OCR
RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

ADDITIONAL APPLIED SCIENCE **A192/02**

Unit A192: Science of Materials and Production (Higher Tier)

Candidates answer on the question paper
A calculator may be used for this paper

OCR Supplied Materials:
None

Other Materials Required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil (✎).
- The number of marks for each question is given in brackets **[ ]** at the end of the question or part question.
- The total number of marks for this paper is **50**.
- This document consists of **12** pages. Any blank pages are indicated.

Answer **all** the questions.

1 **(a)** Wayne tests two different plastics to see which would be best for making corner posts for football pitches.

He wants to compare the stiffness of the two different plastics.

Describe, with the help of a labelled diagram of the apparatus, how this could be done.

✎ The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

(b) Corner posts need to be flexible so they do not cause injury to the players when they run into them.

Suggest with explanation suitable types of materials and dimensions that Wayne could use to create a safe corner post.

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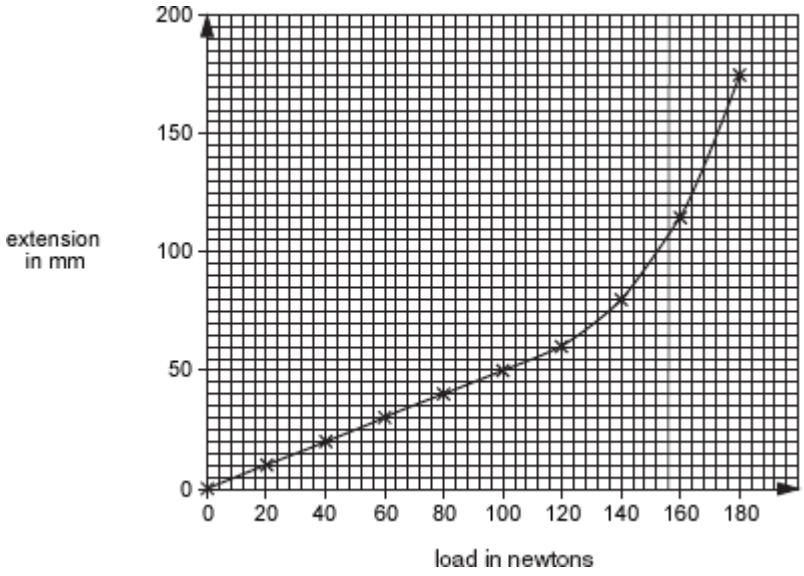
..... **[3]**

[Total: 9]

2 Eva works for a company which makes cloth for the sails of yachts.

Eva tests a sample of the cloth to see how it behaves when it is stretched.

This is the graph of her results:



Use the graph to answer these questions.

(a) Calculate a value for the force constant *k* of the sail when it is in the elastic region.

Use $F = kx$.

k = ... Nm^{-1} **[2]**

(b) Calculate the energy stored in the sample of cloth when it is stretched to its elastic limit.

energy = ... J **[3]**

(c) In practice the sail is designed to be used well below the materials elastic limit.

Suggest why.

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..... **[1]**

[Total: 6]

3 Hannah works for a company which makes cameras.

(a) The camera has a converging lens which refracts light.

Explain what is meant by **refraction**.

You may draw a labelled diagram to help your answer.

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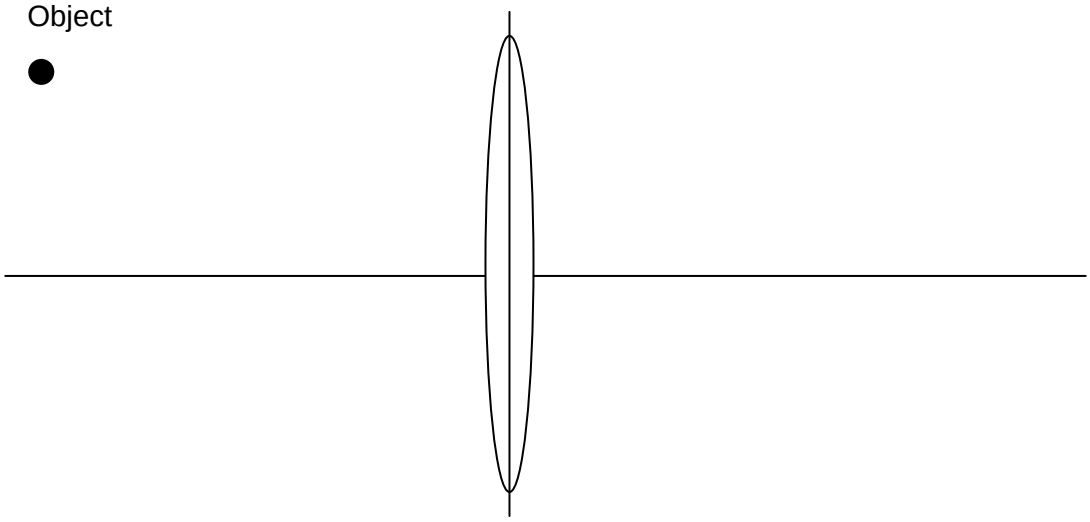
..... **[2]**

