BOARD OF STUDIES
NEW SOUTH WALES

1997 HSC

EXAMINATION REPORT

Science
3/4 Unit

Published by
Board of Studies NSW
GPO Box 5300
Sydney NSW 2001
Australia

ISBN 0 7313 1426 3

98034

1997 HIGHER SCHOOL CERTIFICATE
EXAMINATION REPORT
SCIENCE 3/4 UNIT

In 1997 165 candidates presented for the 3 Unit paper and 468 candidates for the 4 Unit paper, making a total of 633, a decrease on the candidature for 1996.

As in previous years, the general standard and quality of responses were wide–ranging. The standard of drawing still leaves much to be desired and students are again reminded that pencils, ruler and eraser should be used with care and precision. The correct use and conversion of units would help many students to improve their results, as would careful reading and analysis of each question before attempting to answer.

Students should be encouraged to give concise answers, taking into account the allocation of marks, particularly in the Options Paper.

Responses also indicated that more class–time needs to be spent on the application of science (in particular physics) to everyday examples.

PAPER I — CORE

SECTION II

Question 11

This was generally poorly done, with many candidates being unable to determine the mass of any of the elements in the unknown.

A large number of candidates failed to apply the law of conservation of mass to determine either the mass of the unknown organic substance or the mass of the oxygen in the unknown organic substance — depending on the method of calculation.

Many candidates recognised the need to calculate the mass of carbon (and hydrogen) in the carbon dioxide (and water) and were able to do this. They did not, however, know how to proceed from there.

Once the empirical formula was found correctly, there was no difficulty in determining the molecular formula.

Question 12

(a) The equation was very badly done. Few candidates realised that the hydrogen carbonate ion would act as an acid when titrated against sodium hydroxide.

(b) Although many candidates found the total volume of the diluted solution, a significant number of candidates missed the final step of calculating the volume of water required to dilute to that volume.

(c) Many candidates totally ignored the accuracy of the data and gave the final volume to the nearest mL instead of the three significant figures required.

Question 13

Candidates had difficulty in recognising the particular representation of carbohydrates and of an amino acid, but had little problem with the fat. Few used the terminology *monosaccharide*, opting instead for *glucose* which was acceptable. The amino acid and the fat each required two structural units. Formulae were not accepted when names were required.

Question 14

Candidates generally had few problems in the calculation of molar mass of the unknown gas but, once again, rounded off the numbers prematurely. Many gave the *formula* for the gas when asked to *name* it. Nevertheless, the equation was generally well done, although a significant number tried to produce sulfuric acid.

The claim that non–metallic oxides produce acidic solutions in water was accepted but it should be noted that some, notably carbon monoxide, are neutral.

Question 15

(a) Candidates answered this part of the question well. A few calculated the altitude difference twice, saying, for example:

Change in potential energy = mass x *gravity* x *(Δh - 371),* or

Mass x *gravity* x *(1017 - Δh).*

Students must beware of transcribing values from the question paper to the answer book incorrectly.

Some candidates showed confusion when attempting conversion between joule and kilojoule.

(b) This part was not answered as well as part (a). The main error was caused by failure of candidates to identify the connection between change in gravitational potential energy and work when determining the average power required. This confusion seems to have arisen from the inclusion of the distance value 31.0 km in the question. Further confusion arose with the time and energy units and the associated power units.

Question 16

(a) This part was very well answered. Only a small number of candidates failed to draw the required circuit diagram correctly. Some failed to put a power supply into the circuit, others used incorrect circuit symbols or included conductors that would have resulted in *short circuits*.

(b) Most candidates were able to calculate correctly the resistance of the unknown resistor *R*. A small number failed to include the unit for resistance in their answer.

Question 17

(a) (i) This part was generally well done. Some candidates were not able to measure the distance between the students correctly and, instead, measured between the outer edges of the dots. The other common mistake was not knowing how to calculate the appropriate time interval from the frequency value given. Some divided 50 by 60.

(ii) The law of Conservation of Momentum was well understood by the majority of candidates. The most common error was not to use the combined mass in the calculation of total momentum after the collision.

(b) Most candidates answered the question correctly. The most common error was to give a correct definition for an inelastic collision, but then failing to support the answer with calculations as required by the question. A small number of candidates defined an elastic collision as being one in which *momentum* rather than *kinetic energy* is conserved in the collision.

Question 18

(a) The majority of candidates were able to state a major feature of the DNA molecule.

