweigh the bottle and calculate the mass used Rinse the funnel with distilled water to ensure all the Na_2CO_3 is in the flask Roughly half fill the flask with distilled water and dissolve the Na_2CO_3 Make up to the mark with distilled water Ensure the contents are mixed thoroughly **Accuracy** use a teat pipette to get the meniscus on the line tip the contents of the flask into a beaker to ensure proper mixing or stirring weigh to 0.01g

Question			Answer	Marks	Guidance
	(c)		Pipette a known amount of HCl (e.g. 25 cm^3) into a conical flask; Add a few drops of a suitable indicator (e.g. methyl orange) or use a calibrated pH probe or an autotitrator; Fill a burette with the sodium carbonate solution and take accurate reading; Titrate the HCl with the sodium carbonate until the indicator changes colour/the autotirator confirms the endpoint has been reached; Read the burette/note the autotitrator reading; Calculate the number of moles of sodium carbonate used and hence calculate the concentration of the acid;	4	4 marks for describing an appropriate procedures.
3	**(a)**	**(i)**	1.8 or 1.9 min	1	Must include unit
		(ii)	4.2 or 4.3 min	1	Must include unit
		(iii)	Inject/run with internal standard with known amount of aspirin; Compare peak areas (of internal standard and experimental trace); To calculate amount/concentration of aspirin (in sample injected).	2	1 mark for each two correct points made
		(iv)	Mass spectrometer would allow the fragmentation pattern of each substance to be found and compared with a library of patterns for different compounds	1	

Question			Answer	Marks	Guidance
	(b)	**(i)**	Level 3 A detailed explanation of the method that could be replicated. Information is clear and organised into the correct sequence. (5-6 marks) Level 2 Explanation of most of the steps required but not all in the correct sequence. Visualisation not addressed. (3-4 marks) Level 1 Brief outline of method. (1-2 marks) Level 0 Insufficient or incorrect science. (0 marks)	6	Relevant points include: **Method** Set up a suitable tank containing the solvent – below the level of the spot TLC plate prepared by drawing pencil lines at the distances described Put a mark at the place where the spot has to be applied Mixture applied to the spot using a capillary tube If it is dilute, it may be necessary to allow solvent to evaporate and re-spot to get more material Place the plate in the tank Spot just above the solvent level Allow the solvent to travel to near the top of the plate Remove the plate and mark the position of the solvent with pencil Evaporate the solvent Visualise the spots Use fume cupboard if using iodine tank Mark the position of the spots once visualised (darker brown colour) Measure the positions of solvent front and spots **Visualisation** Place in iodine tank - glass tank with a lid and iodine crystals Use Ultraviolet light
		(ii)	(Solvent moved 10 - (1.0+1.5) = 7.5 cm For aspirin R_f (0.291) = distance moved by aspirin/7.5cm Distance moved by aspirin = 7.5 x 0.291 cm = 2.18 cm Distance moved by salicylic acid = 7.5 x 0.945 cm = 7.09 cm	4	1 mark for each of the 3 stages in the calculation for one of the components. 1 mark for using the same method to calculate the distance moved by the other component. All four marks may be awarded if the final answer is correct but the working is not shown.

Question			Answer	Marks	Guidance
4	**(a)**		K^+	1	Formula must be completely correct
	(b)		CO_3^{2-}	1	Formula must be completely correct
	(c)		K_2CO_3	1	Formula must be completely correct
	(d)	**(i)**	Al^{3+}	1	Formula must be completely correct
		(ii)	$Cu^{2+}_{(aq)} + 2OH_{(aq)} \rightarrow Cu(OH)_{2(s)}$	2	1 mark for completely correct equation. 1 mark for completely correct state symbols.
	(e)	**(i)**	SO_4^{2-}	1	Formula must be completely correct
		(ii)	$Ba^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)} \quad BaCO_{3(s)}$	2	1 mark for completely correct equation. 1 mark for completely correct state symbols.
	(f)		$Al_2(SO_4)_3$	1	Formula must be completely correct
	(g)		No, because salts like these are usually found as crystals - with water of crystallisation. Anhydrous means without waters of crystallisation.	1	Response yes or no must be supported by a correct explanation.
	(h)		Atomic emission e.g. using a flame photometer, used the intensity of the lilac colour used in the flame test - a filter being used to select light of that colour (or a monochromator selecting the wavelength on a spectrometer; Standards are made (different low levels of K^+ - generally in the region 0-10 ppm); Standards and a blank are run; A graph of emission reading (y-axis) versus concentration (x-axis) is constructed and a straight line drawn through the points; The emission reading for an unknown is read from the graph;	3	3 marks for outlining an appropriate procedure, to include points noted in the answer column. Learners may add that the samples may have to be diluted so that they are in the range of the standards - that may compensate for another point only being partially correct.
5	**(a)**		10 x 40 = x400	1	

