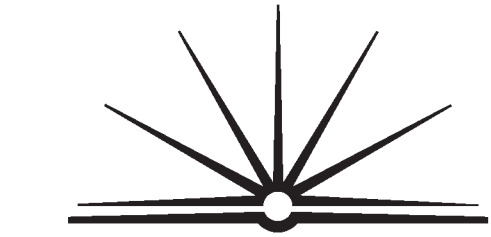

BOARD OF STUDIES
NEW SOUTH WALES

1998
Trial School Certificate Test Report

Science

Includes:

- **Marking guidelines**
- **Markers' comments**
- **Sample responses**
- **Test statistics**

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1 A Standards-referenced Approach to the School Certificate

Introduction

School Certificate grades, prior to 1998 were awarded to candidates for each of their courses in English, Mathematics and Science, on the basis of internal school assessment, moderated by the School Certificate Reference Tests. Across the State, grades were awarded for each course in accordance with a predetermined pattern.

The Reference Test in Science compared each candidate's performance to every other candidate's performance in that test. A rank order could then be established and used to allocate the predetermined set of grades for schools to distribute. This is a norm-referenced approach.

By only comparing one candidate with another, reporting was limited to stating where a particular candidate's performance was positioned in relation to the entire candidature for that course. This did not allow for comparisons with explicit standards.

The New South Wales Government's White Paper *Securing Their Future* recognised the limitations of a norm-referenced model and recommended that the tests be reported 'against standards achieved by students'.

This shift to a standards-referenced approach means that, instead of candidates being compared to each other, their performance will now be compared to a set of standards described in bands on a performance scale.

There is no predetermined distribution of candidates into each of the bands used to report performance on the Trial School Certificate Science Test or future School Certificate Science tests. The distribution is determined by the candidates demonstrating what they know and are able to do on the test.

The advantage of this new system of marking and reporting is that a much more detailed report of student achievement can be communicated to students, parents, schools and the community. Comparisons of the achievement of standards can also be monitored over time.

Setting Standards in Science

The setting of standards in Science in 1998 proceeded through a series of closely monitored stages.

Draft band descriptions were constructed by expert teachers who analysed candidate performance in previous School Certificate Science tests.

The process of aligning raw marks to performance levels is described below:

A committee of experienced Science teachers, consisting of the Supervisor of Marking and the Senior Markers, and incorporating the Test Committee, carefully read and discussed the band descriptions. Individually they then went through the 1998 Science test, question by question and recorded what they would expect a typical candidate at the 'borderline' of each band to

score. Following this, they discussed their judgements for each question, revising their individual estimates where appropriate. Next, statistics were provided to the teachers in a form that facilitated comparisons of candidate ability and item difficulty. They had the opportunity, once again, to revise their judgements in light of these statistics. Finally, when the group cut-off scores for each band were calculated, scripts at or about these scores were examined by a sub-committee to check whether the performance shown in the test was as described in the band description. The cut-off scores were modified as appropriate.

This process enabled the candidates' performances to be aligned to the descriptions in the performance bands.

This process was monitored closely by a consultative committee consisting of academic experts and Board members to ensure the integrity and consistency of the process.

2 Reporting the Trial School Certificate Science Test

As part of the changes to the School Certificate adopted by the New South Wales Government, the candidates' achievements are reported against standards. These standarts are summarised in statements that describe what candidates, typically, know and understand, and can do at six different levels, or bands. Band 6 is the highest performance level, and candidates in this band attained marks between 90 and 100. The next level of performance is band 5, and candidates reported in this band achieved marks between 80 and 89, and so on.

A mark of 50 corresponds to the minimum standard expected. Candidates reported in band 1 achieved below that standard in the 1998 Trial School Certificate Science Test.

The band descriptions were used both to set standards and to report candidate achievement.

3 Overview of the 1998 Trial School Certificate Science Test

In 1998, 67 293 candidates from 634 schools presented for the Trial School Certificate Test in Science. This represented 83% of Year 10 candidates and 79% of schools in NSW.

The 1998 Trial School Certificate Science Test was significantly different from School Certificate Reference Tests administered from 1990 to 1997. While the Reference Tests were limited to testing skills and processes in science, the Trial Science Test covered knowledge and scientific literacy, as well as a wide range of analytical, interpretive and communication skills. Approximately one third of the test required knowledge of Science. The test also encompassed a broader range of question types designed to span the range of candidates' abilities in this subject and to cater for a variety of learning styles.

The test consisted of two sections worth equal marks. Section 1 consisted of thirteen multiple choice questions worth one mark each and twelve computer scanned short response questions (mostly single word or number responses) worth one mark each. Section 2 consisted of four longer written response questions. These questions were worth four, five, seven and nine marks respectively. The time allowed for the test was 1.5 hours.

4 Test Statistics

The table below shows the cumulative percentage of candidates in each Band.

1998 Trial School Certificate Science Test
Cumulative Percentage of Candidates in Each Band

Borderline	Borderline marks	Cumulative % (approx)	
5/6	90	Band 6	4
4/5	80	Band 5 and above	19
3/4	70	Band 4 and above	44
2/3	60	Band 3 and above	72
1/2	50	Band 2 and above	96
	0		100

The table below shows a measure of the difficulties of each question in Section 1 of the Trial School Certificate Science Test. For ease of interpretation, the questions have been placed in one of nine groups. Group 1 contains the easiest questions and Group 9 the most difficult questions.

1998 Trial School Certificate Science Test Table of Question Difficulties

Group		Questions
1	Easiest	6, 17, 7, 21
2		1, 12
3		5, 11, 15
4		2, 3, 4, 8, 9, 10, 19
5		13, 18, 24
6		20, 22
7		14
8		25
9	Most difficult	16, 23

The table below indicates the questions that the typical candidate in each band answered correctly. The typical student in each band was generally able to correctly answer all questions in the bands below as well.

1998 Trial School Certificate Science Test
Items generally answered correctly by students placed in each performance band

Band	Questions answered correctly by typical candidate
6	25, 26
5	14, 22, 27
4	13, 18, 20, 29
3	2, 3, 4, 8, 9, 10, 11, 19, 24, 28
2	1, 5, 7, 12, 15, 21
1	6, 7, 17

Questions 16 and 23 were generally answered correctly only by students at the top of band 6.

The table below indicates the mark achieved by the typical student at the lower cut-off mark for each band in Section 2 of the test.

1998 Trial School Certificate Science Test
Marks typically achieved on Questions 26–29 by students whose test mark equalled the borderline between two bands

Question	Band 1/ Band 2	Band 2/ Band 3	Band 3/ Band 4	Band 4/ Band 5	Band 5/ Band 6
26	0	0	0	2	2
27	0	0	3	3	3
28	2	4	5	6	6
29	1	3	5	7	8

5 Test Item Descriptors

The table below provides an Item Descriptor for each question in the test.

