Oxford Cambridge and RSA Examinations

General Certificate of Education

APPLIED SCIENCE

Unit 3: Monitoring the Activity of the Human Body

G622/TEST

Specimen Paper

Additional materials: None.

TIME 1 hour 30 minutes

Candidate Name	Centre Number	Candidate Number

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the spaces above.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Answer **all** the questions.
- Read each question carefully and make sure you know what you have to do before starting your answer.

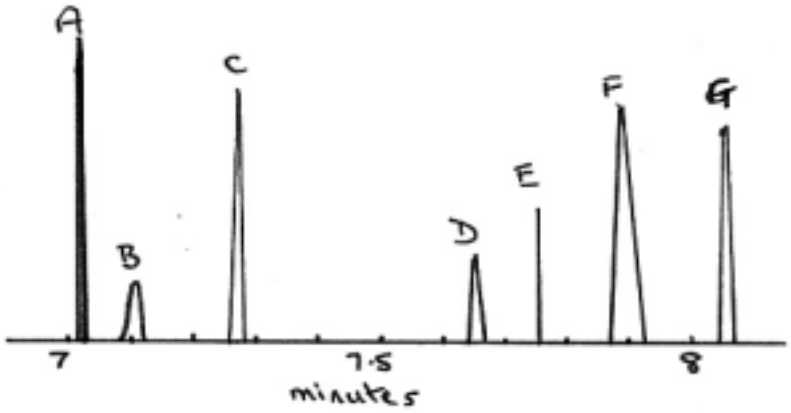
INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **90**.
- You will be awarded marks for the quality of your written communication where this is indicated in the question.

Question number	For examiner's use only
1	
2	
3	
4	
5	
6	
TOTAL	

1 Athletes are subjected to regular drug testing for banned substances.
One of these substances is the performance-enhancing drug nandrolone, an anabolic steroid.
High-performance liquid chromatography is **one** of the techniques used for testing the blood for banned substances.

(a) The chart below shows part of a chart from a high-performance liquid chromatogram of a sample that contains nandrolone.



(i) How can you tell that the chart is only part of the full chromatogram?

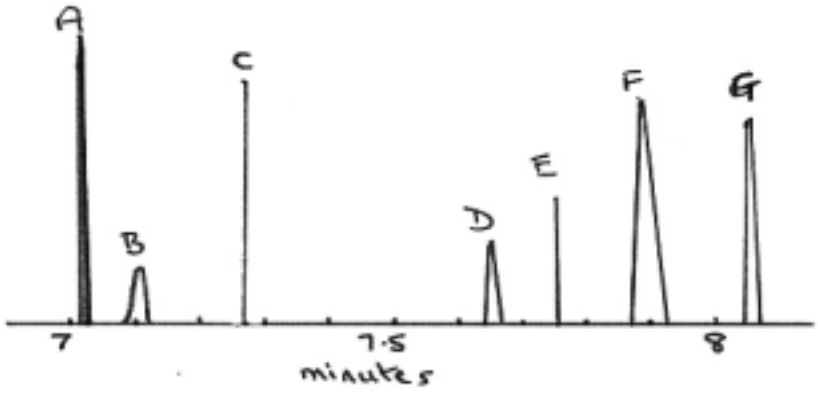
_____

_____ **[1]**

(ii) Nandrolone has a relative retention time of 7.27 minutes.
Which of the substances, A, B, C, D, E, F or G is nandrolone?

_____ **[1]**

(iii) The chart below shows the chromatogram of a blood sample from an athlete suspected of taking nandrolone.



Explain what conclusions can be drawn from the chart.

_____

_____

_____ **[2]**

1 **(a)** **(iv)** Explain why it is important that the blood sample be compared with a standard reference sample.

_____

_____

_____ **[2]**

(v) Suggest which substance, A, B, C, D, E, F or G is present in the greatest quantities.
Explain your answer.

_____

_____

_____ **[2]**

(b) Suggest why anabolic steroids, such as nandrolone, do not improve **all** aspects of fitness.

_____

_____

_____ **[2]**

(c) Describe **one** other way that drugs can be tested for in humans.

_____

_____

_____

_____

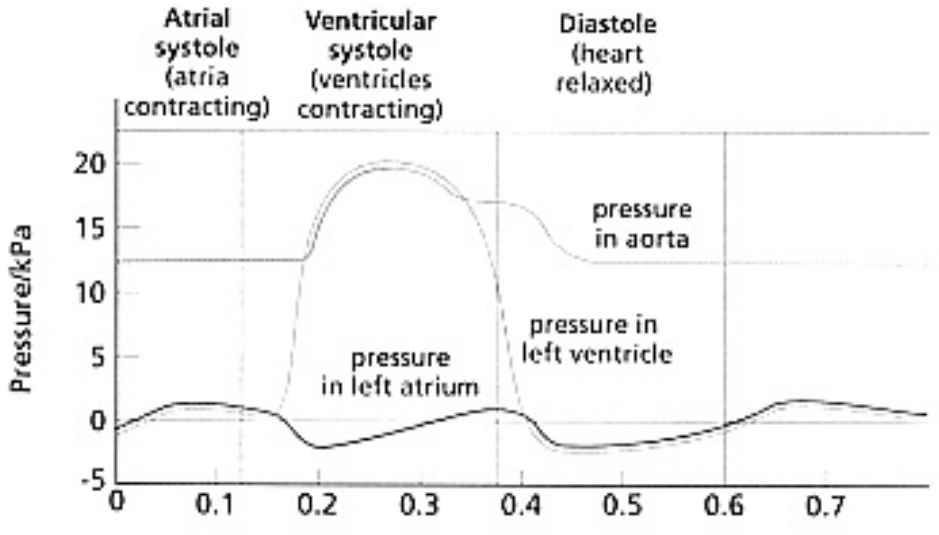
_____ **[3]**

1 **(d)** *In this part of the question, **two** marks are available for the quality of your written communication.*
Describe how you would carry out a simple comparative step-fitness test on **two** different athletes.
You may use bullet points to help you explain your answer.

[7]

Quality of Written Communication **[2]**

2 The chart below shows the changes in blood pressure during the cardiac cycle, in a healthy human heart.



(a) Look at the chart and determine:

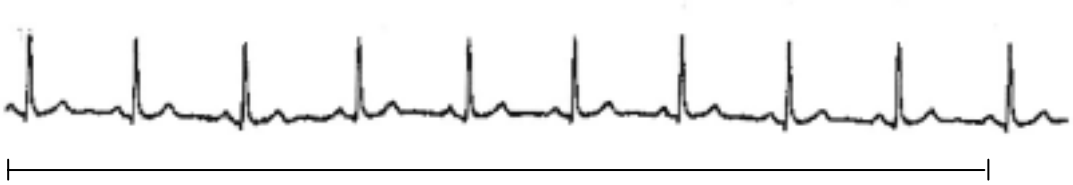
(i) the length of the cardiac cycle:

answer: _____ seconds **[1]**

(ii) the maximum pressure in the ventricles:

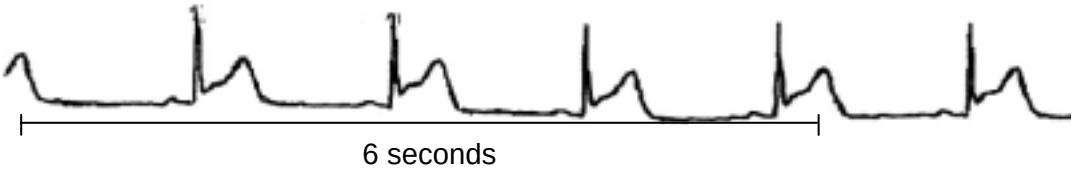
answer: _____ units: _____ **[2]**

2 **(b)** The chart below show the printout of an electrocardiogram from a normal, healthy adult.



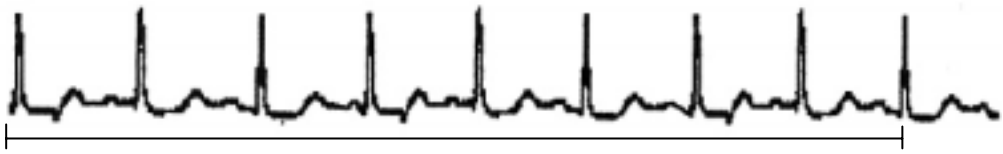
Describe and explain how each of the following charts compares with the chart for the normal, healthy, human adult.

(i)



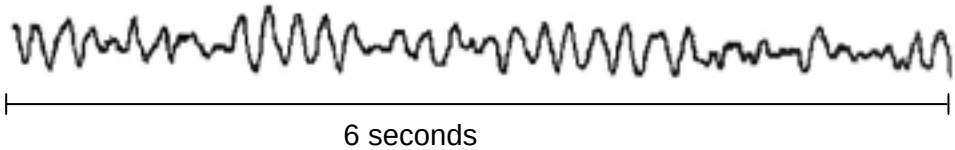
[2]

(ii)



[2]

(iii)



[2]

3 Beccy regularly donates blood.

(a) The National Blood Service needs to know Beccy's blood group.

(i) Beccy thinks that her blood group is AB.
How could Beccy's blood be tested, to check if her blood group really was AB?

[4]

(ii) List the **other** major blood groups that Beccy's blood could belong to.

[4]

(b) Beccy's blood is also tested to ensure that it is free from diseases such as hepatitis and AIDS. **One** of the techniques that might be used is called the ELISA test.

(i) Suggest why it is important for these tests to be carried out.

[1]

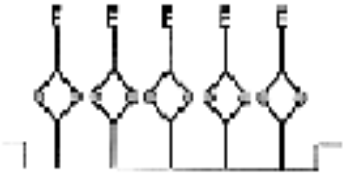
(ii) What do the initials ELISA stand for?

[1]

3 **(b)** **(iii)** The diagrams below show how the ELISA test can be used to carry out **one** of these checks on Beccy's blood.
Write an explanation at the side of each diagram to explain what is happening.

Antibody selected.
Specific to the suspected virus.

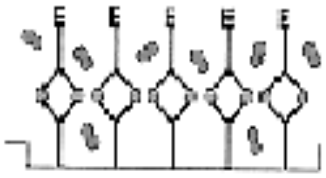
Sample taken from the patient containing suspected antigen.



_____

_____

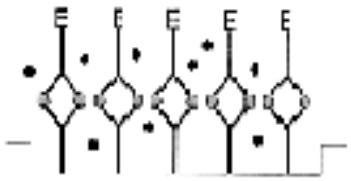
_____ **[2]**



_____

_____

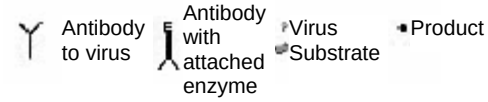
_____ **[2]**



_____

_____

_____ **[2]**



(iv) Which type of ELISA test was being used?

_____

_____ **[1]**

3 **(c)** It may soon be possible to introduce a blood test to provide an early diagnosis of prostate cancer in men.
Discuss the advantages and disadvantages of introducing a new screening programme of this kind.

[4]

4 Medical data is often obtained by using invasive and non-invasive techniques on patients.

(a) Explain the difference between invasive and non-invasive techniques.

[1]

(b) The following techniques are commonly used in health care to gather data about the inside of patient's bodies.
What are the basic principles involved in the following techniques?

(i) X-ray radiography:

[2]

(ii) Ultrasound:

[2]

(c) Why is ultrasound rather than X-ray radiography used in monitoring foetal development in pregnancy?

[2]

5 Nurses are often required to take a sample of blood from a patient. This can be a risky business, particularly for the nurse taking the blood.
Complete the form below to carry out a risk assessment for this activity.