(b) Many mistook *replication* for *transcription.*

Question 19

This was answered well by the majority of candidates.

Question 20

(a) A surprisingly large number of candidates were unable to name two differentiated cell types.

(b) The fact that palisade mesophyll is the major photosynthetic tissue was not well known. Most answers related superficially to chlorophyll.

(c) Few candidates did more than restate the question to explain why more growth occurs at warmer times.

SECTION III

Question 21

The majority of candidates answered this question poorly. Whilst having a basic understanding of the terms *covalent, metallic* and *ionic bonding,* they were unable to relate the type of bonding clearly to the structure of the substance and its properties.

Students did not confuse *intr**a**molecular forces* and *int**er**molecular forces*.

(a) **Substance A**

Many failed to specify **both** bonding and structure or to name the intermolecular forces.

Students tended simply to state the bonding present as well as the property that had led them to this conclusion but failed to link the two.

Substance B

Many failed to describe the nature of the bond in metallic substances. Answers that simply stated *It is a metal* or *It is metallic* were not accepted.

Those who clearly described the structure and bonding for graphite were given credit.

Substance C

This was dealt with better than the first two. Many lost marks as they failed to mention the regular lattice or array of ions of the solid state.

(b) A number of students failed to mention both covalent bonds and simple molecules when discussing the solid and the liquid state. Most failed to indicate that *D* must **react** with water to produce ions.

Question 22

This question was well done by the majority of candidates.

(a) Most students understood the concept of a reductant.

(b) (i) Many students failed to answer the question as asked, writing, instead, the name of a substance (eg potassium) or copying a half–equation from the data sheet. They did not write the **formula** of a substance that can readily act as a reductant. Few selected an obvious pair (from opposite ends of the table) and many selected pairs that were very close, even adjacent.

(ii) Only the better students were able to write a redox equation balanced for both atoms and charge and, therefore, representing this reaction.

(c) The most common error here was to describe potassium. Most chose fluorine but many explanations were either vague or false.

(d) The majority recognised potassium as being highly reactive but did not relate this to the fact that it is not found in its elemental form in nature.

Question 23

While this question began by stating that C_6H_{12} belongs to two different homologous series, in part (b) students were not directed to use **two different** homologous series to complete the table. This enabled a large number of candidates to complete the table correctly by using two alkenes,
eg 1 – hexene and 2 – hexene.

(a) A small number of candidates were able to define the term *homologous series* clearly. The most common error was to describe isomers.

(b) Many confused the name of the homologous series with the name of the molecule. Some did not know what *IUPAC Nomenclature* meant. Many structural formulae were carelessly done, some even drew a *skeleton* showing carbon atoms with sticks but not hydrogens.

Question 24

(a) Here most students chose a satisfactory scale and used a *LOBF [line of best fit]*.

(i) Some chose inappropriate scales, however, in order to 'fill the graph paper';

(ii) plotted with too large dots;

(iii) joined the data points;

(iv) did freehand *LOBF*.

(b) Most students realised that the gradient of the *LOBF* was the resistance. If their *LOBF* went through the origin, a simple substitution into Ohm's Law sufficed. If their *LOBF* did not, however, many did not use two points from it in order to find the gradients.

(c) This part was generally well done. Most students opted for the two step: find I, find $P=UI$ approach but a significant number could not find I correctly. Some had the foresight to choose a graph scale which allowed them to read I at $240v$ from their *LOBF*.

(d) Most used $Q=It$. Some did not convert time to seconds and a few went on to find the number of electrons from the number of coulombs. A few used $E=Pt$ followed by $q=\frac{w.}{v}$

Question 25

Most students had difficulty with this question. Its *2–dimensional appearance* left many to attempt *2–d* vector analysis when, in fact, closer examination would have revealed that this was not the case.

(a) Those who lost marks here did so because they either did not realise that *change* means final – initial, or that the final velocity had an opposite sign. Many did not give a direction for the Δp or any indication that p was a vector.

(b) Those who realised that this was *1–d* and who had correctly answered (a) could repeat the process successfully. Students who became confused with two dimensions were unable to answer the question correctly. Many talked about the two collisions at P cancelling each other out, leaving only the collision at Q.

(c) Most students who correctly answered this part gave the statement $W = \Delta KE$ and went on to calculate KE before and KE after. They then explained the correct answer of $W = 0$ in terms of V; and V_f being the same. Many incorrectly discussed the answer $W = 0$ in terms of $W = F_s$ and the walls not moving.