1998 School Certificate Science Test Item Descriptors

Question	Descriptor
1*	Recall knowledge on seismic waves OR recall plus application to seismic waves.
2*	Read a pictorial code and apply the knowledge of conservation of atoms in a chemical change.
3*	Recall a definition of mixtures and apply this to a pictorial representation of mixtures.
4*	Read and extract information from a multiline graph (juggling balls).
5*	Interpret a multiline graph to evaluate the correctness of a series of statements (juggling balls).
6*	Follow a flowchart to identify an unknown ion from a written description.
7*	Extract information from written material – no interpretation required.
8*	Extract information from written material – comprehension and interpretation required.
9*	Recall of practical experience OR interpret tables to make a deduction (electrostatics).
10*	Analyse a rock cycle diagram and recall knowledge of metamorphism.
11*	Interpret a complex diagram to identify the correct hypothesis from given experimental results.
12*	Interpret a food web to make a prediction.
13*	Recall knowledge that plants start food webs OR recall that phytoplankton are plants.
14*	Recall knowledge of the materials necessary for photosynthesis.
15*	Recall knowledge of the source of energy for photosynthesis.
16*	Determine and apply a scale to calculate diagonal fault movement.
17*	Sequence diagrams (continental drift).
18*	Recall knowledge of the length of a human pregnancy and the Earth's orbit, then synthesise and apply both to a diagram.
19*	Substitute data in a given mathematical formula to calculate acceleration.
20*	Apply knowledge of conservation of mass to a practical situation (reading a balance).
21*	Correlate information contained in a complex table and sector graph.
22*	Recall knowledge of examples of renewal resources and then extract the information from a table.
23*	Recall knowledge of moon phases and by applying to given data, predict the appearance of moons from Mars (spatial exercise).
24*	Read a line graph with dual X axes (pH).
25*	Interpret a complex bar graph, table and line graph, and apply data obtained to solve a problem.
26a	Recall knowledge of a scientific and technological discovery and explain a positive effect of its introduction on society.

Question	Descriptor
26b	Recall knowledge of a scientific and technological discovery and explain a positive effect of its introduction on society.
26c	Recall knowledge of a scientific and technological discovery and explain a negative effect of its introduction on society.
26d	Recall knowledge of a scientific and technological discovery and explain a negative effect of its introduction on society.
27a	Given pictorial stimulus material on plant growth, design a method for an experiment – repetition or large sample size.
27b	Design a method for an experiment – controlling variables other than light, warmth, water.
27c	Design a method for an experiment – simple design.
27d	Design a method for an experiment – more complex design involving testing pairs of variables.
27e	Design a method for an experiment – monitoring the experiment, eg observation, measurement.
28a 1	Read text and table, apply data from the table to the text to give a disadvantage of making a car out of gold.
28a 2	Read text and table, apply data from the table to the text to give an advantage of making a car out of gold.
28b	Recall knowledge on activity of metals OR extract information from text (expense of extracting active metals – aluminium).
28c 1	Recall knowledge of a general property of metals and explain why it is difficult to substitute other materials.
28c 2	Recall knowledge of recycling OR apply information from text to the conservation of natural resources (copper).
28c 3	Recall knowledge of recycling OR apply information from text to conservation of natural resources (iron).
28c 4	Predict an effect of low copper reserves and propose a solution (given in text).
29a 1	Synthesise information from the text, table and diagram to predict the sequence of collection in a distillation column.
29a 2a	Apply knowledge of boiling points to predict the maximum temperature in a given chamber.
29a 2b	Apply knowledge of changes of state (condensation) to explain the answer given in 29a 2a.
29a 3	Construct a bar graph from given data.
29b 1	Recall knowledge of physical and chemical changes (fractional distillation).
29b 2	Identify the characteristics of a physical change.
29c 1	Recall of laboratory experience on distillation OR identify processes from a diagram.
29c 2	Recall of laboratory experience on distillation OR identify process from a diagram.
29d	Recall knowledge of particle theory and draw a diagram of evaporation, given a model.

* indicates computer scanned items (others are extended response items.)

6 Analysis of the Trial School Certificate Science Test

The test's purpose was to assess knowledge, understanding and skills that are valued in Science. It did not attempt to determine attainment in terms of all aspects of the *Science Years 7–10 Syllabus*. Student achievement in relation to the full range of outcomes for Science was assessed by schools through their own assessment programs using the Course Performance Descriptors written for this purpose.

Section 1

Questions 1–13 — Multiple-choice

The table below gives the percentage of candidates selecting each option for the multiple-choice questions. The correct answer is marked with an asterisk.

Question	A	B	C	D
1	69.26*	.97	7.64	21.78
2	11.89	11.38	12.81	63.63*
3	7.46	43.22	47.32*	1.74
4	5.43	19.93	57.18*	17.15
5	65.74*	9.21	15.84	8.87
6	4.37	8.11	81.87*	5.37
7	3.24	81.52*	1.46	13.54
8	53.02*	6.82	13.40	26.40
9	19.57	14.01	10.38	55.60*
10	9.56	21.68	51.56*	16.84
11	7.79	15.35	19.54	56.94*
12	3.37	74.80*	19.15	2.43
13	8.23	40.57	12.19	38.63*

General comments

Generally, candidates were more successful in multiple-choice questions than the other question types in Sections 1 and 2 of the paper. It was also evident, particularly in the multiple-choice questions, that candidates' ability in the skills and processing questions was better than their knowledge of science. The three multiple-choice questions that candidates found to be most difficult were all questions testing basic knowledge. Also, some questions in this part of the paper were challenging for the candidates with a limited knowledge and understanding of scientific concepts.

A small percentage of candidates did not answer all multiple-choice questions. Students should be advised, as part of their examination technique, to respond to all multiple-choice questions.

Comments on the following questions are derived from statistical analysis of the candidates' responses. There are no comments made on the questions for which the statistics indicated that the questions and candidates performed as expected.

Question 3

This question, which required knowledge of mixtures, was difficult for candidates. This may have been due to the difficulty in interpreting a pictorial representation of a concept.

Question 5

The more able candidates found this question to be easier than question 4; the lower ability candidates had great difficulty with it.

Question 6

While flow charts often pose problems for candidates, this question was easy for all candidates except those at the lowest end of the range.

Question 7

This question was equally easy for all levels of candidates and was one of the easiest questions in the test.

Question 9

This question proved to be an excellent discriminator. Students at all ability levels performed as expected when mapped against the question difficulty.

Question 13

The lower ability candidates performed above expectations, while the most able candidates performed below expectations. This may have been due to the lower ability candidates interpreting the question as the simple question that it was, while the most able candidates misinterpreted the demands of the question.

The table below provides information on the marking criteria and candidate responses for questions 14–25.

While there were exact correct responses to questions 16 and 25, the marking criteria allowed for a range of responses to score a mark.

The common errors column of the table indicates candidates' incorrect responses that appeared with a high frequency.

Question	Correct response/ response range	Common errors
14	Water	Oxygen Light
15	Sun	Water Oxygen
16	1.1 –1.3	1.0 2.0 0.5
17	RSQ	RQS
18	Q	L R
19	1.60	1 060
20	220.0	215.0
21	USA	Australia
22	0.9	9.0
23	5 4	5 3 5 7 5 6
24	1.1	1.0
25	45–46	50 54 10 75

General Comments on Questions 14–25

A broad range of skills and knowledge was examined in this section of the test using a variety of question types. The questions addressed a range of common experiences of students in Science through Years 7–10, with an emphasis on scientific methodology.

There was a range of questions from those accessible to all candidates to those that challenged and extended the most able candidates. This section of the test proved to be more difficult for candidates than the multiple-choice section. It was interesting to note that candidates had less difficulty, overall, with the questions that required numerical responses than those that required word or letter responses.

Comments on Questions 14–25

Question 14

The most common response was oxygen. An array of other incorrect responses was given including soil, starch, nitrogen, heat, rain and gas. There was a large number of non-attempts in this question.

Question 15

This aspect of photosynthesis was understood by most candidates, with ‘the sun’ and ‘sunlight’ being, by far, the most common responses. Surprisingly, non-attempts were high for this question.

Question 16

This was the most difficult question in Section 1 of the test. Even allowing for a generous range of responses in the marking criteria for the question, only 5% of candidates gave a correct response. The large number of candidates whose responses were over 1 000.0 suggests that scientific reasoning as well as mathematical skills were problematic for many candidates.

Question 17

Nearly all candidates gave the correct sequence of RSQ. This question was one of the easier questions for candidates.

Question 18

Candidates were required to recall three separate facts of science and then apply this knowledge to the diagram given in the question. Candidates found this question challenging. While every letter in the diagram, and many other letters that were not in the diagram, were given as the correct response by candidates, the most common response was the correct one.