(b) Hannah tests a new converging lens by forming an image from an object.

Draw the ray diagram to show how the image is formed.



[2]

(c) She wants to take photographs using the new lens in a studio using very bright lights.
These lights also produce both UV and IR radiation.
What problems can these types of radiation cause for Hannah?

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

(d) Hannah wants to change the colour of the light coming from her white light sources.
How can she make the white light appear yellow?
Explain how her action changes the colour of the light.

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

(e) Hannah takes a number of portrait photographs at different distances from the person.
What will the lens in the camera need to do?
Explain your answer.

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..... **[3]**

[Total: 11]

4 Read the newspaper story about *E. coli*.

Update on the E. coli outbreak

Last week there was a case of food poisoning in a primary school in Wales.
Since then several other schools have reported cases.
Health inspectors investigating the cause have linked the outbreak to a bacterium called E. coli.

(a) *E. coli* is a bacterium.

In ideal conditions, a single bacterium reproduces itself every twenty minutes.

It takes about 200 bacteria to cause illness.

How long, to the nearest 20 minutes, will it take **a single bacterium** to reach a point where it will cause illness?

You must show how you worked out your answer.

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

(b) The ideal temperature for *E. coli* to multiply is 37^{o}C and they can tolerate acid conditions

It can take up to twenty four hours for food to leave your digestive system.

Use this information to help you explain why humans become ill when they ingest *E. coli.*

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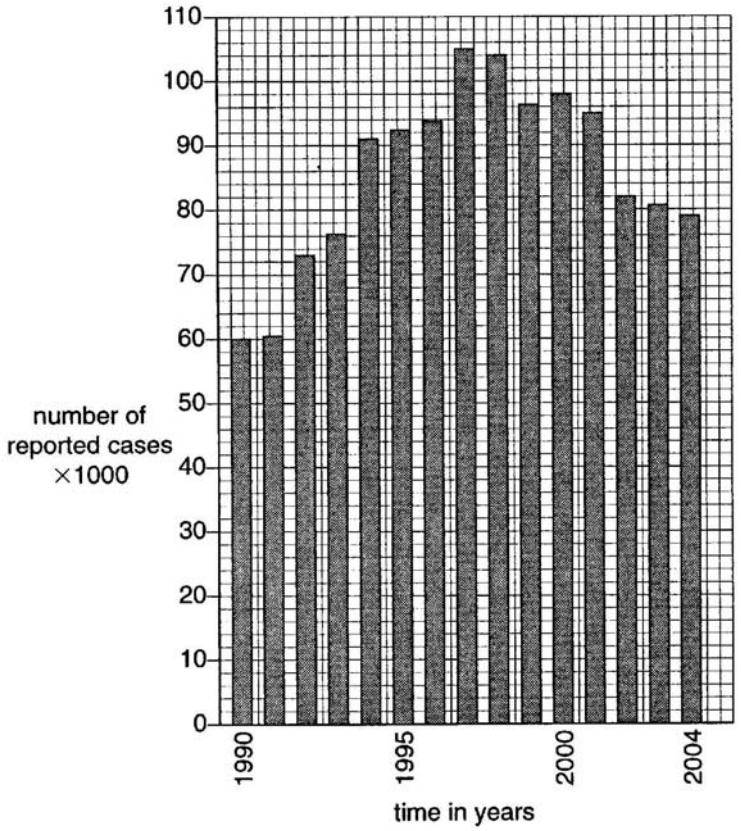
..... **[3]**

(c) The bar chart shows the number of reported cases of food poisoning in the UK between 1990 and 2004.



The Food Standards Agency was created in 2000 to educate the public about food safety.

Use data from the graph to discuss the possible effectiveness of the agency.