Question			Answer	Marks	Guidance
	(b)		Any five correct: Mount the hair on a microscope slide e.g. with Sellotape to hold it in place. Describe how the hair/graticule are positioned to enable the width to be worked out; Measure the number of divisions corresponding to the width of the hair on the graticule; Look through the graticule at a calibration slide to find the number of divisions on the calibration slide corresponding to each division on the graticule; Identify the scale corresponding to the calibration slide and calculate the true distance corresponding to the number of divisions that correspond to the width of a hair; Calculate the width of the hair;	5	
	(c)		Any five correct comparisons: Light microscope advantages – relatively portable, relatively cheap, natural colour of material is viewed, the preparation of slides is relatively easy although some training in using a microtome will be necessary. The main disadvantage is the level of magnification. Electron microscope's main advantage is the enhanced magnification and hence the level of detail observed. With a transmission microscope the depth of field is not apparent. If that is important, a scanning electron microscope should be used. The main disadvantages relate to the cost and lack of portability of electron microscopes and the level of training needed to be able to prepare suitable slides. More training is also needed in order to use the instrument effectively.	5	Advantages and disadvantages of a light microscope evaluated – maximum 2 marks. Advantages and disadvantages of an electron microscope evaluated – maximum 3 marks The answers must match the verb "evaluate" – they must not be one word answers. Comparative list/table – 4 up to 3 marks with no explanation.

Question			Answer	Marks	Guidance
	(d)		Ultrasound identified appropriately – used to test non-destructively with minimum risk of damage to living cells– use on soft tissue X ray image identified appropriately – use to study material which absorbs X rays significantly – e.g. bone X I	4	1 mark for identifying the ultrasound image correctly and 1 mark for stating why that technique was used. 1 mark for identifying the X-ray image correctly and 1 mark for stating why that technique was used.
6	(a)	(i)	**1** Flame the inoculating loop until it is red hot and then allow it to cool. **2** Remove a small amount of bacterial growth (either one loopful from a broth culture or a single colony from a plate or slant) with the sterile inoculating loop. **3** Immediately streak the inoculating loop very gently over a quarter of the plate using a back and forth motion (area 1) taking care not to gauge the agar. **4** Flame the loop again and allow it to cool. Going back to the edge of area 1 that you just streaked, extend the streaks into the second quarter of the plate (area 2). **5** Flame the loop again and allow it to cool. Going back to the area that you just streaked (area 2), extend the streaks into the third quarter of the plate (area 3). **6** Flame the loop again and allow it to cool. Going back to the area that you just streaked (area 3), extend the streaks into the centre	4	Answer to include the six points listed. 3 marks for describing a correct and appropriate procedure - 1 mark to be deducted for each significant omission 1 mark for using the diagram appropriately to illustrate the description - lines in each quarter of circle - at right angles 

			fourth of the plate (area 4). Areas should be clearly shown on the accompanying diagram.		
		(ii)	Any three from: Suitable PPE worn e.g. Howie coat, safety glasses, gloves; Care taken not to create an aerosol with the bacteria; Cleaning the benches with disinfectant e.g. diluted bleach, before (to minimise contamination) and after to remove any microbial hazards; Autoclaving incubated plates to kill any cultured bacteria;	3	1 mark for each of 3 suitable points made
	(b)		(Once incubated) the 4th area of the streak plate should give rise to single colonies which should allow identification; If there are different shapes/colours of colonies, it indicates that more than one type of organism was present in the broth used to inoculate the plate;	2	1 mark for each suitable point made
	(c)		There is a large white growth in addition to the bacteria colonies – indicating contamination e.g. by a fungus	1	
6	**(d)**	**(i)**	The pasteurised may still contain some microorganisms that may contaminate the product. Heating at 80°C will kill them. Heating above this temperature may cause the milk to boil over. Heating to a lower temperature may not destroy the organisms.	2	1 mark for making the point about destroying any microorganisms present. 1 mark for commenting on higher temperatures risking boiling over or lower temperatures not killing the microorganism.
		(ii)	The milk has to be cooled so that the live culture added is not killed by the high temperature. The incubation temperature is a suitable temperature. Lower temperatures may allow some unwanted organisms in the culture, that grow well at lower temperatures, to survive.	2	1 mark for making the point about the need not to kill the live added culture organisms. One mark for making one appropriate observation about the particular temperature chosen.
		(iii)	If there are any unwanted organisms which grow well at 37°C, present, incubation at 37°C may allow them to grow which will contaminate the yoghurt. Heating at 50°C reduces risk of contamination from any organisms that grow at human body temperature.	2	1 mark for an appropriate point made about a lower temperature having the possibility to make other organisms grow which would contaminate the product.