Question 19

There were many non-attempts in this question and a large variety of incorrect responses. Responses of 20 000, 2 000 and 1 000 were common.

Question 20

There were approximately the same number of correct responses of 220.0 and incorrect responses of 215.0. Statistical analysis of the responses indicated that the lower ability students performed above expectations and the more able students performed well below expectations.

Question 21

Candidates, on the whole, had little difficulty with selecting USA as the correct response. The lower ability candidates, however, found this question to be very difficult. Table and pie graph interpretation and correlation appear to be well understood by the majority of candidates.

Question 22

Candidates had far more difficulty with question 22 than question 21. Since they had shown in question 21 that they were generally able to read tables, it appears that the difficulty for candidates was the knowledge of what constitutes renewable energy sources.
There were many non-attempts.

Question 23

Most candidates correctly identified the full moon phase of Deimos, but were unable to give the correct phase of Phobos. The spatial skills required to correctly answer this question posed a difficulty for many candidates.

Question 24

A large number of candidates did not attempt this question. A significant number of candidates, however, gave the correct response of 1.1. It seems that interpreting data in a line graph with a dual X-axis is far more difficult a task for most candidates than interpreting a pie graph as in question 21.

Question 25

The number of correct responses was almost equal to the number of non-attempts for this question. The analysis and interpretation of the pH and indicator tables were difficult for all except the most able candidates, who performed above expectations. Nearly every number between 10 and 100 was given as a response.

The table below shows, for each question in Section 1 of the test, the percentage of candidates who gave a correct response.

Percentage Correct Responses for Questions 1–25

Question	% correct
1	69
2	63
3	47
4	57
5	66
6	82
7	81
8	53
9	56
10	52
11	57
12	75
13	39
14	28
15	58
16	5
17	82
18	40
19	50
20	36
21	78
22	30
23	10
24	48
25	27

The table below shows, for each question in Section 1 of the test, the percentage of candidates who gave a correct response, in increasing order of difficulty of the questions.

Percentage Correct Responses for Questions 1–25 in Increasing Order of Difficulty

Question	% correct
6	82
17	82
7	81
21	78
12	75
1	69
5	66
2	63
15	58
4	57
11	57
9	56
8	53
10	52
19	50
24	48
3	47
18	40
13	39
20	36
22	30
14	28
25	27
23	10
16	5

Section 2

General comments

Section 2 of the paper consisted of four short-response questions with total marks of 4, 5, 7 and 9. While the format will remain as short-response questions and the total marks for this section will remain at 25 marks in the 1999 School Certificate Test, the number of questions and their mark allocations may vary from the 1998 format.

The non-attempt responses were randomly spread throughout the different questions and parts of questions in Section 2 of the test. In fact, some of the computer scanned questions had more non-attempts than question 29. This indicates that candidates, on the whole, had sufficient time to finish the test.

In Section 2 of the test paper, candidates were more able in responding to the questions that provided them with many short sections and required more structured responses to these parts. It was very difficult for most candidates to write scientific, accurate responses for the questions that were less prescriptive. Also, too often, there was evidence that candidates attempted to answer questions from their general knowledge, rather than applying scientific principles to their responses. Candidates also showed some confusion with addressing key terms in the questions, such as explain, suggest, name and justify.

Candidates should be encouraged to use correct writing skills in responding to science questions that require full sentences to answer them. Many responses had poor sentence structure and pattern, no full stops, and incorrect spelling of many simple, common words in science and general vocabulary.

Examples of candidates' responses for each question in Section 2 of the test are provided. They are examples of responses covering the range of marks available for each question. The purpose is to provide teachers and students with examples of the types of responses that candidates typically gave and to show how the marking criteria was applied. Common errors have been included.

Questions 26–29 Marking criteria, sample responses and general comments

Question 26. (4 marks)

Scientific discoveries and new technologies have an impact on our society.
Name a scientific discovery or new technology and explain two positive and two negative effects it has had on society.

Marking Criteria

There was no mark for simply naming a scientific discovery or new technology.

2 Marks Positive effects
1 mark for each legitimate positive **effect** and **how/why** it is a positive effect.

2 Marks Negative effects
1 mark for each legitimate negative effect on society and **how/why** it is a negative effect.

Sample Responses

---

4 marks were gained by the candidate who gave the following response.

		Marks
Name of discovery/technology: *Atomic Bomb*		
Positive effect 1:	*Was able to end World War II in the Pacific.*	1
Positive effect 2:	*Threat of one being fired at a country can stop them from planning war.*	1
Negative effect 1:	*Kills large numbers of people with both the initial explosion and the radiation after-effect.*	1
Negative effect 2:	*Where the bomb is detinated can be unsuitable for human inhabitation for up to 200,000 years.*	1

---

3 marks were gained by the candidate who gave the following response.

		Marks
Name of discovery/technology: *DDT – a type of insecticide*		
Positive effect 1:	*It meant humans were able to keep insects under control so that humans weren't bitten. This meant that less disease was spread with insects as the carriers.*	1
Positive effect 2:	*It meant humans were able to stop insects from eating crops, leading to larger and better crop yields, meaning there was more food for humans.*	1
Negative effect 1:	*Because not all insects were killed by DDT they gradually (over a few years) developed an immunity to it (their offspring received the immunity). This rendered the chemical close to useless.*	0

Negative effect 2:	*DDT was taken in (through breathing and through eating insects) by animals, which then meant that humans ate the animals and consumed DDT. Large amounts of DDT can cause cancer in humans and has killed many birds.*	1

---

3 marks were gained by the candidate who gave the following response.

Marks

Name of discovery/technology: *Cars*

Positive effect 1:	*You can get to where you want to go more quickly. Eg. In case of emergency and you need to get to hospital.*	1
Positive effect 2:	*You can travel further in a shorter period of time and can take more passengers*	0
Negative effect 1:	*Air pollution from the fumes in the exhaust.*	1
Negative effect 2:	*More deaths in road accidents and killing native animals*	1

---

2 marks were gained by the candidate who gave the following response.

Marks

Name of discovery/technology: *The paper making process.*

Positive effect 1:	*A type of media that is used to entertain and inform people such as newspapers, magazines and books.*	0
Positive effect 2:	*Millions of people everyday use paper in schools and offices to do work, print on, to write to someone.*	0
Negative effect 1:	*To make paper the factories must use a lot of harmful chemicals that do damage to the environment.*	1
Negative effect 2:	*A lot of trees must be cut down to make the amount of paper the world needs, and it is hard to plant enough trees to grow quickly enough to replace them.*	1

---

1 mark was gained by the candidate who gave the following response.

Marks

Name of discovery/technology: *automobiles*

Positive effect 1:	*speed up transport time.*	1
Positive effect 2:	*lower transport costs.*	0
Negative effect 1:	*increased death toll.*	0
Negative effect 2:	*air pollution increase.*	0

1 mark was gained by the candidate who gave the following response.

		Marks
Name of discovery/technology: *car*		
Positive effect 1:	*It is a fast means of transport*	0
Positive effect 2:	*People can enjoy driving.*	0
Negative effect 1:	*It is not good for the environment because they pollute the air with exhaust fumes.*	1
Negative effect 2:	*people might die in road accidents.*	0

0 marks were gained by the candidate who gave the following response.

		Marks
Name of discovery/technology: *CLONING*		
Positive effect 1:	*We might be able to wipe out all diseases like HIV AIDS and STD's , Cancer etc*	0
Positive effect 2:	*Crime and evil could be wiped out so there'll be no more crime around the world and everyone would be good.*	0
Negative effect 1:	*With cloning you would lose your identity, personality, appearance and everything.*	0
Negative effect 2:	*How many people or embryos would have to die to create a clone. Hundreds of embryos died before Dolly was produced.*	0

General comments

This question was very difficult for most candidates.