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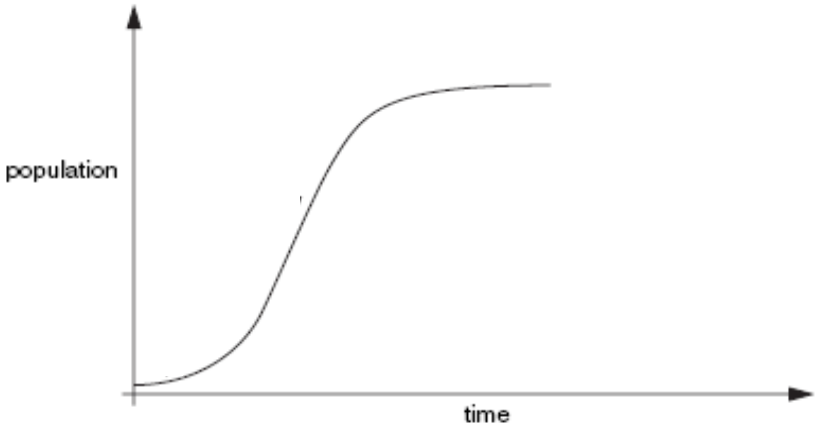
..... **[3]**

[Total: 8]

5 Shabeen is responsible for yoghurt production in a factory.

She records the population growth rate of the microorganisms used in the production.



(a) Continue the graph to show what would happen to the population if the food supply for the microorganisms was stopped.

[1]

(b) The factory inspectors visit the yoghurt factory.

Suggest what they do when they visit the factory.

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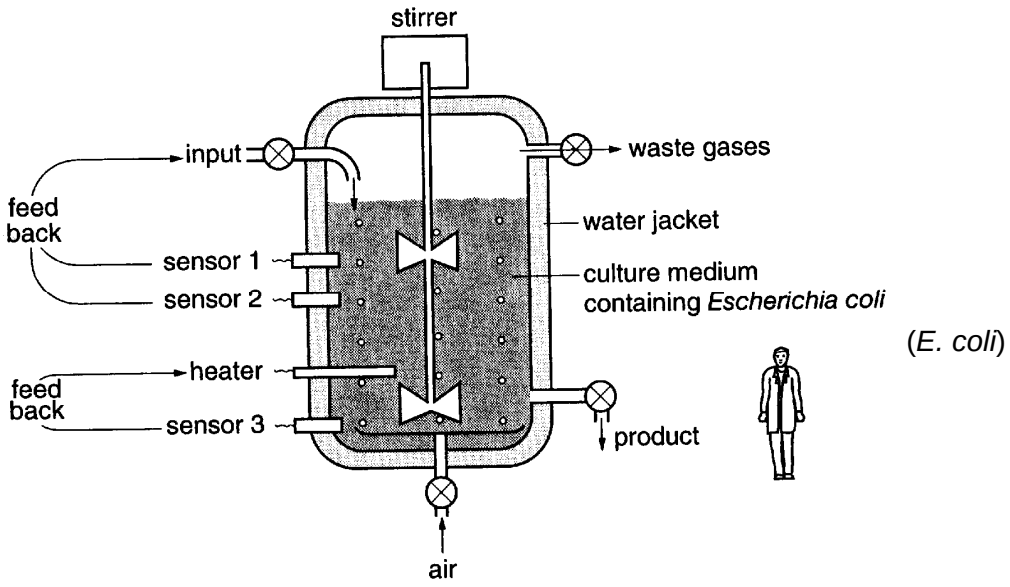
..... **[3]**

[Total: 4]

6 A company in California has developed “Bio-indigo” jeans.

Scientists have found a way of using *E. coli* to produce a blue dye without any red colour.

The bacterium *E. coli* is produced in large quantities using a fermenter like this.



The fermenter has two separate feedback loops.

Suggest why these feedback loops have been included and explain how they work.

✎ The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

[Total: 6]

7 Magnesium sulfate can be used to treat eclampsia in pregnant women.

When used for medical purposes it needs to be very pure.

It can be made by reacting the insoluble salt magnesium carbonate with sulfuric acid.

magnesium carbonate + sulfuric acid → magnesium sulfate + carbon dioxide + water

Describe how to prepare some pure, dry, crystals of magnesium sulfate in the laboratory by this method. Name any apparatus required.

✎ The quality of written communication will be assessed in your answer to this question.

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..... **[6]**

[Total: 6]

[Paper Total: 50]

END OF QUESTION PAPER

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RECOGNISING ACHIEVEMENT

SPECIMEN H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

ADDITIONAL APPLIED SCIENCE **A192/02**

Unit A192: Science of Materials and Production (Higher Tier)

MARK SCHEME

Duration: 1 hour

MAXIMUM MARK 50

This document consists of 12 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. Annotations:
   The following annotations are available on SCORIS.