Risk Assessment Form
Name of person carrying out activity Nurse Susan
Type of activity Taking blood samples
Date carried out 23 January 2005

Material/procedure: _____

_____ **[1]**

Hazard: _____

_____ **[1]**

What could go wrong: _____

_____

_____ **[2]**

Safety precautions: _____

_____

_____

_____

_____ **[3]**

In case of accident: _____

_____

_____ **[2]**

Risk (high/medium/low) explained: _____

_____ **[1]**

6 **(a)** Air passes through a set of tubes on its way to the gas exchange surface in a human lung.

(i) Name the structures which provide the gas exchange surface in a human lung.

_____

_____ **[1]**

(ii) List, in the correct order, the names of the tubes through which air passes to the gas exchange surface in a human lung.

1: nose and mouth

2: _____ **[1]**

3: _____ **[1]**

4: _____ **[1]**

5: gas exchange surface

(iii) *In this part of the question, **two** marks are available for the quality of your written communication.*
Describe how air is moved from the atmosphere into the human lung.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ **[6]**

Quality of Written Communication **[2]**

6 **(b)** Elsie is an 80-year-old woman who is dying from cancer of the lung. She does not know she has cancer.

(i) She needs an operation and is asked by the doctor to sign a consent form. Explain the purpose of the consent form that Elsie signs.

[3]

(ii) Discuss the ethical and moral dilemmas faced by the doctor about whether to tell Elsie about her cancer.

[3]

(iii) The operation is not successful. Elsie lives alone and has no-one to care for her when she leaves hospital. Her doctor says that there is a place for Elsie in a hospice.
Explain the role of the hospice in looking after Elsie.

[3]

Oxford Cambridge and RSA Examinations

General Certificate of Education

APPLIED SCIENCE

Unit 3: Monitoring the Activity of the Human Body

G622/MS

Mark Scheme

Question	Answer	AO	Mark
1(a)(i)	Time line does not start at zero.	**AO2**	**1**
1(a)(ii)	C.	**AO2**	**1**
1(a)(iii)	Athlete has nandrolone in the blood. Smaller quantity than reference sample.	**AO2**	**1** **1**
1(a)(iv)	To check that it is the actual substance. Compare quantities.	**AO2**	**1** **1**
1(a)(v)	A. Covers bigger area of graph.	**AO2**	**1** **1**
1(b)	Steroids build muscle. Does not improve, e.g. vital capacity.	**AO1**	**1** **1**
1(c)	Correct example, such as alcohol/a named recreational drug. Description of appropriate test. Indication of positive result.	**AO1**	**1** **1** **1**
1(d)	*Seven from:* • bench or box of fixed height; • step up and down every **2** seconds; • for **5** minutes; • rest **1** minute; • pulse for **30** seconds; • wait **30** seconds; • pulse for **30** seconds; • wait **30** seconds; • pulse **30** seconds; • time spent on exercise x **100** • **2** x (**3** pulse counts added together); • divide time by pulse count score; • compare result against scale. *Quality of Written Communication*	**AO1**	**7x1** **2**
2(a)(i)	0.6	**AO2**	**1**
2(a)(ii)	20; kPa.	**AO2**	**1** **1**
2(b)(i)	*Two from:* • heart beat slower; • bradycardia; • increased height of T wave.	**AO2**	**2x1**
2(b)(ii)	Increased heart beat. Tachycardia.	**AO2**	**1** **1**

Question	Answer	AO	Mark
2(b)(iii)	*Two from:* • erratic beat; • no fixed base line; • ventricular fibrillation.	**AO2**	**2x1**
3(a)(i)	*Four from:* • blood sample mixed with antibody B; • if coagulates then protein B present; • blood sample mixed with antibody A; • if coagulates protein B present; • if protein A & B present then it is group AB.	**AO1**	**4x1**
3(a)(ii)	A; B; O; ref to Rh – or +.	**AO1**	**4x1**
3(b)(i)	Ensure blood is safe for recipient.	**AO1**	**1**
3(b)(ii)	**E**nzyme-**L**inked **I**mmuno**S**orbent **A**ssay.	**AO1**	**1**
3(b)(iii)	Add antivirus antibody; with enzyme attached. Add substrate; for reaction that is catalysed by enzyme. Substrate converted to product; product detectable, e.g. colour change.	**AO2**	**1** **1** **1** **1** **1** **1**
3(b)(iv)	Direct.	**AO1**	**1**
3(c)	*Four from:* • both sides of argument; • expensive to set up; • cheaper in long run due to NHS savings of long term care; • ref to reliability of results; • qualified, e.g. false positives or negatives;	**AO2**	**4x1**
4(a)	Invasive involves opening up body, non-invasive does not.	**AO1**	**1**
4(b)(i)	*Two from:* • bone absorbs X-rays; • X-rays detected by photographic plate; • negative produced.	**AO1**	**2x1**
4(b)(ii)	*Two from:* • sound waves of very high frequency; • beam aimed at structure to be examined; • reflected waves used to produce an image.	**AO1**	**2x1**
4(c)	Ultrasound not harmful. X-rays may cause genetic damage to mother or foetus.	**AO1**	**1** **1**

Question	Answer		AO	Mark
5	Procedure –	Taking blood sample.	**AO1**	**1**
	Hazard –	Blood may contain infective microbes.		**1**
	What could go wrong –	Stuck by hypodermic; get contaminated.		**2x1**
	Safety –	*Three from:* • wear gloves; • ref to sterilisation; • ref to follow protocols; • seal blood sample immediately; • safe disposal of sharps.		**3x1**
	Accident –	Wash/sterilise; inform someone.		**2x1**
	Risk –	Any level provided explanation correct.	**AO2**	**1**
6(a)(i)	Alveoli.		**AO1**	**1**
6(a)(ii)	Trachea before bronchus. Bronchus before bronchiole. Bronchiole before gas exchange surface.		**AO1**	**1** **1** **1**
6(a)(iii)	*Six from:* • ribs and sternum raised; • by intercostal muscles; • diaphragm lowered; • by contractions of muscles around rim; • volume of thorax increased; • pressure in thorax lowered; • air moves into lung to equalise the pressure. *Quality of Written Communication*		**AO1**	**6x1** **2**
6(b)(i)	Ensure patient is informed of procedure. Check that patient understands procedure. Protect doctor from later complaints.		**AO1**	**1** **1** **1**
6(b)(ii)	Both sides of argument/ref to no right or wrong answer/complexity of decision/each case on merit. Ref to patient's rights. Ref to how bad news may affect patient.		**AO2**	**1** **1** **1**
6(b)(iii)	Terminal health care. Pain relief. Ref to quality of life.		**AO1**	**1** **1** **1**
				Paper: 86 + (QWC) 4 = 90

Analysis of marks: **Total mark available: 90**

	AO1	AO2	AO3	Total
Mark	58	32	0	90
%	64%	36%	0%	100%

Oxford Cambridge and RSA Examinations

General Certificate of Education

APPLIED SCIENCE
Unit 4: Cells and Molecules

G623/INST

Plan for an Investigation: Instructions
To be opened immediately.

Planning Exercise – for issue on or after (**6 weeks prior to the examination**)

This document is for the **Head of Centre** and for the use of the **Science teacher**.

Copies of the Plan for an Investigation accompany the packet containing these instructions.

These packets should be issued to the Science teacher immediately they arrive at the centre, but **they must be kept in a secure place at all times.**

PLAN FOR AN INVESTIGATION

The Plan for an Investigation should be issued to candidates on or after the date shown on the front of this document. The candidates' Plans must be collected in, on or before the date of the examination. These arrangements may be made at the discretion and convenience of the centre.

It should be recognised that the Plan for an Investigation contributes 50% to the assessment of this Unit and candidates should therefore be guided to spend an appropriate amount of time on the work. Candidates should be given **between 7 and 10 days** to complete it.

The mark scheme for the Plan for an Investigation is given in the Specification and a copy of these criteria is provided to candidates to assist them in their work.

Candidates must be given access to laboratory space and facilities in order to be able to carry out preliminary work which will help in constructing their Plan. However, it should be noted that the responsibility for Health and Safety during this period rests with the centre, and the attention of teachers is drawn to the Health and Safety section in the Specification. Access to suitable library and other resources may also be required and, while time at home or in private study will be necessary to complete the task to a high standard, sufficient work must be completed under direct supervision to allow the teacher to authenticate the work with confidence as that of the candidates concerned. Many centres find that this can best be managed by allowing candidates a set period of time to research the topic but requiring the Plan to be written under supervision. The supervising teacher should complete the statement of authentication for each candidate on the front cover page of the Plan. Details should be provided to the examiner of any assistance given to candidates.

After candidates' work has been collected, it must be kept securely until the date of the examination (or must be collected on the day of the examination) and must be included with the scripts for the examination when these are despatched to the Examiner. Please tie together **loosely** (or use a treasury tag) the Plan for an Investigation and the examination paper for each candidate **with the Plan for an Investigation on the top**.

Guidance for Teachers/Tutors on Authenticating Work

The work submitted by candidates for assessment must be entirely their own.

Candidates may however:

- quote from books or any other source; this should be referenced in the work and all sources acknowledged;
- receive guidance from someone other than their teacher/tutor; the course teacher must be informed of the name of the person giving external guidance and the nature of the assistance given;
- produce work at a location away from the examination centre provided that the work remains under the supervision of the teacher/tutor.

In cases of privately entered candidates or distant-tutored candidates, the centre must ensure that:

- the teacher/tutor has acquainted themselves thoroughly with the general standard of candidates' work before accepting work for assessment;
- sufficient on-going regular monitoring of candidates' work has taken place.

Before authenticating work, the teacher/tutor should ask themselves the following basic questions:

- Has the **Declaration by Candidate** been signed by the candidate?
- Was at least part of the work done under my direct supervision?
- Did I check the work during its production?
- Is the standard of finished work consistent with my professional judgement of the candidate's ability?

If you have answered 'YES' to the above questions you may authenticate the work.

The following notes for guidance are issued to candidates:

1 Your Plan should have a clear and helpful structure and should be illustrated by diagrams, tables, charts, graphs etc. as appropriate. Remember that these can often be used to replace words in the text. Diagrams should be relevant to the content of your Plan and positioned appropriately. Labels on diagrams, flow charts or tables should be clear and concise. Large blocks of text should be included in the word count.

2 You should take care to use technical and scientific terms correctly and to write in clear and correct English.

3 Your Plan should be hand-written or word-processed on A4 paper, which should have a hole punched at the top left-hand corner. Pages should be numbered and should have a clear margin on the right hand side. You should write (or print) on **one** side of the paper only and each sheet should be marked with your centre number and candidate number.

4 You should show that you have consulted an appropriate range and variety of sources. At the end of your Plan you should list clearly the sources you have used. You should refer to these references in your Plan where appropriate. Where you have incorporated material which has been copied directly from a source such as a book or the Internet, this must be acknowledged in your Plan and details included in the references at the end. However, it should be noted that the inclusion of copied material will not in itself gain credit. The list of references should not be included in the word count.

5 Your Plan should be based on the use of standard equipment, apparatus, chemicals and other materials available in a school or college science laboratory.

6 Your Plan should be about **800** to **1 000** words. A Plan that is in excess of **1 000** words is likely to have poor structure and unselective choice of material, so that full credit may not be available. You should indicate the number of words in the margin of the Plan at approximately **100** word intervals.

7 When you have finished, tie the pages loosely together (or use a treasury tag), with this sheet on the top, so that the pages turn over freely. Your centre will give you the date by which your Plan must be handed in.