This question was highly relevant to the social relevance of science and its applications.

The better responses answered the question with scientific information. Many candidates' responses were based on beliefs or general knowledge, and they did not adequately address the question. The majority of candidates did not understand what is required in an explanation and simply named an effect. Candidates' responses often indicated that the knowledge and skills linked to the Science syllabus outcomes, that this question addressed, were not familiar to them.

Question 27. (5 marks)

TINA: **Hasn't rained for ages. All the plants need is water and they will be okay.**

ABDUL: **No – they need more light. It's too cloudy.**

GEORGE: **It's too cold for plants to survive here.**

SUE: **I think you are all correct. They need more warmth, light and water.**

Write a method for an experiment you would use to test Sue's idea.

Marking Criteria

Mark 1 **Sample size** of 2 or more plants for each set of conditions tested
OR repetition of experiment (with same or different species)

Mark 2 **Control of variables**
eg pot size
soil type
soil pH
species of plant
condition of plant
time for each experiment

Mark 3 **Simple design** increasing all variables separately
OR increasing the 3 variables at once and using a control

Mark 4 **Multilevel design** with all 3 factors controlled (8 different sets of conditions).

Mark 5 Instruction to **observe/measure/record**

Sample Responses

---

5 marks were gained by the candidate who gave the following response.

Set up eight groups of plants – of all the same species.

1. Place one group of plants in conditions of where there is little rain, cloudy or shady and quite cold.

2. Place one group of plants in conditions of where the plants are watered (rain or manually), cloudy or shady and quite cold.

3. Place one group of plants in conditions where there is little rain, lots of sunlight but quite cold.

4. Place one group of plants in conditions when there is little rain, not much light, but warmth.

5. Place one group of plants in conditions where the plants are watered (rain or manually), lots of sunlight but quite cold.

6. Place one group of plants in conditions where the plants are watered, where it is nice and warm, but not much sunlight.

7. Place one group of plants in conditions where the plants do not receive much water, but get sunlight and warmth.

8. Place one group of plants under conditions of the plants being watered, lots of sunlight and warmth.

Observe colour, droop and liveliness of plants.

4 marks were gained by the candidate who gave the following response.

1. Obtain 150 plants, identical in height, age and type.
2. Put 50 plants in an environment where only sufficient light is received.
3. Put 50 plants in an environment where only sufficient water is received.
4. Put 50 plants in an environment where only sufficient warmth is received.
5. Remove the plants and take the average for each fifty of the following aspects;
    1. Height
    2. Moisture
    3. Flowers
6. Now compare each of the three averages.
7. If they are the same, then all aspects (warmth, light and water) are important to their growth.
8. If one or two differ from the other(s). Make appropriate deductions i.e. If one is taller than the other two, the environment it was contained in is the most important.
9. Tabulate your results and then graph them.

The response scored marks 1, 2, 3 and 5. It did not have a multilevel design.

---

3 marks were gained by the candidate who gave the following response.

Label 4 plants A, B, C and D.

Place A into a cold place but make sure it has adequate light and water.
Place B in a shaded area with very low light levels but make sure it is warm and well watered.
Place C in a dry spot and keep soil dry, or with very little water but make sure it has adequate light and warmth.
Place D in a bright, well watered and warm area. This plant is the control.

Record progress of each plant each week for four weeks.

Make sure all plants are same species and are about the same hight when beginning.

The response scored marks 2, 3 and 5. There was no repetition or multilevel design.

---

2 marks were gained by the candidate who gave the following response.

I would get two plants. One of the plants should be put in a dry, dark, cold condition for 2 weeks and one plant should be put in a place where it gets warmth, light and water regularly for 2 weeks.

After 2 weeks results should be recorded for example how the plants look, did they grow.

If the plant which had warmth, light and water looked healthier than the plant which was in a dry, dark, cold condition. This would mean that Sue's idea of the plant needing more warmth, light and water to survive was right.

You can also have four plants and plant 1 is without water, Plant 2 without light, Plant 3 in a freezer and Plant 4 in a good warm, light and water condition for 2 weeks. After 2 weeks you will be able to find out if Sue's idea of a plant needing warmth, light and water was right or wrong.

The response scored marks 3 and 5. There was no repetition, control of variables or multilevel design.

1 mark were gained by the candidate who gave the following response.

Tina can put more water into it.
Abdul can put the plant somewhere with more light.
George can put it somewhere warmer.
Sue can put it somewhere which is warmer, more light and add more water.

After a period of time there will be a big different between Sue's to everybody else.
Sue's will be the best of all and the plant will live longer.

The response scored mark 3. The response only gave a simple design of the experiment.

0 marks were gained by the candidate who gave the following response.

Start of getting new stuffs such as pot, dirt & seed. Then you begin all you have to do is get the pot & pour the dirt into the pot then get the seed & dig a little hole to put the seed in then you water it then put the pot in a warmth place where more light is & water it every single week so that this seed may grow new plants & the leafs of this plant grow & look wonderful & always remember to water it every single week. If you think it needs more light then take it from where you put it & place it either in a place that has more light & warmth a place where you could see this plant everyday unless you are working to see if the plant is growing & if you don't water it it won't grow at all, but if is dead you put it in a place wheres no light at all.

General comments

This question addressed one of the major skills in science; being able to design an experiment.

A small percentage of candidates showed a scientific understanding beyond simple experimental design and discussed multi-level experiments in their responses to the question. However, most responses indicated that candidates do not fully understand experimental design, even at the simple design level. Many candidates designed an experimental procedure that had no validity.

There was a general lack of understanding of using a control, keeping variables constant, repetition, observation, measurement and recording results.

Some of the better responses included a diagram or table as part of their response. It proved to be an efficient technique in conveying an experimental method. Candidates should be encouraged to wisely and appropriately use diagrams, tables and the like in answering questions where the response is enhanced by doing so.

Once again, as in question 26, candidates had difficulty with a question with a more open-ended approach in the questioning, but requiring a scientific, structured response.

Statistical analysis of the candidates' responses indicated an anomaly. More candidates scored 2 than scored 1. This is probably indicative of the fact that if candidates knew the basic requirements of designing an experiment they were able to score at least 2 marks. Those candidates whose grasp of scientific method was minimal found it very difficult to score any marks. At the other end of the scale, it was difficult to score 5 marks.

Question 28. **(7 marks)**

Modern society depends heavily on metals. More than 60 metals are extracted from the earth and used. Each metal has its own properties which include length, hardness, conduction of electricity and heat, resistance to corrosion, density, and chemical activity.

Some metals are used more than others. This depends on the properties of the metal and how much it costs. The cost depends on how abundant the metal is and how easily we can mine and refine the ore. The more chemically active a metal is, the faster it will corrode and the harder it is to extract from its ore.

Even though new reserves of metal ores are being found, supplies must eventually run out. There are two important ways we are trying to solve this problem:

- **recycling**
- **using substitute materials**.

The table shows information about some metals.

Metal	*Atomic symbol*	*World production (thousands of tonnes per year)*	*Density ($g\ mL^{-1}$)*	*Chemical activity*	*Estimated time known reserves will last (years)*
Magnesium	**Mg**	**300**	**1.7**	**Most active ↑ Least active**	**500+**
Aluminium	**Al**	**15 700**	**2.7**		**260**
Zinc	**Zn**	**9 000**	**7.1**		**150**
Chromium	**Cr**	**6 000**	**7.1**		**100**
Iron	**Fe**	**750 000**	**7.9**		**200**
Tin	**Sn**	**800**	**7.3**		**100**
Lead	**Pb**	**5 000**	**11.3**		**150**
Copper	**Cu**	**12 000**	**8.9**		**40**
Silver	**Ag**	**10**	**10.5**		**150**
Gold	**Au**	**2**	**19.3**		**25**

(a) Ignoring cost, and using only the information provided,

(i) give a disadvantage of making a car out of gold;

(ii) explain an advantage of making a car out of gold.