   ✓ = correct response
   ✗ = incorrect response
   bod = benefit of the doubt
   nbod = benefit of the doubt **not** given
   ECF = error carried forward
   ^ = information omitted
   I = ignore
   R = reject

6. If a candidate alters his/her response, examiners should accept the alteration.

7. 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.

   Eg
   For a one mark question, where ticks in boxes 3 and 4 are required for the mark:

Put ticks (✓) in the two correct boxes.	Put ticks (✓) in the two correct boxes.	Put ticks (✓) in the two correct boxes.
☐	☐	☒
☐	☐	☒
✓	☒	✓
☒	☒	✓
☐	☐	☐
This would be worth 0 marks.	This would be worth one mark.	This would be worth one mark.

8. The list principle:
   If a list of responses greater than the number requested is given, work through the list from the beginning. Award one mark for each correct response, ignore any neutral response, and deduct one mark for any incorrect response, eg one which has an error of science. If the number of incorrect responses is equal to or greater than the number of correct responses, no marks are awarded. A neutral response is correct but irrelevant to the question.

9. Marking method for tick boxes:

   Always check the additional guidance.

   If there is a set of boxes, some of which should be ticked and others left empty, then judge the entire set of boxes.
   If there is at least one tick, ignore crosses. If there are no ticks, accept clear, unambiguous indications, eg shading or crosses.
   Credit should be given for each box correctly ticked. If more boxes are ticked than there are correct answers, then deduct one mark for each additional tick. Candidates cannot score less than zero marks.

   Eg If a question requires candidates to identify a city in England, then in the boxes

Edinburgh	
Manchester	
Paris	
Southampton	

   the second and fourth boxes should have ticks (or other clear indication of choice) and the first and third <u>should be blank</u> (or have indication of choice crossed out).

Edinburgh			✓			✓	✓	✓	✓	
Manchester	✓	×	✓	✓	✓				✓	
Paris				✓	✓		✓	✓	✓	
Southampton	✓	×		✓		✓	✓		✓	
Score:	2	2	1	1	1	1	0	0	0	NR

Question			Expected answers	Mark	Additional guidance
1	(a)	✎	**[Level 3]** Fully labelled diagram. Account includes **all** relevant points, including those in bold. All information in answer is relevant, clear, organised and presented in a structured and coherent format suitable for purpose. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **[Level 2]** Diagram may have some labels missing. Account will omit some relevant points, possibly those in bold. For the most part the information is relevant and presented in a structured and coherent format suitable for purpose. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **[Level 1]** Diagram may have no labels. Account may omit several relevant points, possibly only dealing with the first sample in detail. 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 in order:** • labelled diagram of sample, suspension, load, ruler • measure sample position • add the load • measure new sample position to obtain deflection • **repeat to check answer to increase reliability** • insert a second sample of the **same length, shape and thickness as the first sample** • then repeat measurements • **sample with lower deflection is stiffer** • therefore put the samples in order of stiffness
	(b)		Any three from: strong/stiff material so it will stand up right a polymer so that it is weather proof and flexible taller than a player so they don't get spiked by them thin so flexible enough to bend on impact	**[3]**	
			Total	**[9]**	

Question			Expected answers	Marks	Additional guidance
2	(a)		$k = F/x$ = 100 / 50 = 2 (N/mm) x 1000 = 2000 (N/m)	[2]	data from graph for **ecf:** calculation for
	(b)		elastic limit is 120 N use of area between curve and x axis energy = 0.5 × 120 × (60/1000) = 3.6 J	[3]	**ecf**: incorrect elastic limit method. evaluation
	(c)		to prevent it tearing / losing shape	[1]	
			Total	[6]	

Question			Expected answers	Marks	Additional guidance
3	(a)		For one mark: refraction is the change of direction of wave/light caused by a change in velocity OR for two marks: when light travels from the air into the lens the velocity of the light wave changes because the glass of the lens has a different refractive index to the air so the light ray bends at the air/lens boundary	[2]	
	(b)		draws one line horizontal from object to lens and one line from object to centre of lens top line is shown bent in lens or at surface, and bottom line continues straight through lens, both meeting at a point	[2]	
	(c)		UV can cause skin cancer IR produces heat/ overheating/ too hot	[2]	