Oxford Cambridge and RSA Examinations

General Certificate of Education

APPLIED SCIENCE

G623/PLAN

Unit 4: Cells and Molecules

Plan for an Investigation

*Issued **6** weeks before examination.*

TIME The plan must be handed in by the deadline given by your teacher.

Candidate Name	Centre Number	Candidate Number

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the spaces above.
- Attach this page to the front of your plan.

	For examiner's use only
Planning	

INFORMATION FOR CANDIDATES

- You will be awarded marks for the quality of written communication.
- Detailed notes for guidance are given overleaf.

Authentication by teacher

I declare that, to the best of my knowledge, the work submitted is that of the candidate concerned. I have provided details of any assistance given.

Signature _____ Date _____

Notes for guidance

1 Your Plan should have a clear and helpful structure and should be illustrated by diagrams, tables, charts, graphs etc. as appropriate. Remember that these can often be used to replace words in the text. Diagrams should be relevant to the content of your Plan and positioned appropriately. Labels on diagrams, flow charts or tables should be clear and concise. Large blocks of text should be included in the word count.

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NOTICE TO CANDIDATE

The work you submit for assessment must be your own.

If you copy from someone else or allow another candidate to copy from you, or if you cheat in any other way, you may be disqualified from at least the subject concerned.

1 Any help or information you have received from people other than your subject teacher(s) must be clearly identified in the work itself.

2 Any books, information leaflets or other material (e.g. videos, software packages or information from the Internet) which you have used to help you complete this work must be clearly acknowledged in the work itself. To present material copied from books or other sources without acknowledgement will be regarded as deliberate deception.

Declaration by candidate

I have read and understood the **Notice to Candidate** (above). I have produced the work without any help from other people apart from that which I have declared in the work itself. I have acknowledged all source materials in the work itself.

Candidate's signature _____ Date _____

EXAMINATION PRE-TASK

Read the article about crop selection for saline soils. The article is to give you some background that you might find helpful in planning for the task that follows. Not all the information will be directly relevant and you are expected to select the information which is relevant to the task.

Your task is to plan an investigation into the salt tolerance of a variety of potato called 'white rose'. Your plan should clearly indicate how you would carry out the procedure and you should indicate how you would present and analyse your data to draw your conclusions.

There is no requirement to carry out your plan.

Your plan will be marked according to the following assessment criteria.

Candidates:	**Marking criteria**	**Mark**
• include a risk assessment to show how the investigation will be carried out safely;	easily recognised safety procedures highlighted;	**1**
• make a prediction and produce justification;	prediction made; with justification;	**1** **1**
• describe and explain the reasoning behind any preliminary work carried out;	description; clear and in detail; reasons explained; clear and in detail;	**1** **1** **1** **1**
• identify relevant secondary sources of information used;	identified; relevance explained;	**1** **1**
• plan how to use appropriate techniques to carry out a detailed practical investigation;	basic skills and reasonable accuracy; sound skills and accuracy;	**1** **1**
• list the equipment required;	range of appropriate; full range of appropriate;	**1** **1**
• state the number of measurements to be undertaken;	appropriate number;	**1**
• state the range of measurements to be undertaken;	need recognised; appropriate range;	**1** **1**
• identify any variables that could affect the validity of any conclusions made and explain how variables will be controlled;	relevant variables are identified; controlled;	**1** **1**
• show how they would present and display the data they could collect using suitable methods;	suitable methods identified;;	**1** **1**
• indicate how the data will be analysed;	simple data-handling; conclusions possible;	**1** **1**
• evaluate the investigation.	recognises sources of error; suggests methods for improving accuracy and/or validity.	**1** **1**
	Total marks available:	**24**
	Additional marks awarded on plan for use of scientific terminology:	**1**
	Total:	**25**

Oxford Cambridge and RSA Examinations

General Certificate of Education

APPLIED SCIENCE
Unit 4: Cells and Molecules

G623/INSERT

Plan for an Investigation

INSERT

INSTRUCTIONS TO CANDIDATES

The article which follows on pages 3-6 of this insert is to give you some background that you might find helpful in planning for the task that follows. Not all the information included will be directly relevant and you are expected to select the information which is relevant to the task.

Crop Selection for Saline Soils

2000Web* Adaptation from HandBook 60 (pp65-67) *Originally published in 1954

Because of

- **Saline irrigation water,**
- **High water table, or**
- **Low permeability of the soil,**

It may not be economically feasible to maintain low salinity. In such instances, the judicious selection of crops that can produce satisfactory yields under saline conditions and the use of special management practices to minimize salinity may make the difference between success or failure.

As has already been pointed out, the availability of water to plants is always a factor under saline conditions. For example, suppose alfalfa is being grown on a loam having a salt content of 0.2 percent sodium chloride and a wilting percentage of 6 when the latter is determined on a nonsaline sample. Under such conditions, because the osmotic effect is additive with soilmoisture tension, alfalfa will stop growing when the soil dries to a moisture content of only 13 percent. In other words, if the soil contains 0.2 percent salt, the alfalfa plant cannot use a large part of the soil moisture that is normally available under nonsaline conditions. The presence of even smaller quantities of salt in this soil would cause a fraction of the soil moisture above the wilting percentage to be unavailable to the plant. More frequent irrigation would be required to decrease the inhibitory effect of the salt on the growth of alfalfa.

Although it has been shown that crop growth on saline soils is definitely benefited by more frequent irrigation, the need for this irrigation may not be indicated by the appearance of the crop (Richards and Wadleigh, 1952). In nonsaline soils, there is usually a relatively abrupt transition from low moisture stress to high moisture stress conditions, and the wilting of the plant indicates the need for irrigation. In saline soils, changes in moisture stress are more gradual and, although the plants may be subjected to high stress, there is no abrupt transition in the turgor condition of the plant and, hence, no sign of the need for irrigation. Nevertheless, experiments have shown that crop growth is greatly improved by more frequent irrigation under such conditions. Careful leveling of the fields to insure more uniform moisture distribution during irrigation will also improve chances for successful crops on saline soils.

Germination

In selecting crops for saline soils, particular attention should be given to the salt tolerance of the crop during germination because poor crops frequently result from a failure to obtain a satisfactory stand. This problem is complicated by the fact that some crop species which are very salt tolerant during later stages of growth may be quite sensitive to salinity during germination (fig. 19). Sugar beets, for example, which are very salt tolerant during later stages of growth, are extremely sensitive during germination. On the other hand, barley has very good salt tolerance during all stages of growth, although it is more sensitive during germination than at later stages (Ayers and others, 1952). Under field conditions, it is possible by modification of planting practices to minimize the tendency for salt to accumulate around the seed and to improve the stand of crops that are sensitive to salt during germination (Heald and coworkers, 1950).

Fig. 19

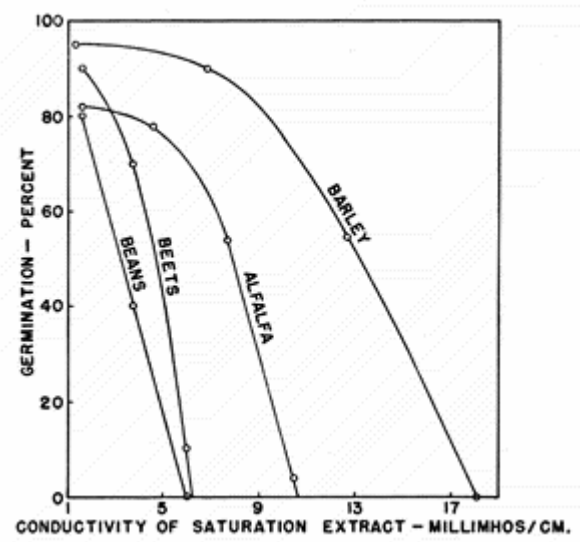


TABLE 8.—*Relative tolerance of crop plants to salt* [1]

FRUIT CROPS

High salt tolerance	Medium salt tolerance	Low salt tolerance
Date palm	Pomegranate	Pear
	Fig	Apple
	Olive	Orange
	Grape	Grapefruit
	Cantaloup	Prune
		Plum
		Almond
		Apricot
		Peach
		Strawberry
		Lemon
		Avocado

Relative Salt Tolerance of Crop Plants

The salt tolerance of many species and varieties of crop plants has been investigated at the Laboratory. Previously published lists (Magistad and Christiansen, 1944, and Hayward and Magistad, 1946) have been modified on the basis of recent findings and are presented in **Table 8**.

The salt tolerance of a crop may be appraised according to three criteria:

- **Ability** of the crop to survive on saline soils,
- **Yield** of the crop on saline soils, and
- **Relative yield** of the crop on a saline soil as compared with its yield on a nonsaline soil under similar growing conditions.

Many previous observations on salt tolerance have been based mainly on the first criterion, ability to survive; but this method of appraisal has very limited practical significance in irrigation agriculture. Although it is recognized that the second criterion is perhaps of greater agronomic importance, the third criterion was used in compiling the present salt-tolerance lists because it provides a better basis of comparison among diverse crops.

FORAGE CROPS

$EC_e \times 10^3 = 18$	$EC_e \times 10^3 = 12$	$EC_e \times 10^3 = 4$
Alkali sacaton	White sweetclover	White Dutch clover
Saltgrass	Yellow sweetclover	Meadow foxtail
Nuttall alkaligrass	Perennial ryegrass	Alsike clover
Bermuda grass	Mountain brome	Red clover
Rhodes grass	Strawberry clover	Ladino clover
Rescue grass	Dallis grass	Burnet
Canada wildrye	Sudan grass	
Western wheatgrass	Hubam clover	
Barley (hay)	Alfalfa (California common)	
Bridsfoot trefoil	Tall fescue	
	Rye (hay)	
	Wheat (hay)	
	Oats (hay)	
	Orchardgrass	
	Blue grama	
	Meadow fescue	
	Reed canary	
	Big trefoil	
	Smooth brome	
	Tall meadow oatgrass	
	Cicer milkvetch	
	Sourclover	
	Sickle milkvetch	
$EC_e \times 10^3 = 12$	$EC_e \times 10^3 = 4$	$EC_e \times 10^3 = 2$

FIELD CROPS

$EC_e \times 10^3 = 16$	$EC_e \times 10^3 = 10$	$EC_e \times 10^3 = 4$
Barley (grain)	Rye (grain)	Field beans
Sugar beet	Wheat (grain)	
Rape	Oats (grain)	
Cotton	Rice	
	Sorghum (grain)	
	Corn (field)	
	Flax	
	Sunflower	
	Castorbeans	
$EC_e \times 10^3 = 10$	$EC_e \times 10^3 = 6$	

[1] The numbers following $EC_e \times 10^3$ are the electrical conductivity values of the saturation extract in millimhos per centimeter at 25° C. associated with 50-percent decrease in yield.

The salt-tolerance lists are arranged according to major crop divisions; and, in each division, crops are listed in three groups. Within each group, the crops are listed in the order of decreasing salt tolerance, but a difference of 2 or 3 places in a column may not be significant. EC, values given at the top of a column represent the salinity level at which a 50 percent decrease in yield may be expected as compared to yields on nonsaline soil under comparable growing conditions. For example, for crops with high salt tolerance in the division of field crops, EC, values of 16 mmhos/cm. occur at the top of the column and 10 mmhos/cm. at the bottom. This indicates that crops near the top of this column will produce about 50 percent as well on a soil having an EC, of 16 mmhos/cm. as on a nonsaline soil under similar conditions, and crops near the bottom of this column will produce about 50 percent as well on soils having an EC, of 10 mmhos/cm. as on a nonsaline soil. EC, values having similar significance have been shown for each group of plants for which such data are available.