(b) Aluminium is the most abundant metal in the Earth's crust. Despite its abundance, aluminium is one of the more expensive to obtain. Using only the information provided, suggest a reason for this.

(c) Use the information given, or your knowledge, to response the following questions.

(i) Name a property of metals for which it is difficult to use substitute materials. Explain your response.

(ii) Suggest one reason why most of the copper we use is recycled.

(iii) Suggest one reason why less than half of the iron we use is recycled.

(iv) The world reserves of copper are predicted to run out in 40 years. Suggest one way this might affect people.

Marking Criteria

1 Mark a (i) **The disadvantges must come from a property, feature or the table of data AND it must be stating or implying a comparison or qualifier,**

eg too heavy, too dense, high density
low estimated time of known reserves
low world production/rare

1 Marks (ii) Any legitimate advantage which links, directly or by inference, inactivity or rate of corrosion to ease of extraction and therefore money savings,

eg will not corrode/rust
will not need to be rust proofed
no need to paint it
will last a long time

note: inactivity is not enough on its own

1 Mark b eg it is hard/expensive to mine & refine
it is difficult to extract from its ore

1 Mark c (i) **Any legitimate distinctive property of metals. No mark for the property, the mark is given for the explanation. A valid comparison is needed to other materials,**

eg electrical conductivity – metals are currently our most commonly available electrical conductors
malleability/ductility – only metals are malleable and ductile
strength at high temperatures – no other materials retain strength at high temperatures
lustre
high density

1 Mark c (ii) eg has a high $ value
it is mostly in a pure state/can be melted and reused
used in accessible situations
does not corrode excessively
there's not much left / low world reserves

note: easy to recycle is not enough alone – it must be qualified

1 Mark c (iii) eg has a low $ value
more will corrode
expensive to extract from some use situations / alloys, reinforcing
lost produced/big reserves
cost of gathering wide spread items using iron

note: Hard to recycle must be qualified

1 Mark c (iv) Any legitimate effect,
eg *need substitute materials* for its many uses – conductors/pipes/brass, etc
economic implications copper products/subsitutes will become more expensive
social implications – loss of business in the copper industry
Loss of copper for medical needs, eg copper bracelets, creams
improved recycling

Sample Responses

7 marks were gained by the candidate who gave the following responses.

Marks

(a) Ignoring cost, and using only the information provided,

(i) give a disadvantage of making a car out of gold;
Gold is very dense, so too heavy for a car. 1

(ii) explain an advantage of making a car out of gold.
Gold is very unreactive, therefore it will not corode which will keep the car safe to drive. 1

(b) Aluminium is the most abundant metal in the Earth's crust. Despite its abundance, aluminium is one of the more expensive to obtain. Using only the information provided, suggest a reason for this.

Aluminium is very chemically active which means it is harder to extract from its ore, making it expensive. 1

(c) Use the information given, or your knowledge, to response the following questions.

(i) Name a property of metals for which it is difficult to use substitute materials. Explain your response.
Conduction of electricity and heat. Metals are very important in the conductivity of electricity and heat, other materials do not perform this as well; many can not at all. 1

(ii) Suggest one reason why most of the copper we use is recycled.
Copper is likely to run out in 40yrs, so it is important to recycle. 1

(iii) Suggest one reason why less than half of the iron we use is recycled.
There is a lot of iron produced per year, and there are about 200 years 1

of reserves available so people see less need in recycle it.

(iv) The world reserves of copper are predicted to run out in 40 years. Suggest one way this might affect people.
Copper is very often used in conducting electricity, therefore people may have to go without or find a substitute. 1

---

6 marks were gained by the candidate who gave the following responses.

Marks

(a) Ignoring cost, and using only the information provided,

(i) give a disadvantage of making a car out of gold;
its reserves will not last long, only 25yrs 1

(ii) explain an advantage of making a car out of gold.
It is least active of all the metals listed. Meaning that it will be good to drive as it will least react with rain or any other chemical put on the car. Preventing rust. 1

(b) Aluminium is the most abundant metal in the Earth's crust. Despite its abundance, aluminium is one of the more expensive to obtain. Using only the information provided, suggest a reason for this.

Aluminium, though in abundance, may be quite hard and expensive to mine, as it might be deep within the earth's crusts.

(c) Use the information given, or your knowledge, to response the following questions.

(i) Name a property of metals for which it is difficult to use substitute materials. Explain your response.
Conductivity as it is only through metal wires that we gain and pass electricity. Finding a substitute for this would be very difficult. Those semi-metals may conduct, but would not last long like metals do. 1

(ii) Suggest one reason why most of the copper we use is recycled.
As so much copper is produced annually, the used pieces from these items would be quite abundant and copper is used in most electrical items and so is in great demand. It's supply is also estimated to be 40 yrs more. 1

(iii) Suggest one reason why less than half of the iron we use is recycled.
Iron is made into strong foundations. A lot of what iron is made into is not recyclable and can be used for a long time. Eg. bridges. It also has a high "estimated time known reserves will last". 1

(iv) The world reserves of copper are predicted to run out in 40 years. Suggest one way this might affect people.
People would be trying to find a substitute for copper. They would also be more catious in how they use it. Recycling it would also become popular to preserve it. 1

5 marks were gained by the candidate who gave the following response.

Marks

(a) Ignoring cost, and using only the information provided,

(i) give a disadvantage of making a car out of gold;
There is only a world production of 2000 tonnes a year. 1

(ii) explain an advantage of making a car out of gold.
It is the least chemically active of all the metals in the table which means that it will not corrode. 1

(b) Aluminium is the most abundant metal in the Earth's crust. Despite its abundance, aluminium is one of the more expensive to obtain. Using only the information provided, suggest a reason for this.

It is one of the most chemically active and therefore it would be difficult to extract from its ore. This makes it more expensive. 1

(c) Use the information given, or your knowledge, to response the following questions.

(i) Name a property of metals for which it is difficult to use substitute materials. Explain your response.
The chemical activity of a metal would be difficult to produce in a substitute material because it derives from the chemical makeup of the metal which would be difficult to copy. 1

(ii) Suggest one reason why most of the copper we use is recycled.
The estimated time that the known reserves will last is 40 years which makes it important that it be recycled. 1

(iii) Suggest one reason why less than half of the iron we use is recycled.
The world production of iron is the largest compared to the other metals and it is expected to last another 200yrs. 1

(iv) The world reserves of copper are predicted to run out in 40 years. Suggest one way this might affect people.
It is difficult to make electrical wire and there reduced production of them as most of the wires today are made with copper. 0

4 marks were gained by the candidate who gave the following response.

Marks

(a) Ignoring cost, and using only the information provided,

(i) give a disadvantage of making a car out of gold;
it is too heavy to make a car out of gold 1

(ii) explain an advantage of making a car out of gold.
An advantage of making a car out of gold is that it has a less chemical activity which means the car will not rust. 1

(b) Aluminium is the most abundant metal in the Earth's crust. Despite its abundance, aluminium is one of the more expensive to obtain. Using only the information provided, suggest a reason for this.

Aluminium has a light density of 2.7g mL^{-1} 0

(c) Use the information given, or your knowledge, to response the following questions.

(i) Name a property of metals for which it is difficult to use substitute materials. Explain your response.
Magnesium is too active and also it can be lasted for more than 500 years. 0

(ii) Suggest one reason why most of the copper we use is recycled.
Because copper is mostly used as a conductor it needs to produce more otherwise it will run out. 1

(iii) Suggest one reason why less than half of the iron we use is recycled.
Because the world produced 750 000 thousands of tonnes per year and it is a lot more than other metals. 1

(iv) The world reserves of copper are predicted to run out in 40 years. Suggest one way this might affect people.
Running out of copper might affect people because people needs copper to get electricity working. Copper is most conductive. 0

---

3 marks were gained by the candidate who gave the following response.