(d) Most students could recite Newton's Third Law but a significant number did not relate it to this specific situation. There was confusion regarding the existence of two forces and their separate points of application. Some students incorrectly referred to *elastic collisions* and *constant velocities* in trying to explain their answer.

Question 26

(a) Although a straightforward question, this was not well answered. Most students could describe the wide distribution, but too many still talked about *lived for a short time*, *existed for a short time*, *found in only one layer* etc. Any answer which could refer either to the lifetime of individual organisms (few students used the term *species*) **or** referred to the approximate length of time the fossil was in the rock *(fossil existed for a short time)* cannot be correct.

(b) (i) The major problem with this section was the generalised answer, for example, *destroyed (eg eaten) before burial*, *conditions were not right for fossil formation.*

(ii) Many students interpreted this question well. Some explained the impact of *fossils* rather than the impact of *gaps in the fossil record.* A worrying trend was attempts to explain the gaps by the concept of punctuated equilibrium which refers to the absence of *change* in fossils (before a sudden dramatic change) rather than the absence of *fossils*.

(c) Too many students described the formation of the molecules of life (eg, by Urey and Miller's experiment) rather than the first living cell on Earth.

Question 27

(a) This section was very well answered. A few students reversed the order of the changes in the animals illustrated and a few stated that changes had occurred, but did not describe *what* the changes were.

(b) Candidates generally understood this question well. Many did not refer the principle of natural selection to the specific changes shown. There was some confusion about explaining how ONE of the changes could have occurred.

(c) Most students realised that correlation would be necessary here and many explained the Law of Superposition. The idea of a relative timescale was not well understood.

Question 28

(a) Far too many candidates did not answer part (a) at all. Those who did attempt it generally gave the correct response.

(b) *P*

- Some candidates did not realise that feature *P* was a mid–ocean ridge, therefore their explanations were varied. Many of these candidates explained the formation of the *elongate mountain ranges* as a **convergent** plate boundary.
- Many candidates could not provide an adequate explanation for the cause of the *uplift* at MORs.
- Cross–sectional diagrams of plate boundary varied — most were well done.

Q

- This was surprisingly well done.
- Many candidates failed to indicate the location of the trench. A number labelled plates as being *heavy* or *light* instead of *dense*/*less dense*.

R

- Answers here were generally poor. Many candidates did not understand the tectonic origin of a broad flat abyssal plain.

(c) A number of candidates were confused in answering this question, stating that these earthquakes had *shallow and deep trenches* or simply were *deep* focus earthquakes.

Volcanoes: this part was generally well answered. A small percentage of candidates described the *formation* rather than the *nature* of the volcanoes.

Many tried to combine the information on earthquakes and volcanoes. They are better treated separately.

Question 29

(a) (i) Most students referred to the graph and answered this question adequately.

(ii) Some answers were poorly expressed so it was difficult to determine if the students had compared the *rates* of oxygen consumed rather than the *amount* of O_2 consumed.

(iii) Many students did not interpret the phrase *need to be controlled* as meaning *kept constant*.

(b) (i) The physics equations, especially conversions, were generally well understood.

(ii) The concept of power remaining constant was not widely recognised.

(iii) Candidates did not use biological reasons to explain decreased performance by the muscle. They tended to use popular non–biological reasons for poor performance.

Question 30

(a) Many candidates had difficulty in determining the direction of river flow in relation to the location of two other primary ore bodies. There was a tendency to locate the ore bodies downstream from the sediment.

(b) (i) Most could write a balanced equation for this reaction.

(ii) A number of candidates wrote the formula rather than the name of the oxidised species. Many incorrectly identified the oxidation state in FeS_2 as *Iron IV*.

(c) This part was well done.

(d) (i) Candidates had difficulty in identifying both the species of sulfide waste reacting and that being produced. Some had difficulty in balancing the equation.

(ii) Most candidates failed to link the denaturing of enzymes and, thus, reduction of metabolic activity resulting from the acid seepage from a dam such as that shown.

Paper II — Electives

Group 1 Biology Electives

Question 1 Flowering Plants and Mammals

(a) (i) This part was well answered.

(ii) Quality and care in drawings were still a problem; diagrams were very small and not well labelled.