	(d)		using a filter (yellow filter) that absorbs the blue light from the white light letting the rest of the light spectrum through creating yellow light OR for one mark using a filter that absorbs blue light	**[2]**	
	(e)		lens will need to move towards the object as she takes close ups to keep the object in focus	**[3]**	accept reverse argument
			Total	**[11]**	

Question			Expected answers	Marks	Additional guidance
4	(a)		2 hours 40 minutes or 160 minutes	[2]	correct answer with no working gets 2 marks If incorrect answer given, then evidence of trying to double at equal time intervals gets 1 mark
	(b)		bacteria not killed by stomach acid and the temperature is ideal for growth only small amounts of bacteria are needed to cause illness and from 6(b) they will have enough time to replicate so there will be enough bacteria to produce enough toxin to cause illness	[3]	
	(c)		• E. coli cases going down after 2000, the year the Food Standards Agency (FSA) was created • but only fall to about 80,00 cases • so the FSA has been partially effective but still more steps need to be taken OR • cases peaked at 1997 • so are already falling by 2000 when the FSA was created • therefore there is little evidence that the FSA has been successful as the numbers could have fallen anyway	[3]	look for evidence quoted from graph - either years or cases quantified.
			Total	[8]	

Question			Expected answers	Marks	Additional guidance
5	(a)		continues line decreases rapidly, mirroring first part of graph, to same level as at A before the end of the horizontal line	[1]	all parts required

	(b)		any three from: check cleanliness is up to food production standards inspect the factory (health and safety) investigate accidents/complaints give advice and information to workers check machinery is safe and up to standard	**[3]**	
			Total	**[4]**	

Question			Expected answers	Mark	Additional guidance
6	✎		**[Level 3]** Mentions all relevant points. All information in answer is relevant, clear, organised and presented in a structured and coherent format suitable for purpose. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **[Level 2]** Mentions most relevant points. May not say anything sensible about the top loop. For the most part the information is relevant and presented in a structured and coherent format suitable for purpose. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **[Level 1]** Mentions some of the relevant points. May just discuss the bottom loop. Account may omit several relevant points, possibly only dealing with the first sample in detail. 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:** **General points** • loops maintain constant conditions in fermenter • to optimise growth of bacteria • by sensing conditions • and altering inputs appropriately **Bottom loop** • sensor measures temperature • if fermenter gets too cold • heater switches on • until fermenter is at the correct temperature **Top loop** • sensible suggestion for sensors e.g. liquid level, pH, turbidity, nutrients ... • how signals from these sensors control the input flow • reasons why the input flow is controlled in this way eg to keep the culture medium level or pH constant all the time, to keep conditions constant to maximise production
			Total	**[6]**	

Question			Expected answers	Marks	Additional guidance
7	✎		**[Level 3]** Mentions all relevant points, including names of equipment listed in **bold**. All information in answer is relevant, clear, organised and presented in a structured and coherent format suitable for purpose. Specialist terms are used appropriately. Few, if any, errors in grammar, punctuation and spelling. (5 – 6 marks) **[Level 2]** Mentions most relevant points, including names of all equipment listed in **bold**. May add acid to solid. For the most part the information is relevant and presented in a structured and coherent format suitable for purpose. Specialist terms are used for the most part appropriately. There are occasional errors in grammar, punctuation and spelling. (3 – 4 marks) **[Level 1]** Mentions majority of the relevant points. May omit some or all names of items of equipment. Account may omit several relevant points, possibly only dealing with the first sample in detail. 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:** • place sulfuric acid in **beaker** • add some solid carbonate • stir / heat as necessary to make reaction go • then add more solid until no more will dissolve and reaction stops • pour solution through **filter paper** in **funnel** • and collect solution in **evaporating dish** • heat gently with **bunsen flame** • until crystals start to form • leave for water to evaporate • wash and dry crystals **ignore** references to fizzing
			Total	**[6]**	
			Paper Total	**[50]**	

Assessment Objectives (AO) Grid

(includes quality of written communication✎)

Question	AO1	AO2	AO3	Total
1(a)✎	6			**6**
1(b)		3		**3**
2(a)		2		**2**
2(b)		3		**3**
2(c)		1		**1**
3(a)	2			**2**
3(b)	1	1		**2**
3(c)	2			**2**
3(d)	1	1		**2**
3(e)	3			**3**
4(a)		2		**2**
4(b)	1	2		**3**
4 (c)			3	**3**
5(a)		1		**1**
5(b)	2	1		**3**
6✎		6		**6**
7✎	4	2		**6**
Totals	**22**	**25**	**3**	**50**

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