Marks

(a) Ignoring cost, and using only the information provided,

(i) give a disadvantage of making a car out of gold;
reserves will not last as long. 1

(ii) explain an advantage of making a car out of gold.
Gold has very high density, which means in an acident the car will not crush as easily. 0

(b) Aluminium is the most abundant metal in the Earth's crust. Despite its abundance, aluminium is one of the more expensive to obtain. Using only the information provided, suggest a reason for this.

Has a high world production and a high chemical activity 0

(c) Use the information given, or your knowledge, to response the following questions.

(i) Name a property of metals for which it is difficult to use substitute materials. Explain your response.
The chemical activity because it will be made out of different materials with different chemical activities 0

(ii) Suggest one reason why most of the copper we use is recycled.
Reserves will not last very long (40 years) 1

(iii) Suggest one reason why less than half of the iron we use is recycled.
Reserves will last longer than our lifetime (200 years) 1

(iv) The world reserves of copper are predicted to run out in 40 years. Suggest one way this might affect people.

World production will fall dramatically, world uses a lot of copper per year 0

---

2 marks were gained by the candidate who gave the following responses.

Marks

(a) Ignoring cost, and using only the information provided,

(i) give a disadvantage of making a car out of gold;
Reserves won't last very long. Only 25 years. 1

(ii) explain an advantage of making a car out of gold.
Gold has a density of 19.3mL, which is high . People driving a gold car would be at a lower risk of being severely injured during an accident. 0

(b) Aluminium is the most abundant metal in the Earth's crust. Despite its abundance, aluminium is one of the more expensive to obtain. Using only the information provided, suggest a reason for this.

To obtain aluminium, you need expensive equipment, because it is so fragile, and because of its position in the Earth's crust.

(c) Use the information given, or your knowledge, to response the following questions.

(i) Name a property of metals for which it is difficult to use substitute materials. Explain your response.
The hardness of a metal. Some metals are harder than others, and some are extremely soft. It is very rare to obtain three or four metals with the same hardness as one another. 0

(ii) Suggest one reason why most of the copper we use is recycled.
It has quite a low density so it is easily moulded into another object. 0

(iii) Suggest one reason why less than half of the iron we use is recycled.
The world's production of iron is enormous. There is plenty, therefore there is no need to recycle iron. 1

(iv) The world reserves of copper are predicted to run out in 40 years. Suggest one way this might affect people.
Without copper, many things can not be produced. It would be hard to find a substitute for copper. 0

---

0 marks were gained by the candidate who gave the following responses.

Marks

(a) Ignoring cost, and using only the information provided,

(i) give a disadvantage of making a car out of gold;
not very strong 0

(ii) explain an advantage of making a car out of gold.
Looks good 0

(b) Aluminium is the most abundant metal in the Earth's crust. Despite its abundance,

aluminium is one of the more expensive to obtain. Using only the information provided, suggest a reason for this.

It is a very reactive metal

(c) Use the information given, or your knowledge, to response the following questions.

(i) Name a property of metals for which it is difficult to use substitute materials. Explain your response.
Conductivity 0
Because only metal or carbon is conductive

(ii) Suggest one reason why most of the copper we use is recycled.
Because it is very easily recycled 0

(iii) Suggest one reason why less than half of the iron we use is recycled.
Because it is not easy to recycle iron 0

(iv) The world reserves of copper are predicted to run out in 40 years. Suggest one way this might affect people.
Electric wire has copper in it, there will be less electric wire 0

General comments

Candidates' responses for this question were of a higher standard than to questions 26 and 27. Most candidates were able to score at least 3 marks and the candidates' total marks reflected the expected spread of marks. The greater structuring in this question seemed to allow the question to be more accessible to candidates.

This question required candidates to extract information from tables and text, and apply interpretation and application skills. Some candidates had problems integrating information from the text and the table. Many candidates did not read or use the text, which made it difficult to answer some parts of the question. Candidates often ignored the instruction to use only the information provided in the question, and there were a noticeable number of flippant responses with no scientific basis. The technical language in the question posed some difficulties for candidates.

Part (a)

This part was generally well understood and answered. Many candidates ignored the instruction to ignore cost in their response. Many candidates also interpreted the last column in the table, showing the estimated time that reserves of the metal are predicted to last, to mean how long a sample of the metal would last. There was evidence in the candidates' responses that some candidates think density and strength are synonymous terms, and chemical activity is synonymous with dangerous. Most candidates needed to use the information in the text to adequately answer Part (a) (ii). Many, however, did not.

Part (b)

Again, many candidates did not use the text information that would have made the question a relatively easy one. Instead, many candidates did not score this mark.

Part (c)

Part (c) (i) proved to be the most difficult part of question 28. Candidates had great difficulty with being asked to name a property of metals. Some didn't understand that a generalisation was required; some didn't understand the word 'property'.

Candidates tended to either score both marks for Parts (ii) and (iii) or neither.

In Part (iv), the word 'affect' caused great difficulty for many candidates. Many candidates provided a solution as their response, rather than answering the question. Many candidates thought that once reserves run out, there will be no copper pipes and wire, therefore existing water and power would cease.

Question 29. (9 marks)

(a) (i) Complete the table below by correctly identifying the vapour that would condense in each chamber during the distillation process.

(ii) What is the maximum temperature in the middle chamber for the column to work correctly?

Explain your response.

(iii) Complete the bar graph below to show the proportion of each liquid in the original mixture. Indicate the liquids in the order P, then Q, then R.

(b) Is fractional distillation a physical or chemical change?

(c) Name the main process occurring in the apparatus at each position indicated.

(d) Complete the particle model diagram to represent evaporation.

Marking Criteria

1 Mark a (i) Correct completion of table showing **Correct gases** or **volumes** or **boiling points** as per:

CHAMBER	VAPOUR	OR	OR
Top	*Q*	*240*	*54*
Middle	*R*	*350*	*67*
Bottom	*P*	*410*	*85*

1 Mark (ii) depending on gas candidate states to be in middle chamber in a(i) above, **R = 66, 66.9** or **P = 84** or **84.9** or **Q = 53** or **53.9.** regardless of gas in middle chamber according to candidates response in a(i), **66** or **66.9** must be paid as it is the correct response.

1 Mark **so that R will condense in the middle chamber** or
so that R will not pass through into the top chamber or
so that R will separate from gas passing through to top chamber or
if T was greater, R would not condense or **similar**

2 Marks (iii) Labelled bar showing all correct ratios or
unlabelled bar showing all correct ratios **in order PQR**

P – 4.1 cm	Q – 2.4cm	R – 3.5 cm

OR

1 Mark labelled bar with **any one correct segment any order**
unlabelled bar with any one correct segment, **order PQR assumed**

1 Mark (b) In first response position, candidate must respond **physical change.** This by itself does not score. To score, candidate must give a correct justification showing they know what a physical change is or how it

differs from a chemical change. Responses must include one distinguishing property:

e.g. **no new chemicals are formed/no chemical reaction occurs**
chemical properties same before and after
no chemical bonds broken/atoms rearranged
can be reversed by physical means
it is only a change from liquid to gas
only physical properties change
it is just a change of form
it is simply a change of state
it is only a separation of a mixture

1 Mark (c) Process at **A: evaporation, vaporisation, boiling**

1 Mark Process at **B: condensation**

Alternate
1 Mark **TWO** descriptions of the changes of state occuring at A and B,
eg: **A:** (liquid) changes into gas
B: (gas) changes (back) into liquid

1 Mark (d) Diagram must show **gas particles above liquid**. Particles must be **random** and **further apart than candidate's liquid particles**

OR if no liquid particles shown, **random** and **further apart than original diagram particles**
Ignore level of liquid
Do not accept 'evaporation lines' **unless particles drawn with them**.