(iii) Students did not handle this question well and the mechanism of stomate opening was badly explained. Answers were too general, with students saying, for example: *stomates open, CO_2 in, closed: no CO_2 in!*

(iv) Most students wrote O_2 but very few distinguished between water and water *vapour*.

(b) (i) On the whole this was handled well, although some students gave functional rather than physical features.

(ii) Answers here were reasonably good.

(c) (i)
and A great deal of confusion was evident between *diffusion, osmosis* and *active transport*,
(ii) with many students finding it difficult to differentiate between them.

(d) (i) Answers here were good.

(ii) On the whole this part was generally very poorly answered. Most students wrote *small intestine* for *place of absorption*; fewer gave *liver* as a stopping place for blood, then gave *body cells*, missing the major organs (heart and lungs) in between.

(e) Here candidates gave carbon dioxide in plasma as HCO_3 and red blood cell for O_2 (oxyhaemoglobin), answering the question well.

Carbaminohaemoglobin and dissolved CO_2 in blood were not often considered by students.

(f) (i) *Despite external changes* was rarely included in the definition.

(ii) This part was reasonably well done.

(iii) Flow diagrams were poor. Students became confused with only one side of balance, while the terms *INPUT* and *OUTPUT* seemed to confuse them, causing them to lose sight of the main idea.

(g) Answers here were reasonably good, although the mode of transport for plant hormones was not well understood. Many students did not show the ORGANISM's response, instead they discussed *cellular response*.

Question 2 Reproduction and Genetics

(a) (i)
and Students were inconsistent in their descriptions of differences between reproduction
(ii) methods, for example, plant and animal reproduction vs bacterial reproduction — on one hand they would describe *sexual* reproductive processes (plants and animals) and then describe *asexual* reproduction in bacteria. Many simply stated a different means of reproduction without answering in the format required by the question, ie '**DESCRIBE** one way ...'

Viral reproduction was generally well understood.

(b) (i) The majority of students understood the idea of variation's being an advantage, although most did not state this as being *genetic variation*. A number of students did not fully explain the **advantage** of genetic variation to a species.

(ii) Many candidates did not clearly express the concept of environmental pressures as a selection agent in the development of new species.

(c) (i), (ii) *and* (iii) The sections of this question were neither well understood nor well answered by most candidates. The majority were unable to distinguish between the sections of the question.

(d) (i) This part was generally well understood by most candidates.

(ii) Most aspects of this part were also well understood by the majority of students, although the action of ligases was often omitted.

(e) (i) This part was generally well done, although some students did not include their diagrams!

(ii) Answers here were very poor since most students attempted to answer the converse of the question. Few used experiments that had been carried out using genotypes, gametes etc, while many did not describe any experiment.

(f) Here students were asked to state the genotypes of parent plants — too many did not use conventional symbols that **clearly** showed dominant and recessive characteristics.

(g) (i) *and* (ii) Answers here were very good, although candidates did not know human parts and corresponding parts in plants!

(h) (i) *and* (ii) Answers to both parts were too general. Students described only one similarity and not one difference.

(i) Descriptions of the relevant process were very poor. Terminology was not understood, although candidates did attempt to use most terms.

The majority described the process in greater depth than was required by the question. The process of protein synthesis was emphasised but **not** transmission of genetic information.

Question 3 Micro–organisms and Disease

(a) Most candidates did not explain the cyclic changes in parasite numbers, ie, the difference in maximum numbers of parasites *A, B, C* and *D*. They thought that *A, B, C* and *D* were different parasites **not** different antigens on the one parasite as described in the question. The majority, however, did understand about mutation's giving rise to new surface antigens.

(b) (i) Some candidates did not understand the meaning of the word *dispersal*.

(ii) The description of the methods of control of dispersal of disease–carrying organisms was often too brief and was not couched in scientific language.

(c) On the whole, this question was well done.

(d) The use of the correct terminology was often poor and candidates frequently confused the pathogen with the disease. Many missed the role of the remaining antibodies and the importance of booster shots.

(e) (i) This was well–answered, although many candidates simply named the problem, without explaining it. They said: *antibiotics do not work against viruses* but did not explain why.

(ii) Answers here were generally good.

(iii) This was poorly answered since candidates showed no understanding of the details of the processes involved in the culture of viruses.

(f) This was poorly answered; candidates did not recognise any mechanism other than passive protection and then often only named the mechanism instead of *describing* it.

(g) In answering here candidates brought an understanding of the techniques of microbiology but often failed to answer the question asked.