In most instances, these data are based on a field-plot technique in which crops are grown on soils that are artificially adjusted to various salinity levels after the seedlings are established. By this method, crop yields were related to EC, values for comparable saline and nonsaline soils, and the salinity level associated with a 50percent decrement of yield was determined graphically. In many of these studies, a number of varieties of a given crop were compared. Significant varietal differences were found for cotton, barley, and smooth brome, while for truck crops such as green beans, lettuce, onions, and carrots varietal differences were not of practical significance.

In applying the information in the following table, it is important to remember that climatic conditions may influence profoundly the reaction of plants to salinity. The choice of suitable salt-tolerant varieties and strains will depend on local climatic factors; and, consequently, information on salt-tolerant varieties should be evaluated with reference to the conditions under which the crops are to be grown. The position of each crop in this table reflects its relative salt tolerance under management practices that are customarily employed when this crop is grown under irrigation agriculture and not the inherent physiological ability of the crop to withstand salinity under some given set of conditions that is uniform for all crops.

A salt-tolerance list for some important crops of Holland has recently been prepared by Van den Berg (1950). Based on field-plot studies in areas which had been inundated by salt or brackish water in 194.4.-45, the salinity values ("salt index," expressed as grams NaCl per liter of soil water) associated with 75 percent of normal yields for 14 crops were determine Despite obvious differences in climate and cultural practices, Van den Berg's results for relative salt tolerance are in good agreement with those in **Table 8.**

Article from *Handbook No 60: Saline and Alkaline Soils*, 1954. 2000 Web Adaptation
http://www.ussl.ars.usda.gov/answers/cropsali.htm

Oxford Cambridge and RSA Examinations

General Certificate of Education

APPLIED SCIENCE
Unit 4: Cells and Molecules

G623/TEST

Specimen Paper

Additional materials: None.

TIME 45 minutes

Candidate Name	Centre Number	Candidate Number

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the spaces above.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Answer **all** the questions.
- Read each question carefully and make sure you know what you have to do before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **45**.
- You will be awarded marks for the quality of your written communication where this is indicated in the question.
- You may use an electronic calculator.

Question number	For examiner's use only
Investigation	
1	
2	
3	
TOTAL	

1 Scientists need to understand how cells function. They sometimes use an electron microscope.

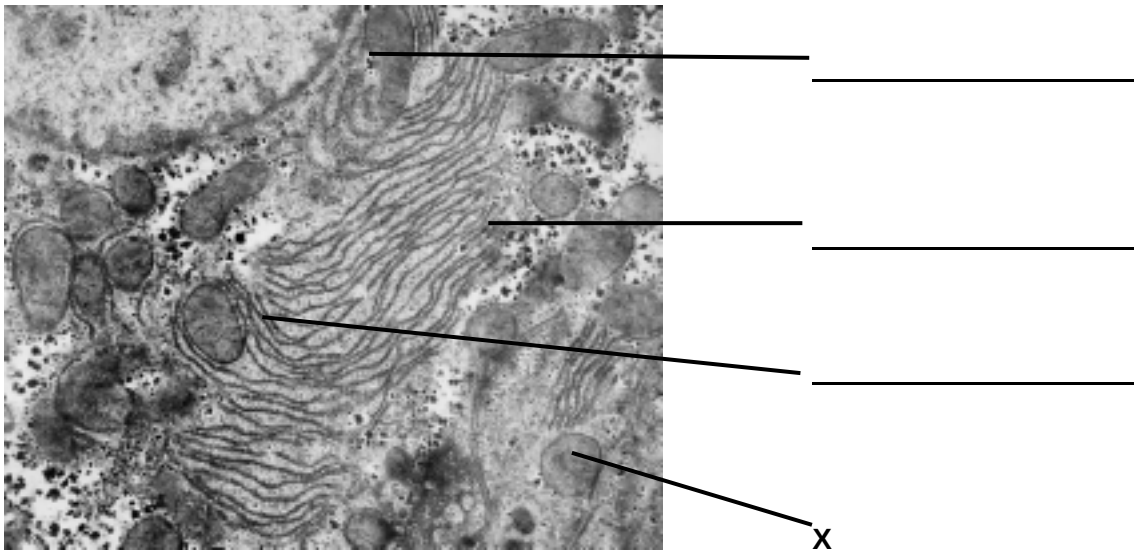
(a) Explain how an electronmicroscope differs from the sort of microscope you would use in your school or college laboratory.

_____

_____

_____ **[2]**

(b) Look at the electronmicrograph of a cell.



(x 25 000 magnification)

(i) Complete the labels to the cell. **[3]**

(ii) State whether the electronmicrograph shows an animal cell or a plant cell.
Explain your answer.

_____

_____

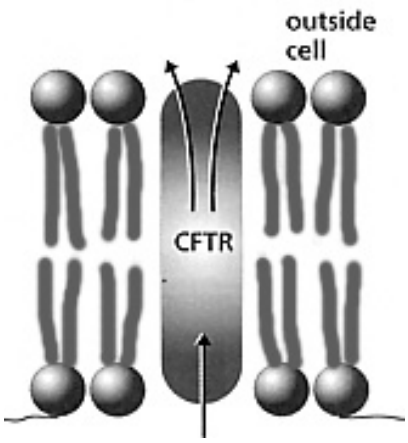
_____ **[2]**

(iii) Structure **X** is an organelle found within the cell.
Calculate the actual size of the structure.
Show your working.

_____ **[2]**

1 **(c)** Cystic fibrosis is a disease that affects how the cell membrane that surrounds the cell functions.

(i) Use the following diagram of a cell membrane to explain how cystic fibrosis affects its working.



[3]

(ii) Cystic fibrosis is caused by a faulty gene. Scientists are attempting to find ways of repairing the DNA of patients who suffer from the disease.
Discuss the moral and ethical implications faced by society and the scientists who carry out research into genetic engineering.

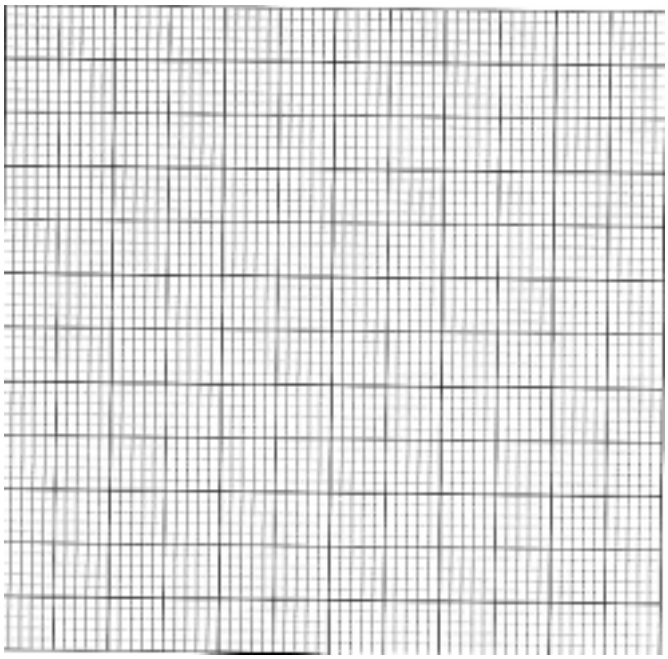
[3]

2 Scientists working in an agricultural research station wanted to investigate how potatoes would grow on land contaminated by seawater. They carried out an experiment where raw potato chips were immersed in different concentrations of salt solutions. The potato chips were weighed before immersion in the solutions and after they were taken out.
The results are shown below.

	initial mass of potato chip/g				final mass of potato chip/g					
concentration of sucrose solution/mol dm^{-3}	chip 1	chip 2	chip 3	average	chip 1	chip 2	chip 3	average	change in average mass	% change in average mass
0.0	3.71	4.12	3.13	3.65	3.85	4.45	3.41	3.90	0.25	6.85
0.25	3.24	4.10	3.38	3.57	3.04	3.64	3.19	3.29		-7.84
0.5	3.24	4.02	3.14		2.41	3.83	2.65	2.96	-0.51	-14.7
0.75	3.03	4.07	3.61	3.37	2.03	3.19	2.56	2.59	-0.78	
1.0	2.44	3.01	4.34	3.26	1.51	1.89	2.79	2.06	-1.2	-36.81

(a) **(i)** The scientists did not complete all the calculations.
Complete the missing calculations in the table. **[4]**

(ii) On the grid, plot a graph of the percentage change in mass of the potato chips, against the molarity of the salt solution.



[3]

2 **(a)** **(iii)** *In this part of the question, **two** marks are available for the quality of your written communication.*
Explain, in terms of water potential, the mean changes in mass of the potato chips that occurred in:

0.0 mol dm^{-3} (distilled water):

1.0 mol dm^{-3} (salt solution):

[5]

Quality of Written Communication **[2]**

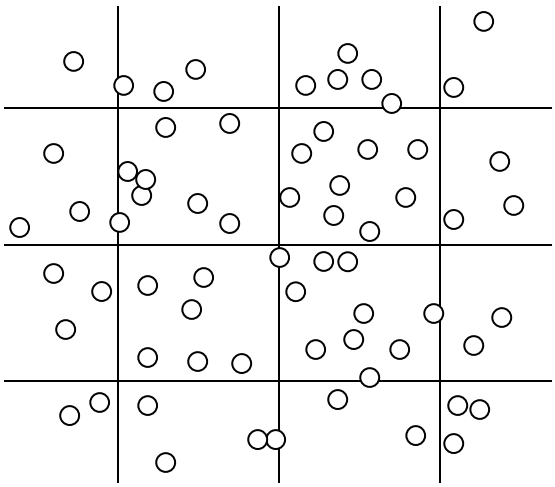
(iv) Use your graph to determine the original molarity of the cell contents of the potato chips.
Explain your answer.

[2]

(v) Sea water has a molarity of 0.479 M.
Suggest the effect on any potatoes that were grown on land completely contaminated with sea water.

[3]

3 Anaemia is a lack of red blood cells in the blood. Scientists who work in pathology laboratories need to count the number of red blood cells in a sample of blood, to check for anaemia.
One way they can do this is to use a haemocytometer.
Look at the picture of the haemocytometer as seen under a microscope.
It shows red blood cells and **four** complete squares, called **c squares**.



(a) **(i)** Count the number of red blood cells in each of the **c squares**.
Complete the table below.

c square	number of red blood cells
top left	
top right	
bottom left	
bottom right	
total	

[3]

(ii) Calculate the average number of red blood cells in **one** c square.
Show your working.

[2]

3 **(a)** **(iii)** C squares have a volume of 0.00025 mm^3.
Calculate the number of red blood cells that you would expect to find in 1mm^3 of this blood sample.
Show your working.

_____ **[2]**

(iv) A healthy person would expect to have about 5 million red blood cells /mm^3.
Explain what conclusions you might draw from your results.

_____

_____

_____ **[2]**

(b) Using a haemocytometer is a time consuming process.
Explain how the process might be speeded up in a modern pathology laboratory.