Sample Responses

9 marks were gained by the candidate who gave the following response.

Marks

(a) (i) Complete the table below by correctly identifying the vapour that would condense in each chamber during the distillation process.

CHAMBER	VAPOUR
Top	*Q*
Middle	*R*
Bottom	*P*

1

(ii) What is the maximum temperature in the middle chamber for the column to work correctly?
66.9˚ C 1

Explain your response.
This allows R to condense in the middle chamber, and Q vapour to pass through to the top chamber. 1

(iii) Complete the bar graph below to show the proportion of each liquid in the original mixture. Indicate the liquids in the order P, then Q, then R.

P	Q	R

1

(b) Is fractional distillation a physical or chemical change?
physical 1

Justify your response.
No chemical reaction occurs. The process is a simple physical separation of a mixture. 1

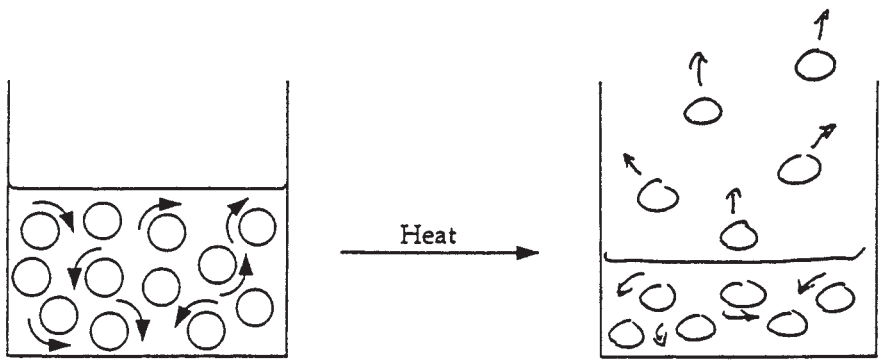
(c) The diagram shows a distillation unit used in a school laboratory to separate two liquids.

Name the main process occurring in the apparatus at each position Indicated.

Process at A *Evaporation* 1

Process at B *Condensation* 1

(d) Complete the particle model diagram below to represent evaporation.



8 marks were gained by the candidate who gave the following response.

Marks

(a) (i) Complete the table below by correctly identifying the vapour that would condense in each chamber during the distillation process.

CHAMBER	VAPOUR
Top	*Q*
Middle	*R*
Bottom	*P*

1

(ii) What is the maximum temperature in the middle chamber for the column to work correctly?
66 ˚ C 1

Explain your response.
If it was any higher, liquid R would evaporate and go into the chamber for liquid Q. 1

(iii) Complete the bar graph below to show the proportion of each liquid in the original mixture. Indicate the liquids in the order P, then Q, then R.

P	Q	R

1

(b) Is fractional distillation a physical or chemical change?
Physical

Justify your response.
None of the substances change chemically. They simply change from a liquid to a gas and back again. 1

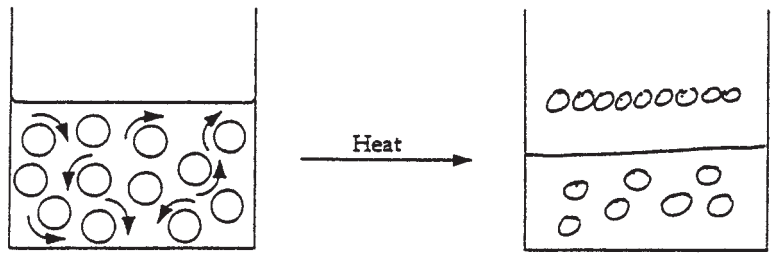
(c) The diagram shows a distillation unit used in a school laboratory to separate two liquids.

Name the main process occurring in the apparatus at each position Indicated.

Process at A *Evaporation* 1

Process at B *Condensation* 1

(d) Complete the particle model diagram below to represent evaporation.



0

7 marks were gained by the candidate who gave the following response.

Marks

(a) (i) Complete the table below by correctly identifying the vapour that would condense in each chamber during the distillation process.

CHAMBER	VAPOUR
Top	*Q*
Middle	*R*
Bottom	*P*

1

(i) What is the maximum temperature in the middle chamber for the column to work correctly?
60˚ C

Explain your response.
The temperature must be below 67˚ , so R condenses, but above 54˚, so Q doesn't condense.

(iii) Complete the bar graph below to show the proportion of each liquid in the original mixture. Indicate the liquids in the order P, then Q, then R.

P	Q	R

1

(b) Is fractional distillation a
physical 1

Justify your response.
Chemical changes only occur when the chemical composition of a substance is changed. 1

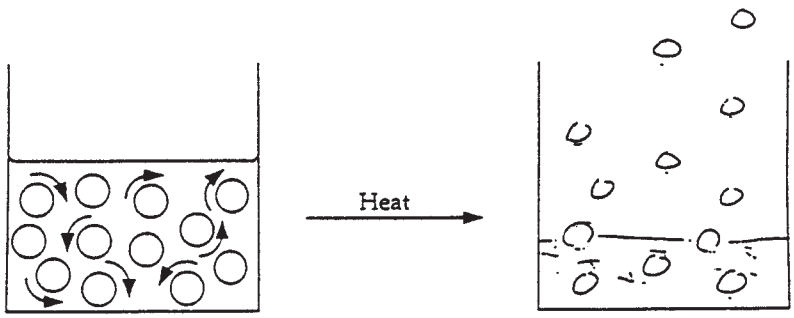
(c) The diagram shows a distillation unit used in a school laboratory to separate two liquids.

Name the main process occurring in the apparatus at each position Indicated.

Process at A *vaporisation* 1

Process at B *condensation* 1

(d) Complete the particle model diagram below to represent evaporation.



1

6 marks were gained by the candidate who gave the following response.

Marks

(a) (i) Complete the table below by correctly identifying the vapour that would condense in each chamber during the distillation process.

CHAMBER	VAPOUR
Top	*Q*
Middle	*R*
Bottom	*P*

1

(ii) What is the maximum temperature in the middle chamber for the column to work correctly?
70˚ C 0

Explain your response.
It has to be hot but not to hot so 70˚ is perfect 0

(iii) Complete the bar graph below to show the proportion of each liquid in the original mixture. Indicate the liquids in the order P, then Q, then R.

P	Q	R

1

(b) Is fractional distillation a physical or chemical change?
physical 1

Justify your response.
Because when it is fractioned into each group they must split apart from each other. 0

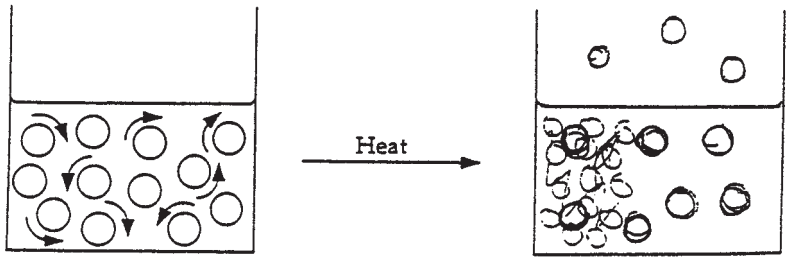
(c) The diagram shows a distillation unit used in a school laboratory to separate two liquids.

Name the main process occurring in the apparatus at each position Indicated.

Process at A *Boiling* 1

Process at B *Condensation* 1

(d) Complete the particle model diagram below to represent evaporation.



1

5 marks were gained by the candidate who gave the following response.