Question 4 Coordination and Control

(a) (i) Candidates answered this well.

(ii) Candidates did not score well here since they discussed the straightening of the plant shoot in terms of *phototropism* , rather than *negative geotropism*.

(b) (i) Students found it easier to answer this question in terms of *parts of the CNS*. They received credit for this. Extra credit went to those who recognised that the question required a knowledge of *nerve tissue* plus any other tissue.

(ii) *Compare and Contrast* requires candidates to state similarities and differences in regard to heart muscle and skeletal muscle. The majority found it very difficult to state any similarities.

Many did not understand that both the autonomic nervous system and the somatic nervous system are parts of the peripheral nervous system.

(iii) Some students confused *substance present in the insulating sheath* with the substance in a neurone and talked about Na^+ and K^+ ions.

(c) Candidates described both systems instead of their **role** in maintaining homeostasis. Very few supplied a definition of homeostasis.

(d) Candidates were not specific in stating that plants *flowered* or *did not flower* under different conditions of light and dark. Instead they used words such as *grow* or *develop*.

Very few candidates could state an hypothesis to explain the relationship between the response of the plants and the light conditions.

A small number appeared to realise that the length of darkness is the critical factor in photoperiodism.

(e) Drawings were generally good. Students should pay more attention to labelling, eg, give a title to the type of neurone drawn; extend the label line to the structure specified.

(f) Answers here were generally good. Students should remember to use full names of hormones, not abbreviations.

Group 2 Chemistry Electives

Question 5 Energy

(a) (i) The majority of candidates understood well the uses of the fuels given.

(ii) Even though candidates appeared to have a good understanding of the characteristics of the fuels, in answering they selected trivial properties and had difficulty in writing a good definition of them.

(b) (i) Many candidates failed to recognise the sign ΔH for heats of combustion. When faced with a complicated problem of this type, students would be well advised to write equations to represent the data given. In doing so they could collect marks and also gain an insight into the direction of the problem.

(ii) There was significant ambiguity in the nature of the question here. Many candidates could not see the need for a nominated standard condition.

(c) (i) A number of candidates failed to distinguish between an *electrolytic* and an *electrochemical* cell, and the need for the external energy source in electrolysis.

(ii) Here many students wrongly chose electrodes that would take part in the reaction.

(iii) *and* (iv) Those who chose the correct electrodes managed the electrode reactions well and the majority successfully determined the minimum voltage.

(v) Tests for gases were often poorly described: both test and result were required here. Candidates who have studied 3/4 Unit Science should have been able to describe accurately the test for chlorine gas.

(vi) This question was handled well by most candidates.

Question 6 Atomic Structure and the Periodic Table

(a) (i) This straightforward question was very well done.

(ii) Most students recognised argon as an inert gas. Explanations were good, but the poorer students simply said *Group 8*.

(iii) A small number of students thought anions were positive and so chose calcium. Most chose fluoride and explained it well.

(iv) Valencies of phosphorous were only understood by the better students; few, however, understood how it can have a valency of 5.

(v) Although most candidates answered this well, a few gave representation of *Ca* rather than Ca^{2+}.

(vi) 1 Poor wording of this question cost many students marks. A number wrote incorrectly about *orbitals* and vaguely about *shells*. Few understood the term *subshell*.

2 On the whole this was well done, although axes were often omitted and seldom labelled.

(b) Stable Helium was understood with its complete *1s* shell. Many wrote: *Beryllium uses its p subshell to form compounds*. About half wrote of *Be* losing the two *2s* electrons to form Be^{2+} and compounds.

(c) (i) This part was generally well done, since most candidates knew of the trend in increased activity down the group. They were able to quote reactions of *Na* and C_5 with water.

Few gave balanced equations to illustrate their choice of reaction.

(ii) There was widespread confusion with this question. Some wrote: *Do you mean hydrogen or lithium?*.

Most students, however, managed to make a true statement to set either $H_{2(g)}$ or *Li*, apart from the other Group I metals.

(iii) The majority of students found it difficult to come up with a sound definition of *S–block*. Some referred to it as an area of the Periodic Table.

(d) Those who had not scored well earlier in the paper displayed a surprisingly good knowledge of the historical development of the atomic model.

The work of Bohr and that of Shroedinger were sometimes confused. That of Thomson and Rutherford, however, was better understood. Many students were vague about the work and contributions of Chadwick and Schroedinger.