_____

_____

_____

_____

_____ **[3]**

Oxford Cambridge and RSA Examinations

General Certificate of Education

APPLIED SCIENCE

Unit 4: Cells and Molecules

G623/MS

Mark Scheme

Question	Answer	AO	Mark
1(a)	*Two from:* • size; • em does not view directly; • em uses electrons not light; • em uses vacuum; • em greater magnification.	AO1	**2x1**
1(b)(i)	Nuclear membrane. EPR. Mitochondria.	AO1	**1** **1** **1**
1(b)(ii)	*Two answers to explain that it is an animal cell from:* • lack of cell wall; • absence of chloroplasts; • lots of ER; • lots of mitochondria; • golgi body.	AO1	**2x1**
1(b)(iii)	Size of organelle on emg 7mm; Mag of emg x 25000; therefore 7/25000; 0.00028mm.	AO2	**2**
1(c)(i)	CFTR transports Cl^- out of cell. If faulty, Cl^- ions build up inside cell causing water to enter by osmosis. Mucus on the outside loses water and thickens.	AO1	**1** **1** **1**
1(c)(ii)	Good argument for. Good argument against. Both sides of argument even if not valid.	AO2	**3**
2(a)(i)	- 0.28; 3.47; - 23.15; both minus signs correct.	AO2	**1** **1** **1**
2(a)(ii)	Plots correct. Axes labelled, scale correct, orientation correct. Line of best fit.	AO1	**1** **1** **1**
2(a)(iii)	*Five from:* • distilled water has higher water potential; • than salt solution; • so water enters potato by osmosis; • cell sap has higher water potential than 1.0 M salt solution; • therefore water leaves cell by osmosis; • cell contents plasmolyse. *Quality of Written Communication*	AO2	**5x1** **2**

Question	Answer	AO	Mark
2(a)(iv)	Answers will vary, please read from graph. Ref. to isotonic solutions/net movement of water through membrane is zero.	AO2	**2x1**
2(a)(v)	Salt water hypertonic to potato cell sap. Potato loses water by osmosis. Ref. to plant death.	AO2	**1** **1** **1**
3(a)(i)	8 9 6 8 31	AO2	**3**
3(a)(ii)	31/4 7.75	AO2	**1** **1**
3(a)(iii)	7.75 x 4 000 31 000	AO2	**1** **1**
3(a)(iv)	Less than expected. Reference to anaemia or qualified reason.	AO2	**1** **1**
3(b)	Reference to automation; Coulter counter; Explanation, e.g. uses laser.	AO2	**1** **1** **1**

Total mark available: 45

Analysis of marks:

	AO1	AO2	AO3	Total
Mark	13	32		45

Oxford Cambridge and RSA Examinations

General Certificate of Education

APPLIED SCIENCE
Unit 9: Sampling, Testing and Processing

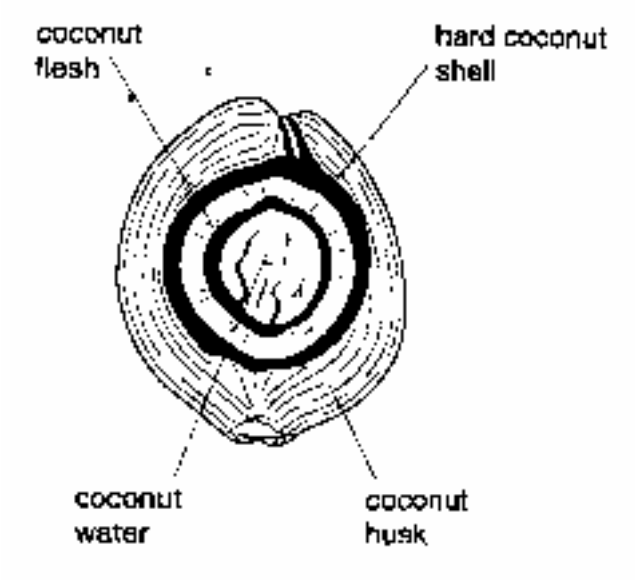
G628/CASE STUDY

Pre-Released Case Study Material

COCONUTS – AN ESSENTIAL COMMODITY

Coconuts are an important raw material in tropical countries. To grow successfully, coconuts need humid conditions with a very high rainfall, a temperature of around 27^{o}C and at least **six** hours of sunshine each day.

The most useful part of the coconut palm is the nut itself. Strictly, the coconut is not a nut, but a dry drupe. The smooth outer skin of the coconut covers the husk, which is a fibrous layer. Beneath this husk, covered by a hard shell, is the 'nut' itself. Until it is mature, the centre contains a clear liquid. On average, a coconut weighs **3** to **4** kg, of which 36% is the husk, 12% is the shell, water makes up another 25% and the rest is the flesh.
The coconut that we buy in the shops is the central part, comprising the shell, flesh and watery liquid.



Coconut fruit

It is very important for a country's economy that all parts of the coconut are used, as far as possible.

The fibrous husk of the coconut is used to produce the fibre coir, which is used for making mats, brushes and stuffing for upholstery. When coir is made, there is a residue of light fluffy material, which has now found a use as a substitute for garden peat.

The flesh of the coconut is dried and then used in confectionery and cakes. Lower grade coconut flesh is dried to a water content of about 5%, producing copra. This material is then treated to extract coconut oil, leaving a solid which is used as an animal feed.
Copra gives about 70% by mass of coconut oil. This oil is used to make soap and sodium lauryl sulphate, which is a 'green' detergent base for many cleaning products.

The third component is the shell. This is used for making ornaments, ladles and buttons. When the coconut shell is heated in a reduced supply of air, charcoal is produced. The charcoal can be used as a fuel or converted to activated carbon.
The activated carbon has many uses. It can be used in nuclear power stations to absorb radioactive gases long enough for their radioactivity to fall to acceptable levels. Other uses for this carbon include the absorbent material in domestic cooker hoods, which removes the smell of cooking. Another use is in producing cigarette filters.

The yield of charcoal is only about 35% and its production causes heavy pollution. No attempt is made to recover volatile by-products. One major by-product is ethanoic acid, which can reach as much as 5% of the mass of the heated shell.

A recent use for coconut shells is to reduce them to a powder and then impregnate them with an insecticide.
When this shell is slowly burnt the insecticide is released over a **seven**-hour period and acts as an effective control over mosquitoes.

The fruiting life of a coconut palm is up to **80** years and the annual production rate can be up to **100** coconuts per tree. In Sri Lanka alone, around **3×10^9** coconuts are produced each year.
The coconut palm is an extremely useful tree and a wide variety of uses have been found for its products. It continues to be an important commodity in humid tropical countries.

KONZO – A CASE OF CYANIDE POISONING FROM FOOD

Konzo has been known for some **seventy** years, but it was not until the 1980s that serious outbreaks occurred in a number of African countries. The symptoms of Konzo are paralysis, difficulty in speaking and hearing, dizziness and vomiting. Although the symptoms disappeared after a few days, many people were left paralysed. Doctors believed that it was an infectious disease, but local people thought that their illness was caused by their diet of cassava.

Cassava is a very important tropical food source. In the tropics, it is the third most important food source after rice and maize. The tuber roots of the cassava plant are dried and made into cassava flour. This material is then mixed with water to form a kind of porridge. Some people eat up to 500g of this cassava porridge every day.

Unfortunately, **one** kilogram of fresh cassava may contain up to 1000mg (1g) of cyanide.

Just 35mg (0.035g) of cyanide is enough to kill an adult.

Some varieties of cassava taste more bitter than others and are less likely to be eaten by monkeys when they is growing in the fields, but these tend to contain higher quantities of cyanide. These bitter varieties of cassava are valued for their drought-resistance and comparatively high yields in poor soil, and are less likely to be attacked by pests, probably because of their higher cyanide content.

The following information is known about the serious outbreaks of Konzo in the 1980s:

- Konzo mainly affected people who ate bitter cassava;
- several members of the same family or village were affected;
- the symptoms of **acute** cyanide poisoning did **not** match those of Konzo;
- the symptoms did match **chronic** cyanide poisoning;
- only some people who had been eating large quantities of cassava developed Konzo;
- apparently, in times of food shortage, the incidence of Konzo increases.

When cassava is properly prepared, a sequence of slow chemical reactions occur which remove cyanide from the cassava.

Measurements have been made of the cyanide levels in cassava flour. The concentration of cyanide present depends on the method of preparation.

Treatment	**Cyanide content / mg kg^{-1}**
Fresh cassava roots	300
Peeled, soaked 1 day, sun-dried 4 days	80
Peeled, sun-dried 7 days	59
Peeled, soaked 3-5 days, sun-dried 7 days	32
Grated, followed by soaking and drying	8

Table 2.1

The World Health Organisation recommends a maximum level of cyanide in cassava flour of 10mg kg^{-1}.

Cyanide ions are slowly converted to thiocyanate ions in the liver and then excreted in the urine. The thiocyanate level in urine gives a measure of the amount of cyanide consumed. Researchers have used a colorimetric method to find the thiocyanate concentrations in the urine of Konzo victims and in a control group. Those who had Konzo showed a blood thiocyanate level **12** times greater than those in the control group.

Some people did not suffer from Konzo even though they had consumed the same quantity of cyanide as those who developed Konzo. These people who were free from Konzo ate more sulphur-containing protein than those who developed Konzo.

One possibility for reducing outbreaks of Konzo is to develop a low-cyanide cassava plant – these exist at present but are less drought-resistant and more susceptible to attack by pests. A more immediate practical approach is to monitor the cyanide content of cassava flour where it is produced and to give advice where necessary on its preparation.

Adapted from Chemistry Review September 1998, v.8 no 1

Oxford Cambridge and RSA Examinations

General Certificate of Education

APPLIED SCIENCE
Unit 9: Sampling, Testing and Processing

G628/TEST

Specimen Paper

Additional materials: None.

TIME 1 hour 30 minutes

Candidate Name	Centre Number	Candidate Number

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the spaces above.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Answer **all** the questions.
- Read each question carefully and make sure you know what you have to do before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **90**.
- Questions 1 and 2 refer to the articles sent to centres as pre-released case study material.
- You will be awarded marks for the quality of your written communication where this is indicated in the question.

Question number	For examiner's use only
1	
2	
3	
TOTAL	

Section 1

The questions in this section refer to the materials supplied to your centre in the pre-released case study. You are supplied with fresh copies at the back of this question paper.

Question 1 is based on the article 'Coconuts – an essential commodity'.

1 **(a)** Sometimes coconuts do not grow well enough to make high grade flesh.
Suggest **three** factors which might prevent coconuts growing well.

Factor 1: _____ **[1]**

Factor 2: _____ **[1]**

Factor 3: _____ **[1]**

(b) The article says that, strictly, a coconut is not a nut but a *drupe*.
State what is meant by the term *drupe*.

_____

_____ **[1]**

(c) Coconut buyers test samples of a farmer's crop before the coconuts are picked from the trees.
How could the buyer be certain that the sample is representative of the whole crop?

_____

_____

_____ **[2]**

(d) A group of students have decided to find the percentages of flesh, shell and water in *bought* coconuts.

(i) Calculate the percentage of coconut flesh in the *whole* coconut as described in the article.

_____

_____ **[1]**

(ii) A student then calculates that the percentage of coconut flesh in a *bought* coconut is 42% by mass.
Use your answer to **1(d)(i)** above to show that this figure is correct.

_____

_____

_____ **[2]**

1 (d) (iii) The students sampled **five** coconuts and reported the percentage of coconut flesh in each coconut. The results are given in **Table 1.1**.

Coconut	1	2	3	4	5
% of coconut flesh	47.8	48.2	48.0	59.0	47.7

Table 1.1

Coconut 4 gave a much higher value than the rest.
Suggest what should be done.

_____

_____ **[1]**

(iv) Suggest **one** factor which may influence the percentage of coconut flesh in the bought coconuts so that higher results are obtained than expected, as shown in **Table 1.1**.

_____

_____

_____ **[2]**

(e) (i) How might you obtain oil from a coconut? List the **three** most important stages.

Stage 1: _____ **[1]**

Stage 2: _____ **[1]**

Stage 3: _____ **[1]**

(ii) The article states soap is made from coconut oil. In industry, soap is made by heating coconut oil with concentrated sodium hydroxide solution.
If you were to make soap from coconut oil in the laboratory using a standard method, state what you should do before you attempt this experiment.