Marks

(a) (i) Complete the table below by correctly identifying the vapour that would condense in each chamber during the distillation process.

CHAMBER	VAPOUR
Top	*Q*
Middle	*R*
Bottom	*P*

0

(ii) What is the maximum temperature in the middle chamber for the column to work correctly?
72˚ C 0

Explain your response.
Can only have a maximum of 18˚ between each chamber. 0

(iii) Complete the bar graph below to show the proportion of each liquid in the original mixture. Indicate the liquids in the order P, then Q, then R.

P	Q	R

1

(b) Is fractional distillation a physical or chemical change?
physical 1

Justify your response.
No new substance is formed, the substance has just changed from a liquid to a gas (that is a change of state). 1

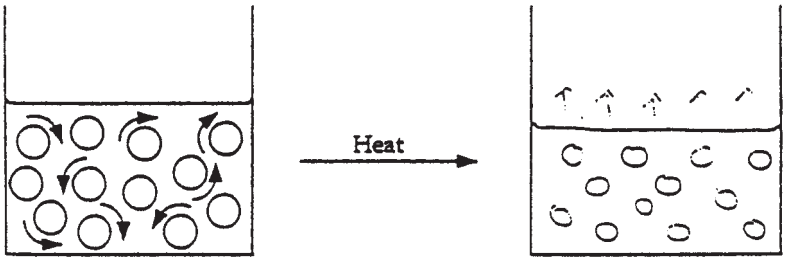
(c) The diagram shows a distillation unit used in a school laboratory to separate two liquids.

Name the main process occurring in the apparatus at each position Indicated.

Process at A *evaporate* 1

Process at B *condense* 1

(d) Complete the particle model diagram below to represent evaporation.



0

4 marks were gained by the candidate who gave the following response.

Marks

(a) (i) Complete the table below by correctly identifying the vapour that would condense in each chamber during the distillation process.

CHAMBER	VAPOUR
Top	*Q*
Middle	*R*
Bottom	*P*

1

(ii) What is the maximum temperature in the middle chamber for the column to work correctly?
66˚ C 0

Explain your response.
Because the boiling point of solution R is 67˚ C 0

(iii) Complete the bar graph below to show the proportion of each liquid in the original mixture. Indicate the liquids in the order P, then Q, then R.

P	Q	R

1

(b) Is fractional distillation a physical or chemical change?
physical 1

Justify your response.
Because its being boiled. 0

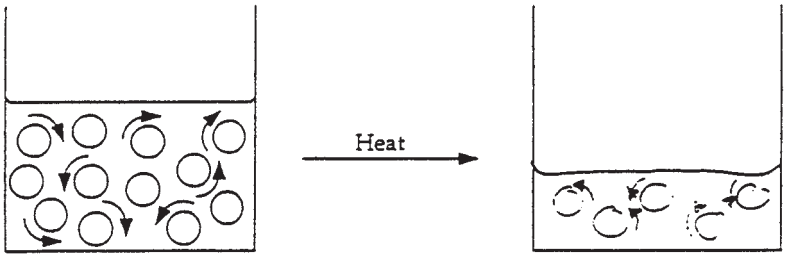
(c) The diagram shows a distillation unit used in a school laboratory to separate two liquids.

Name the main process occurring in the apparatus at each position Indicated.

Process at A *being heated* 0

Process at B *being cooled* 0

(d) Complete the particle model diagram below to represent evaporation.



3 marks were gained by the candidate who gave the following response.

Marks

(a) (i) Complete the table below by correctly identifying the vapour that would condense in each chamber during the distillation process.

CHAMBER	VAPOUR
Top	*Q*
Middle	*R*
Bottom	*P*

1

(ii) What is the maximum temperature in the middle chamber for the column to work correctly?
67˚ C 0

Explain your response.
It reaches boiling point 0

(iii) Complete the bar graph below to show the proportion of each liquid in the original mixture. Indicate the liquids in the order P, then Q, then R.

P	Q	R

1

(b) Is fractional distillation a physical or chemical change?
chemical 1

Justify your response.
It is changing into seperate liquids 0

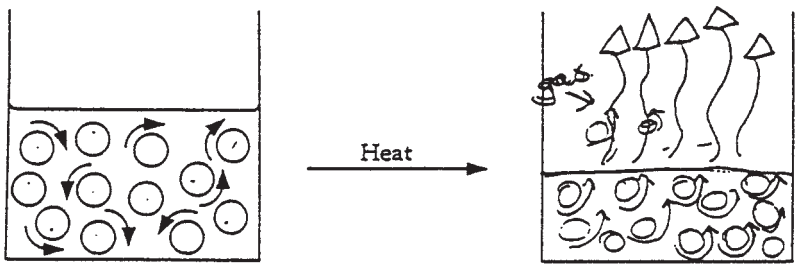
(c) The diagram shows a distillation unit used in a school laboratory to separate two liquids.

Name the main process occurring in the apparatus at each position Indicated.

Process at A *seperation of liquids* 0

Process at B *The water goes through. Cools the liquid* 0

(d) Complete the particle model diagram below to represent evaporation.



2 marks were gained by the candidate who gave the following response.

Marks

(a) (i) Complete the table below by correctly identifying the vapour that would condense in each chamber during the distillation process.

CHAMBER	VAPOUR
Top	*Q*
Middle	*R*
Bottom	*P*

1

(ii) What is the maximum temperature in the middle chamber for the column to work correctly?
67˚ C 0

Explain your response.
It reaches boiling point 0

(iii) Complete the bar graph below to show the proportion of each liquid in the original mixture. Indicate the liquids in the order P, then Q, then R.

P	Q	R
410	210	350

1

(b) Is fractional distillation a physical or chemical change?
chemical 1

Justify your response.
Because it is used to seperate mixtures of liquids of different boiling points. 0

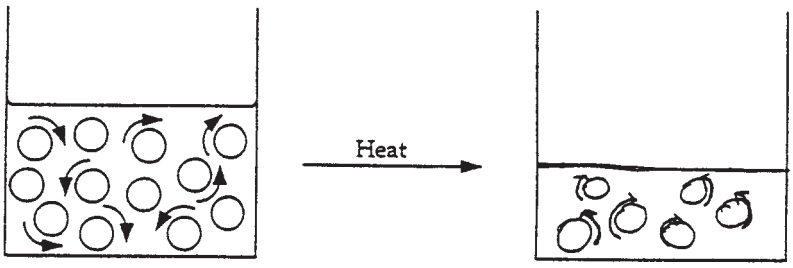
(c) The diagram shows a distillation unit used in a school laboratory to separate two liquids.

Name the main process occurring in the apparatus at each position Indicated.

Process at A *heating liquids* 0

Process at B *seperating liquids* 0

(d) Complete the particle model diagram below to represent evaporation.



General comments

This question proved to be more difficult than question 28. Most candidates were able to score at least 3 marks and the spread of candidates' total marks was as expected.

The question tested several cognitive skills, offering scope for a range of candidate ability. Most candidates appeared to have little understanding of kinetic particle theory and demonstrated misconceptions with this model. A significant number of candidates simply extracted the relevant sentence from the stimulus material, rather than showing any real understanding of the concepts.

In part (a) (i) some candidates did not understand that that the letters P, Q and R were required to be placed in the correct order; instead they gave temperatures or millilitres.

In part (b), most candidates had no difficulty in stating that fractional distillation is a physical change, but the justification was beyond them.

Part (c) tested very basic scientific terms. All candidates should know terms such as evaporation and condensation, although many indicated that they did not.

Part (d) proved to be difficult for many candidates. Candidates were required to show gas particles above the liquid, further apart than the liquid particles and in random movement. The inclusion of squiggly, vertical 'evaporation lines' was common, but was often meaningless in the way the lines were drawn.