Question 7 Carbon Chemistry

(a) (i) Those who tackled the flowchart in alphabetical order generally scored well in this question.

Difficulties arose for students who were unable to distinguish between the effects of hot concentrated and cold dilute $KMnO_4$.

Several candidates still omitted their hydrogen atoms in the structural formulae, although the majority wrote them correctly.

The structural formula for sodium butanoate was often poorly done, with candidates failing to recognise that it is an ionic compound.

(ii) *and* (iii) Answers to both these parts were generally good.

(b) (i) Most candidates recognised the use of concentrated sulfuric acid as the dehydrating agent and included it as a necessary condition without its being a reactant.

(ii) Too many candidates could not see beyond alcoholic drinks as a major industrial use for ethanol. Although production of alcoholic beverages is carried out on an industrial scale, ethanol is not a starting point for such production. Its use as a solvent in the manufacture of esters and perfumes or as a fuel should be stressed.

(iii) In discussing the making of ethanol in a school, *fermentation* was the most common method cited but candidates often found writing the equation difficult. *Hydration of ethene* (**not** *hydrolysis of ethene*) was equally acceptable, as was substitution of an alkyldalide using aqueous *NaOH*. The name of the process was often overlooked in the answer.

(c) (i) The equation for the production of the ester was generally handled well, but a large number of candidates failed to include water as a product or to indicate the need for concentrated sulfuric acid when writing the equation.

(ii) Answers to this part were generally good.

(iii) The diagrams of the equipment used for refluxing would suggest that few candidates had actually handled such equipment or had its operation explained in detail. Many failed to show that:

- flask and condenser are two separate pieces of equipment, and
- they must fit snugly together to prevent loss of any vapour
- the top of the condenser must be open (ie no plug, no thermometer) to avoid an explosion
- there is a jacket of water around the central tube of the condenser.

Direction of the water flow should be included.

(iv) Candidates need to recognise that at the temperatures needed for a reasonable yield, the reactants will vaporise, therefore their vapours need to be condensed to return to the reaction vessel.

Group 3 Geology Electives

Question 8 Regional Geology

No candidates attempted this question.

Question 9 Mountains

(a) This part was very well done, although some candidates thought that the active volcanoes in Group 1 were on an ocean–continent convergent boundary and that the properties of those in Group 2 lie somewhere between Group 1 and Group 3.

(b) (i) Answers here were good.

(ii) Candidates had trouble in presenting a good cross–sectional diagram through a continental fold mountain system to illustrate the main tectonic and geological features present.

(iii) Most candidates could name a rock that occurs in fold mountains, but only a few described the rock, consequently answers were poor.

(iv) Most answers here were good.

(c) This was also well done. Some candidates, however, confused a *shield area* with a *shield volcano*.

Group 4 Physics Electives

Question 10 Electromagnetism

(a) Most students understood that relative movement between the circular conductor and the horseshoe magnet was required, but some did not describe the direction of this movement clearly.

(b) (i) The majority of candidates correctly identified which sides experienced a significant *e.m.f.* Many, however, were unable to use the information in the question to determine the length of the sides.

(ii) Some candidates confused the concept of *induced e.m.f.* and current flow in the loop of wire.

(c) (i) Most candidates selected and used the appropriate equation, correctly identifying the charge *q* and *sen 0*.

(ii) The majority of students used an appropriate *hand rule* correctly and readily identified the relative motion between the charge and the field, but some had difficulty in showing the path taken by the electron in their diagrams; this involved parallel field lines.

(d) Although students readily applied Lenz's Law to this situation, this usually resulted in the wrong direction of rotation. Many correctly used the concepts of eddy currents and induced magnetic fields, although some failed to note all the information given in the text of the question.

(e) Candidates were confused in their use of the terms *eddy currents* and *back e.m.f.* Some were unable to identify the relationship between the iron rod and the solenoid.

A significant number discussed only the function of AC transformers.

(f) (i) Most candidates correctly applied the equation for magnetic flux. A number, however, were unable to convert the area from cm^2 to m^2.

(ii) The absence of a value for l meant that most students ignored l in the equation.

(g) The majority of candidates answered this well.

(h) (i) On the whole answers here were good.

(ii) Few candidates showed that they did not understand the orientation of a field around a conductor, but a significant number failed to show this orientation clearly with their diagrams.

(i) This part was generally answered well.

Some confusion arose in the use of the terms *force* and *torque* and many descriptions were not good.