_____

_____ **[1]**

1 **(e)** **(iii)** In the laboratory, soap is made from coconut oil by the following method.
'A known volume of coconut oil is placed in a flask and the required quantity of concentrated aqueous sodium hydroxide solution is added. The flask is then covered with a loose fitting lid and the mixture heated to boiling using a Bunsen burner. After boiling for some time the mixture is cooled and strong salt water is added. The soap floats to the surface and is skimmed off using a spatula, washed and dried. The co-product of the reaction, glycerol, remains in the liquid and is discarded.'
If this method is to be modified so that soap can be produced on a larger scale, suggest **four** ways in which the method should be altered.

Way 1: _____ **[1]**

Way 2: _____ **[1]**

Way 3: _____ **[1]**

Way 4: _____ **[1]**

(f) The results from the analysis of some copra samples from different areas are given in **Table 1.2**.

Sample	Mass of copra/g	Mass of coconut oil obtained/g	% coconut oil
A	3.71	2.43	65.5
B	3.82	2.60	68.1
C	3.95	2.63	66.6
D	4.21	3.07	72.9
E	4.60	2.99	

Table 1.2

(i) Calculate the percentage of coconut oil in sample **E**, to **one** decimal place, recording your answer in the table. **[2]**

(ii) Calculate the average (mean) value for the percentage of coconut oil in these **five** samples.

_____

_____ **[1]**

(iii) A student suggested using 0.4g of copra to analyse the oil content.
Explain why 0.4g is an *unsuitable* quantity to use for the analysis of its oil content.

_____

_____

_____ **[2]**

1 **(g)** The article mentions an experiment in which slow burning of the powdered impregnated shell gives **seven** hours protection from mosquitoes.
What information would you want to know about this experiment so that you could repeat it?

_____

_____

_____

_____

_____

_____ **[4]**

(h) **(i)** The mass of a coconut shell is 350g. On heating, 5% of this mass is converted to ethanoic acid which is released into the air.
Sri Lanka produces **3×10^9** coconuts in a year.
Assuming that each coconut shell has a mass of 350g and that 5% of this mass is converted, on heating, to ethanoic acid, calculate the total mass of ethanoic acid lost to the atmosphere each year in Sri Lanka.

_____

_____

_____ **[2]**

(ii) Suggest how the process of heating the powdered coconut shell to produce charcoal and ethanoic acid could be made more economical.

_____

_____

_____ **[2]**

Question 2 is based on the article 'Konzo – a case of cyanide poisoning from food'.

2 **(a)** What information suggested that the outbreaks of Konzo might be due to an infectious disease?

_____

_____ **[1]**

(b) Raw cassava is very toxic.
Calculate how much raw cassava is a **fatal dose**. Assume that 1kg of the material contains 1000mg of cyanide.

_____

_____ **[1]**

(c) Suggest **one** reason why bitter cassava is preferred by farmers to other varieties of cassava.

Reason: _____ **[1]**

(d) The article suggests that Konzo is a form of *chronic* cyanide poisoning.

(i) Distinguish between the **two** terms *chronic* and *acute*.

_____

_____

_____ **[2]**

(ii) Suggest **two** reasons why the incidence of Konzo increases at times of food shortage.

Reason 1: _____ **[1]**

Reason 2: _____ **[1]**

(iii) **Table 2.1** shows the cyanide content in fresh cassava and in samples of prepared cassava.
Using the data in the table, deduce how the cyanide content of cassava is reduced to an acceptable value of 10mg kg^{-1}, as recommended by the World Health Organisation.
Your answer should refer to both the method(s) and the time taken.

_____

_____

_____ **[2]**

2 **(e)** People who eat a cyanide-free diet get rid of sulphur by excreting *sulphate ions* in their urine.
Explain why people who developed Konzo excreted less sulphur as *sulphate ions* in their urine.

[1]

(f) *In this part of the question, **two** marks are available for the quality of your written communication.*
Testing urine for thiocyanate ions is an important way of identifying chronic cyanide poisoning. Thiocyanate ions give a red colour with aqueous iron(III) ions. Measurements of the intensity of this colour give a value of the thiocyanate concentration present. The intensity of the colour can be measured by eye, or by using a colorimeter.
Describe how you would set up an experiment which gives information about the concentrations of solution from their colour.

[4]

Quality of Written Communication **[2]**

2 **(g)** *In this part of the question, **two** marks are available for the quality of your written communication.*

Local health workers travel to villages to test samples of cassava flour for their cyanide content. For this purpose, a special test kit has been prepared. **One** test for cyanide involves adding iron(II) sulphate solution and heating. Adding iron(III) chloride to this heated mixture gives a blue colour if cyanide is present.

Give **three** factors, other than cost, that must be considered when developing this test kit and then discuss the items which you would need to include in this special test kit so that this test can be carried out.

[9]

Quality of Written Communication **[2]**

(h) If a new, low-cyanide cassava plant is developed, what are **two** essential features that the plant should have?

Feature 1: **[1]**

Feature 2: **[1]**

Section 2

Question 3 is based on the following situation.

A group of students are studying the history of lead mining in the Peak District of Derbyshire.

As part of their course, they visited several localities to study the geology of the area and collect samples from the spoil heaps of several disused mines. They took the samples back for further investigation in the laboratory.

The age at which lead mineralisation occurred can be estimated by looking at fossils in the surrounding sedimentary rocks. Samples of these fossils were collected for later study. These were obtained by using a hammer and chisel to remove the fossil from the rock.

3 (a) (i) Suggest **two** precautions which should have been taken when collecting these fossils.

Precaution 1: _____ **[1]**

Precaution 2: _____ **[1]**

(ii) The collected fossils were stored in labelled bags.
What should have been written on the label?

_____

_____ **[1]**

(iii) Suggest why it was important **not** to collect fossils, for this purpose, from fallen rocks.

_____

_____ **[1]**

(b) As well as collecting fossils, samples of lead ore (galena) were collected from the spoil heaps of disused mines. This ore was **not** contaminated with other material.
The samples were taken back to the laboratory and analysed for their lead content.
They did **not** give the expected percentage of lead.

Assuming that the analytical method was correct, suggest **two** reasons for this variation.

Reason 1: _____ **[1]**

Reason 2: _____ **[1]**

3 **(c)** Much of the galena was contaminated with the mineral barytes. A student remembered that a simple graphical method could be used for finding the percentage of galena present in these contaminated samples.

(i) State **two** different ways by which the student could find the details of this method.

Method 1: _____ **[1]**

Method 2: _____ **[1]**

(ii) The graph below, **Figure 3.1**, shows how the density of these impure galena samples is related to the percentage of galena present.

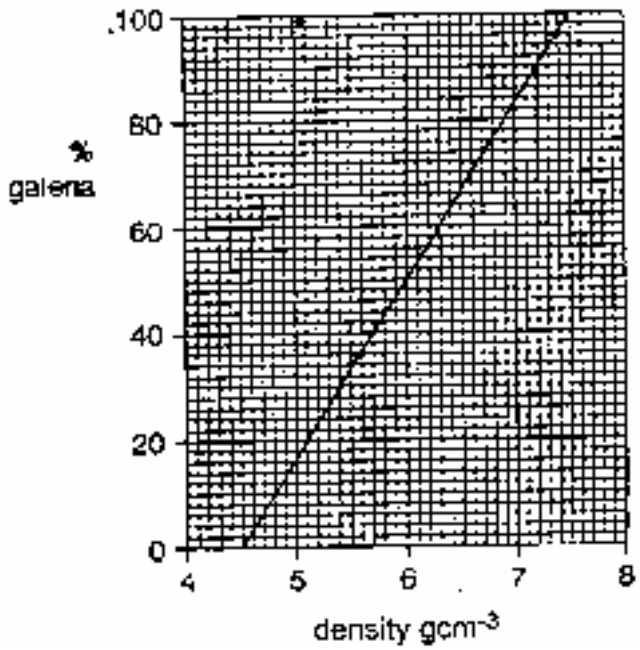


Figure 3.1

Use the graph to find the density of:

pure galena: _____ gcm^{-3} **[1]**

barytes: _____ gcm^{-3} **[1]**

3 (c) (iii) The density of a sample of impure galena is found by measuring its mass and then immersing the sample in water in a large measuring cylinder to find its volume.

The volume of a sample of mass 56.7g is 9cm^3.

You are reminded that density is measured in g dm^{-3}.

Use **Figure 3.1** (on page 11) to calculate the percentage of galena in this sample.

[2]

(iv) Discuss the number of significant figures that should be given in the percentages of galena in the samples.

[2]

(d) **One** way of separating barytes from galena is to grind the material to produce small particles and then put the ground-up material into a liquid of suitable density. The galena will sink and the barytes will float.

(i) Suggest why the particles have to be small.

[1]

(ii) Suggest a suitable value for the density of the liquid.

gcm^{-3} **[1]**

3 (d) (iii) The mass of lead obtainable from pure galena is given by the formula:

$$\text{mass of lead} = \frac{\text{mass of galena} \times 207}{239}$$

A 20g sample from the spoil heap has a density of 7.0gcm^{-3}.

Use **Figure 3.1** (on page 11) to calculate the mass of **lead** in this 20g sample.

[3]

3 **(e)** The students decided to extend their study and investigate ways of extracting the lead from its ore. They researched the literature and found that a number of methods have been used to extract lead from galena.
State **three** factors which must be considered before they chose a method to extract lead from its ore in the laboratory.

Factor 1: _____ **[1]**

Factor 2: _____ **[1]**

Factor 3: _____ **[1]**

(f) The method which they chose is outlined below.
'A weighed sample of powdered galena is placed in a crucible and heated in air.
The galena (lead sulphide) is oxidised to solid lead oxide and gaseous sulphur dioxide.
After cooling, the solid lead oxide is mixed with carbon and the mixture again heated strongly, using a crucible equipped with a lid. Carbon monoxide and carbon dioxide are lost as gases and liquid lead is formed at the bottom of the crucible.
After cooling the lead is removed and weighed.'

(i) State why this method **must** be carried out in the fume cupboard.

_____

_____ **[1]**

(ii) Suggest why the lead obtained in this method is likely to be impure.

_____

_____ **[1]**

(iii) Suggest **two** changes which should be made to this method if it is to be used for the pilot scale extraction of lead.

Change 1: _____ **[1]**

Change 2: _____ **[1]**

(iv) In practice, both zinc and lead are found together as ores and the reduction process outlined produces both lead and zinc. However, lead is produced as a liquid and zinc is produced as a vapour. The melting and boiling points of both zinc and lead are given in **Table 3.1**.

	Melting point/^{o}C	**Boiling point/^{o}C**
Lead	327	1744
Zinc	420	907

Table 3.1

Suggest and explain a temperature at which this process operates.