Question 11 Oscillations and Waves

(a) (i) This question was well answered by the majority of candidates. A small number (approximately 5%), however, used incorrect units.

(ii) This question was well answered by most candidates.

(iii) Almost all candidates answered this question well. The most common source of error was the incorrect transposition of data from elsewhere within the question.

(iv) This part was well answered by the majority of candidates. Errors were often made in choosing the *mass of a hydrogen* atom for the mass volume rather than the *mass of an electron.*

Some candidates used up to eight significant figures in their answers, showing unfamiliarity with the correct use of significant figures, while a small number incorrectly tried to convert mass values from kilograms into grams.

(b) (i) Approximately two–thirds of the candidature used the appropriate formula $T = \pi \sqrt{\frac{m}{k}}$; only a small number used the formula $f = \frac{1}{2\pi} \sqrt{\frac{k}{m}}$ as an acceptable substitute.

Many candidates incorrectly tried to use $Mg = kx$; they confused the amplitude of oscillation with the extension of a spring due to a hanging mass.

A number of candidates used Newtons as their units rather than Newtons.metre^{-1}.

(ii) Some candidates were unable to address the question of energy transformation, others did not recognise that there were two positions (at the extremes) at which Potential Energy was *at a maximum*.

In their answers candidates often did not make it clear that the change between Potential Energy and Kinetic Energy was a continuous process with *PE + KE = constant*.

(iii) Almost all candidates were able to draw a suitable displacement–time graph of the movement of the web. Some candidates did not calculate the period of the oscillation and, therefore, did not supply the required numerical data from the time axis.

(iv) Fewer than half of the candidature were able to identify the process as being *Resonance*; frequently the process was incorrectly identified as being *Constructive Interference*. Many did not supply an appropriate explanation of *resonance,* particularly ignoring the idea of *energy transfer*.

(c) (i)
and The majority of candidates could correctly identify **and** name the type of waves produced,
(ii) both horizontally and vertically. Many, however, offered inadequate descriptions of these waves. Frequently they did not relate the relationship between the *motion of the particles* within the metal rod with the direction of *energy transfer*.

(d) (i) This question was well answered, most of the candidature could correctly determine the wavelength.

(ii) The majority of candidates could correctly name two changes to a wave at a boundary. A large number, however, did not attempt to **describe** the changes as required by the question.

(iii) 1 This part was well answered. The majority of candidates could correctly draw a suitable diagram of reflected waves and explain how the spectrum is produced. Many diagrams were, however, poorly drawn.

2 Many candidates could correctly draw a suitable diagram of refracted waves. A small proportion, however, did not draw waves that were refracted *towards the normal*.

(iv) A number of students failed to indicate clearly what change in the energy of the wave would occur at a boundary.

(e) (i) Less than 50% of candidates could correctly identify the process involved as being *diffraction*.

(ii) Few candidates gave a good explanation of how diffraction would relate to the reception of radio waves.

A number of candidates believed that radio waves are a type of sound wave. This question was generally poorly answered.

(f) (i) The majority of candidates could correctly calculate wavelength. A number, however, did not make the additional calculations to find the length of the string.

(ii) This question was poorly answered. Few candidates recognised the need to use the velocity of sound in air to find the wavelength and the necessary length of the closed organ pipe. The majority of students incorrectly used the speed of the wave in the string of part (i) for the velocity of sound.

(iii) 1
and Most candidates correctly answered both of these questions with appropriate diagrams.
2 A significant number, however, presented poorly drawn diagrams without the aid of pencil or rule.

Some incorrectly answered these questions with diagrams of the fundamental modes rather than the required first overtone modes of vibration.

Question 12 Light

(a) (i) This part was not well done. Too many candidates confused *wavefronts* with *rays*. Many did not draw a secondary wavelet correctly and did not seem to know what *wavelets* meant or how to use them to obtain the refracted wavefront.

(ii) Answers here were also very badly done, with many candidates offering poor exmplanations. A surprisingly large number of students drew light going from the eye to the bottom of the pool. Too many did not draw the two rays needed to indicate the position of the image.

(b) (i) This part was very well answered. Most candidates correctly calculated the two angles of refraction and then subtracted to obtain the angle of dispersion.

(ii) This was not as well done as the previous part. Even after correctly calculating the angles in part (i) candidates did not draw the colours in the correct positions.

(iii) This part was badly done. Candidates did not know that the separation of colours was due to interference and used the word *dispersion*. Another misconception was that the separation was due to red light diffracting more than blue light.