Temperature: _____ ^{o}C

Explanation: _____

_____ **[2]**

Oxford Cambridge and RSA Examinations

General Certificate of Education

APPLIED SCIENCE

Unit 9: Sampling, Testing and Processing

G628/MS

Mark Scheme

Question	Answer	AO	Mark
1(a)	*Three from:* • not enough rainfall; • temperature too high/low; • not enough sunshine; • low humidity; • not enough nutrients.	AO1	**3x1**
1(b)	A fruit with a stone.	AO2	**1**
1(c)	*Two from:* • from more than **one** tree; • of similar growth period OR similar size/mass; • free from disease; • appropriate sample size.	AO2	**2x1**
1(d)(i)	27%.	AO1	**1**
1(d)(ii)	Percentage of shell + water + flesh = **64**. % flesh in bought coconut = 27/64 x 100 = **42**	AO2	**1** **1**
1(d)(iii)	Check the readings.	AO1	**1**
1(d)(iv)	The % of water depends on the maturity of the coconut. If ripe the % of water will be less and the % of flesh will be therefore higher.	AO1 AO2	**1** **1**
1(e)(i)	Husk removed/shell broken/coconut water removed. Flesh dried. Milled/pressed/squeezed.	AO1(2) AO2(1)	**3x1**
1(e)(ii)	Do a risk assessment.	AO1	**1**
1(e)(iii)	Larger volume vessel/not a flask. Alternative method of heating/steam heating. A different method of soap removal. Glycerol recovered/use for glycerol.	AO1 AO2	**4x1**
1(f)(i)	**65.0** (2) correct answer (1) to 1 decimal place(1)	AO1 AO2	**1** **1**
1(f)(ii)	**67.6**	AO2	**1**
1(f)(iii)	Quantity is too small. Could lead to greater % errors in weighing.	AO1 AO2	**1** **1**

Question	Answer	AO	Mark
1(g)	*Four from:* • volume of the room; • effective slow/constant burning for **seven** hours; • mosquitoes allowed free access to test, restricted exit; • need to repeat test under identical conditions; • ventilation rate; • mass of powder used; • quantity of insecticide present.	AO1 AO2	**4x1**
1(h)(i)	• Mass of ethanoic acid from one coconut = 17.5g • Total mass of ethanoic acid for 3x109 coconuts = 3x109x17.5g = 5.25x1010g/5.25x107kg/5.25x104 tonnes.	AO1 AO2	**1** **1**
1(h)(ii)	The ethanoic acid should be recovered; and a use found for it.	AO1	**1** **1**
2(a)	Several members of the same family/village were affected.	AO1	**1**
2(b)	1g cyanide in 1000g / 1kg 1000mg in 1000g ∴ 35mg in 35g / more than 35g	AO2	**1**
2(c)	*One from:* • not attacked by pests; • eaten by monkeys; • drought resistant.	AO1	**1**
2(d)(i)	Chronic – an illness/symptom which goes on for a period of time. Acute – a sudden illness, producing major changes, even death.	AO2	**1** **1**
2(d)(ii)	Increased reliance on cassava. Insufficient cooking time.	AO1 AO2	**2x1**
2(d)(iii)	Soaked, for more than **5** days. Sun-dried for more than **7** days.	AO1 AO2	**1** **1**
2(e)	The sulphur combined with the cyanide ions giving thiocyanate ions.	AO2	**1**
2(f)	A range of solutions; of known concentration. Prepares colour chart/graph from (standard) solutions. Compares colours with standards. *Quality of Written Communication:* candidate uses technical language in the correct context.	AO1(3) AO2(3)	**4x1** **2x1**

Question	Answer	AO	Mark
2(g)	Whether the test is: • accurate; • simple/easy to operate; • 'safe'.	AO1(2) AO2(1)	**3x1**
	Then six from: • test tubes/beaker; • spirit burner etc.; • bottles of reagents; • iron(II) sulphate; • iron(III) chloride; • colour chart; • pen/paper; • scoop/measuring device; • white card; • safety goggles.	AO1(4) AO2(2)	**6x1**
	Quality of Written Communication: candidate uses correct spelling and grammar.	AO1 AO2	**2x1**
2(h)	*Two from:* • able to withstand drought/more drought resistant; • resistant to pests; • gives a good yield; • comparable in price to existing plants; • flour safe to eat.	AO1 AO2	**2x1**
3(a)(i)	*Two from:* • wear safety glasses; • do not collect from overhangs/unstable areas.	AO1 AO2	**2x1**
3(a)(ii)	The location.	AO1	**1**
3(a)(iii)	It is not clear where they have come from.	AO1	**1**
3(b)	*Two from:* • samples may have weathered/leached/oxidised; • samples may not be representative.	AO1 AO2	**2x1**
3(c)(i)	*Two from:* • asking colleagues/teachers; • looking in the written literature; • electronic means.	AO1	**2x1**
3(c)(ii)	7.5 (gcm^{-3}). 4.5 (gdm^{-3}).	AO1 AO2	**1** **1**

Question	Answer	AO	Mark
3(c)(iii)	Density = $\frac{56.7}{9}$ = 6.3 (gcm^{-3}) % of galena = 60.	AO1 AO2	**1** **1**
3(c)(iv)	The answer cannot be given to 1 decimal place/three significant figures; because the volume is only accurate to the nearest cm^3	AO2	**1** **1**
3(d)(i)	To ensure that each particle consists solely of **one** mineral.	AO2	**1**
3(d)(ii)	Any value > 4.5 and < 7.5 *[consequent on **3(c)(ii)**]*	AO2	**1**
3(d)(iii)	From the graph a density of 7.0gcm^{-3} contains 83% galena. 83% of 20g is 16.6g. Mass of lead = $\frac{16.6 \times 207}{239}$ = 14.4g	AO2	**1** **1** **1**
3(e)	*Three from:* • whether it is safe; • whether it is feasible; • whether the yield will be acceptable.	AO1(1) AO2(2)	**3x1**
3(f)(i)	Toxic gases are produced.	AO1	**1**
3(f)(ii)	Not all the lead sulphide has been oxidised/not all the lead oxide has been reduced/the product is contaminated with carbon.	AO1	**1**
3(f)(iii)	*Two from:* • there should be a method of trapping sulphur dioxide/gaseous products; • a method for running off molten lead; • other suitable examples.	AO1 AO2	**2x1**
3(f)(iv	Any temperature > 907^oC and < 1744^oC; as the zinc will be a vapour and the lead will be a liquid.	AO2	**1** **1**

Total mark available: 90

Analysis of marks:

AO1 45 marks

AO2 45 marks

Oxford Cambridge and RSA Examinations

General Certificate of Education

APPLIED SCIENCE
Unit 16: Working Waves

G635/TEST

Specimen Paper

Additional materials: None.

TIME 1 hour 30 minutes

Candidate Name	Centre Number	Candidate Number

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the spaces above.
- Write your answers, in blue or black ink, in the spaces provided on the question paper.
- Answer **all** the questions.
- Read each question carefully and make sure you know what you have to do before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **90**.
- You will be awarded marks for the quality of your written communication where this is indicated in the question.

Question number	For examiner's use only
1	
2	
3	
4	
5	
6	
TOTAL	

1 **(a)** An engineer investigating the possibility of using wave power to generate electricity investigates the frequency and wavelength of the waves on the surface of the sea. Explain what is meant by the terms frequency and wavelength.

Frequency: _____

_____

_____ **[2]**

Wavelength: _____

_____

_____ **[2]**

(b) Waves may be either longitudinal or transverse. Explain the difference between the terms longitudinal or transverse with particular reference to sound waves and microwaves.

_____

_____

_____

_____

_____

_____ **[4]**

(c) When ripples travel along the surface of water the displacement of the wave is the vertical height of the surface relative to its undisturbed position.
State what the displacement is, in the case of electromagnetic waves.

_____

_____ **[1]**

(d) Electromagnetic waves can be produced by radio transmitting aerials. A typical aerial consists of a metal rod. Electrons move up and down inside the rod.
Explain how this gives rise to the displacements you have identified in **1(c)**.

_____

_____

_____

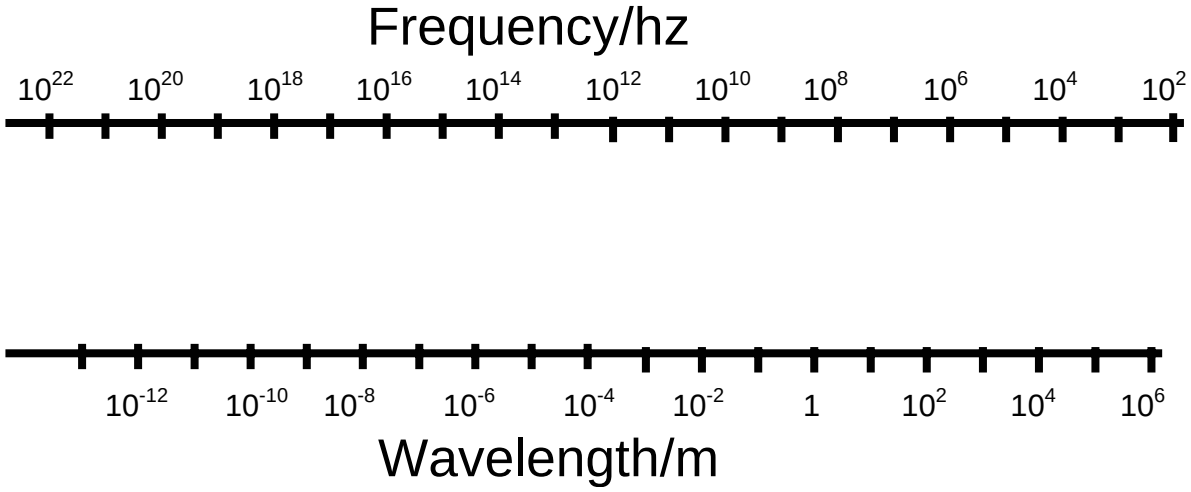
_____

_____ **[3]**

1 **(e)** Radio waves can reach us from distant spacecraft, even when there is a vacuum between the spacecraft and the earth.
Explain why radio waves can cross a vacuum, but not sound.

[3]

(f) The diagram below shows the range of frequencies of the electromagnetic spectrum with the corresponding wavelengths below.



(i) On the diagram, indicate the regions corresponding to radio waves, visible light and gamma radiation. **[3]**

(ii) Calculate the velocity of light in a vacuum from these scales, explaining your working.

[4]

2 Thermography is used by doctors to detect circulation problems in patients.

(a) What part of the electromagnetic spectrum is used in thermography?

_____

_____ **[1]**

(b) Sketch **two** graphs on the same axes to show the spectra of radiation emitted by **two** parts of the body at different temperatures. Your axes should be labelled, but no scale is required.

[6]

(c) Detectors used in thermography are often cooled in liquid nitrogen.
Explain the reason for this.

_____

_____

_____

_____

_____ **[3]**

2 **(d)** Give **one** non-medical example of the use of this form of imaging

[1]

3 **(a)** *In this part of the question, **two** marks are available for the quality of your written communication.*
Describe, with the aid of a diagram, an experiment you have done to measure the critical angle of a sample of glass.
Indicate how the refractive index can be calculated from the result of your experiment.

[9]
Quality of Written Communication **[2]**

(b) An instrument manufacturer wishes to increase the critical angle for the interface between a glass component and air. To do this he decides to use a different kind of glass.
State in what way the properties of the new glass should differ from the original and explain why this changes the critical angle.

[3]

3 **(c)** Give **one** advantage of fibre optic transmission compared to conventional electrical signals along wires.

_____

_____ **[1]**

(d) Explain what you understand by the term step-index applied to a glass fibre used for data transmission.

_____

_____

_____ **[2]**

(e) Sketch graphs to show the shape of a square wave signal as it enters and leaves a step-index optical fibre.

[4]

4 **(a)** A local pop radio station calls itself Pop – FM. Radio 5 broadcasts on AM.

(i) What do the terms FM and AM stand for?

FM: _____ **[1]**

AM: _____ **[1]**

(ii) Explain how the principles of FM and AM differ

_____

_____

_____

_____

_____

_____ **[4]**

(b) **Diagram 4.1** below shows a simple analogue signal. It is sampled **eight** times per cycle.

(i) Sketch the sampled pulses on the graph.

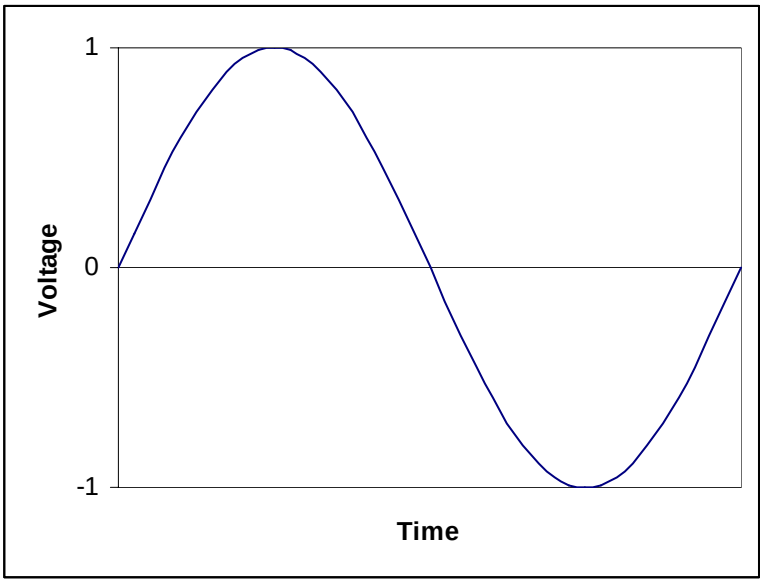


Diagram 4.1

[3]

4 **(b)** **(ii)** The pulses are then converted to a 3-bit binary code.

1 State the highest binary code possible with 3 bits.

_____ **[1]**

2 State the binary code for the first level above zero.

_____ **[1]**

(c) One binary-coded signal starts 001, 101, 011.
Sketch the corresponding digital waveform.

[2]

(d) State why it is better to send pulses of the same amplitude, rather than pulses of varying amplitude.

_____

_____

_____ **[2]**

5 A mobile phone is moved away from a base station. As a result, the signal intensity falls to one-sixteenth of its original value.

(a) What is the maximum ratio by which the distance of the mobile phone from its base station has increased?

[3]

(b) In cities, base stations are often very close together. Suggest **two** reasons for this.

Reason 1: **[1]**

Reason 2: **[1]**

6 X-rays are used extensively for medical diagnosis, but are also potentially hazardous.

(a) One device used to reduce the intensity of X-rays is an intensifying screen.

(i) Sketch a labelled diagram showing the layers in a cassette with intensifying screens.

[4]

6 **(a)** **(ii)** Explain briefly how the screens enable the intensity of the X-rays used to be reduced.

[5]

(b) *In this part of the question, **two** marks are available for the quality of your written communication.*
Outline what other precautions are taken to monitor and reduce the effect of X-rays on hospital staff.

[5]

Quality of Written Communication **[2]**

Oxford Cambridge and RSA Examinations

General Certificate of Education

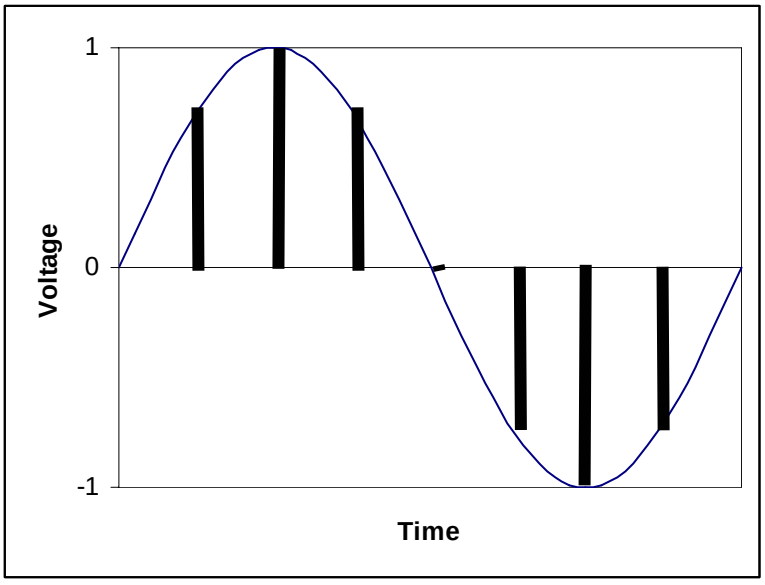
APPLIED SCIENCE
Unit 16: Working Waves

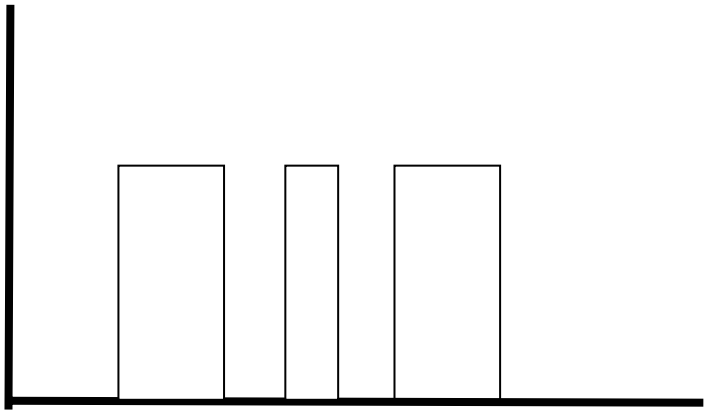
G635/MS

Mark Scheme

Question	Answer	AO	Mark
1(a)	Frequency is the number of cycles/waves/crests per sec/unit time; passing a point. Wavelength is the distance between **two** peaks/troughs/ equivalent points on successive waves; at a given time.	AO1	**1** **1** **1** **1**
1(b)	Sound waves are longitudinal; microwaves are transverse; longitudinal waves have displacement/movement (of air molecules) in the same direction as the wave/propagation; transverse waves have displacement/movement at right angles to the direction of the wave/propagation.	AO1 AO2 	**1** **1** **1** **1**
1(c)	Electric field (vector) and/or magnetic field (vector).	AO1	**1**
1(d)	*Three from:* • electric charge creates electric field; • moving charge causes changing electric field; • moving charge is a current; • current creates magnetic field; • changing magnetic field causes e.m.f/electric field.	AO2	**3x1**
1(e)	Sound waves require a medium/air to move in. Electric/magnetic fields can exist in a vacuum. Since electromagnetic waves consist of changing electric/ magnetic fields they can be detected across a vacuum or words to that effect.	AO2	**1** **1** **1**
1(f)(i)	Radio waves – accept any range of wavelengths from 10m upwards. Visible light - accept any range of wavelengths from 10^{-7} to 10^{-6}m. Gamma radiation - accept any range of wavelengths below 10^{-10}m.	AO1	**1** **1** **1**
1(f)(ii)	$v=f\lambda$ applied to readings in region to 10^{-7} to 10^{-6} m wavelength/ statement that readings at any point will give same result because all regions of spectrum have same velocity/speed (in vacuum); appropriate values substituted; $v = 3 \times 10^8$ m s^{-1} (accept any value correctly calculated between 1×10^8 and 1×10^9 m s^{-1}).	AO2	**1** **1** **1** **1**

Question	Answer	AO	Mark
2(a)	Infra-red.	AO1	**1**
2(b)	Vertical axis labelled intensity. Horizontal axis labelled frequency of wavelength. At least **one** curve peaking other than at the ends. **One** curve lower than the other at all frequencies. Indication that higher curve corresponds to warmer part of body. Warmer curve skewed to higher frequencies/lower wavelengths.	AO1 AO2 	**1** **1** **1** **1** **1** **1**
2(c)	To reduce unwanted signals; current from (photoconductor) detects is small/signal to noise ratio is high; if surroundings are cooled they produce less noise.	AO2	**1** **1** **1**
2(d)	*One from:* • to detect disturbed ground; • night sights; • weapon systems; • burglar alarms; • electric circuit fault detection; • non-destructive testing; • remote sensing from satellites; • detecting survivors in collapsed buildings; • any other appropriate example.	AO1	**1**
3(a)	*Diagram shows:* • semicircular block of glass, or alternative means of controlling angle between internal ray and surface; • mechanism to trace path of rays e.g. light box or pins; • totally internally reflected ray shown; • critical angle correctly marked. *Description shows:* • incident ray meets surface inside glass; • angle of incidence adjusted until emerging ray just disappears; • measure critical angle; • means of defining path of ray. (e.g. marking ends of ray on paper, removing block and drawing line); • means of measuring angle (protractor or sides of triangle + trig.) *Quality of Written Communication*	AO1(3) AO2(1) AO1(3) AO2(2) AO2	**4x1** **5x1** **2**
3(b)	Different refractive index/velocity of light in glass; higher refractive index/lower velocity of light in glass; because sin C = 1/n **or** glass entering surface at grazing incidence will have a greater angle of refraction inside prism or words to that effect.	AO2	**1** **1** **1**

Question	Answer	AO	Mark
3(c)	*One from*: • very large information capacity; • low material costs; • small cable size; • negligible crosstalk; • high immunity to interference; • complete electrical isolation; • large repeater spacings.	AO1	**1**
3(d)	*Refractive* index; changes suddenly between central core and sheath/outer layer.	AO1 AO2	**1** **1**
3(e)	Enters: square pulse drawn; leaves: curve; broader; lower.	AO1	**1** **1** **1** **1**
4(a)(i)	FM Frequency Modulated; AM Amplitude Modulated.	AO1	**1** **1**
4(a)(ii)	Carrier wave; AM the amplitude/size/height of the wave varies in accordance with the audio signal being transmitted; FM frequency of the wave varies in accordance with the audio signal being transmitted; FM gives better quality because it is less susceptible to noise.	AO2	**1** **1** **1** **1**
4(b)(i)	 Vertical lines representing pulses; 8 or 9 lines equally spaced horizontally; from time axis to curve.	AO2	**3x1**

Question	Answer	AO	Mark
4(b)(ii)	111 001	AO2	**1** **1**
4(c)		AO2	**2**
4(d)	Pulse height may be reduced due to attenuation; if all pulses are the same height this will not result in a loss of information.	AO2	**1** **1**
5(a)	Inverse square law mentioned or applied. $\frac{r}{R} = \sqrt{\frac{I_R}{I_r}}$ $= 4$ *[Full credit given for correct answer only]*	AO2	**1** **1** **1**
5(b)	Obstructions reduce range. There is a limit to the number of calls that can be carried by **one** station/frequency/lots of people in same area may wish to use network.	AO2	**1** **1**
6(a)(i)	Film layer + adjacent intensifying screen layer shown and labelled. Second screen layer on other side of film & labels indicating front and rear screens. Front and rear cassettes shown. Cassette material indicated (plastic front, metal rear).	AO1	**1** **1** **1** **1**

Question	Answer	AO	Mark
6(a)(ii)	*Five from*: • some of X-rays pass straight through film without interacting; • indication that this is a large proportion; • light photons more readily absorbed; • intensifying screens are fluorescent; • convert X-ray energy into light; • image is produced by combined effect of light and X-rays; • most of image is produced by light; • less X-ray intensity needed to produce visible image.	AO1	**5x1**
6(b)	*Five from:* • wear film badges; • individual exposure should not exceed recommended limits; • all exposures should be kept As Low As Reasonably Achievable (ALARA); • wear lead aprons; • stand behind screens/leave room; • keep distance; • reduce exposure time; • work in controlled areas; • hazard signs/lights to keep out other staff; • equipment checked regularly; • don't take X-rays unless there is a net benefit; • codes of practice; • other appropriate precautions. Clear wording using technical terms appropriately.	AO1	**5x1**
	Quality of Written Communication	AO2	**2**

Total Mark Available: 90

Analysis of marks:

	AO1	AO2	Total
Mark	44	46	90
%	49%	51%	100%