(c) (i) This was correctly answered by most candidates.

(ii) This part was badly answered. It appears that candidates had not studied the astronomical telescope. Common errors were:

- lack of direction arrows
- light from the object did not consist of parallel rays, ie, the object was not at infinity
- face of the eyepiece and objective lens were not superimposed
- no indication was given of appropriate focal lengths, ie 38cm and 5cm, while rays to the eye were not parallel.

(iii) This part was generally well answered. The reasons given for the different wavelengths were rather confused.

(iv) Most candidates were not awarded full marks for this part because they failed to give a reason for the blurring of the image. Many gave spherical or chromatic aberration as the reason for the blurring, whereas the question asked about *interference effects*.

(d) (i) On the whole this part was answered well. The most common error was giving photosynthesis as an example of the photoelectric effect.

(ii) This part was well done.

(e) (i) Answers here were generally good. The following were common errors:

- forgetting to multiply by 9
- failing to convert *nm* to *m* correctly.

(ii) This part was not very well answered. The most common error was failing to mention energy.

(f) This part was very well done and most candidates gained full marks.

Question 13 Biochemistry

The majority of students produced well–thought–out answers and explained themselves well.

Areas of strength:

- Enzyme action was well understood, as were:
- *DNA, RNA* structure
- Sites of respiration
- Energy production in (ii) and (iv)

Area of weakness:

- Designing investigations using scientific method.

Question 14 Photography

Only a very small number of candidates attempted this question. They all displayed an excellent knowledge of the subject material and a strong understanding of the processes.

No common areas of weakness were identified.

Question 15 Physics in Medicine

(a) (i) This part was answered well. Some students gave indefinite (eg *patients*) or imprecise answers (*eg cords*).

(ii) This part was very well answered by most students.

(b) Some candidates appeared to confuse thermocouple devices used in medicine with those used in industry.

(i) The majority of candidates answered this part well.

(ii) This part was not as well answered as the previous part because some students gave superficial descriptions, saying, for example, *unsafe, impractical*, showing little depth in their responses.

(c) Many candidates gave an excellent description of the measurement of blood pressure, accurately describing what each number represents. Some students **defined** systolic and diastolic pressures without explaining **how** they are measured.

(d) (i) Students had great difficulty in answering this question. No one knew the name of a specific medical instrument that uses ultrasound.

(ii) Most students had a general idea of ultrasound measurements; only about 20% could describe, however, the key energy transformations in the pizoelectric transducer.

(iii) Answers here were fairly good, although many students simply referred to the danger of *rays* in alternative medical techniques.

(e) The majority of students were not prepared for quantitative questions on this section of the Syllabus.

(i) Only 5% of students were able to calculate the correct answer in this part, which was not well done.

(ii) The majority of students (60%) knew the relationship between dose per second, mass and energy.

(iii)
and Most candidates answered this part well. A common error was to relate the answer in (i) to
(iv) parts (ii), (iii) and (iv). It appeared that the more capable students were able to determine (correctly) the relationships in part (iv).

(f) (i) Answers to this were not very good — the majority of candidates were able to describe (many using diagrams) the basic workings of optical fibres, but less than half could clearly explain in terms of optics *(critical angle, Total Internal Reflection)* how light is transmitted along an optical fibre. Those who could do so wrote excellent answers.

(ii) Candidates answered this part very well.

(g) As in (f)(i), many answers lacked detail, saying for example, *powerful, very intense,* without providing a description in terms of physical properties, simply saying, for example, *coherence.* Many students appeared to have rote–learned *coherence, monochromatic, collimated* using terms inappropriately and contradictorily.

Question 16 Space Science

(a) (i)
and Answers to both sub–sections were good.
(ii)

(b) Answers to this section were also good.

(c) In answering this part some students simply described Newton's Third Law without applying it to the question. Few could describe the workings of a rocket in terms of conservation of momentum.

(d) (i)
and These parts were answered very well.
(ii)

(e) Approximately a third of the students discussed the orbit of the spacecraft rather than the gravitational effects on the space debris. Such students were clearly unable to identify what the question was asking.

(f) Approximately a third of the candidature included Mars as an *outer planet*, otherwise this was well answered.

(g) Answers here were fairly good. The question gave scope for some excellent answers, nevertheless, some responses were superficial and/or did not relate to the **biological** problems in the question.