1995 HIGHER SCHOOL CERTIFICATE EXAMINATION

Science 3/4 Unit

In 1995 235 candidates presented for the 3 Unit paper and 608 candidates for the 4 Unit paper, making a total of 843, a slight decrease on the candidature for 1994.

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 1 — CORE

SECTION I

Question	Correct Answer	Question	Correct Answer
1	B	6	A
2	C	7	B
3	D	8	D
4	C	9	A
5	B	10	B

SECTION II

Question 11

This question was well answered by the majority of candidates.

(a) Candidates' ability to write acid/base equations was good; a significant number, however, did not use the correct physical states.

(b) Some candidates were unable to use volumes and concentrations to calculate moles. The majority correctly used molar ratios (from equations) and calculated molar masses. Some, however, had problems with appropriate units.

Question 12

(a) This was generally well done, the major error arising was the use of the incorrect formula for ammonium bromide. A minor error was the rounding down of the atomic mass of bromine from 79.9 to 79.

(b) This was done correctly by the majority of candidates. Some, however, changed their correct answer to *ionic*. A small but significant number inappropriately used the term *hydrogen bonding*.

(c) This question was poorly done by the majority. Major errors included:

- not stating the fact that dissociated ions were mobile
- confusing the valency within the ammonium ion with the ionic bonding of ammonium bromide
- using the term *electron* instead of the term *ion*.

Question 13

This was poorly answered by the majority of students.

(a) Major errors included:

1. incorrect valency for silver ions
2. inability to write ionic equations (however, once written correctly, candidates could balance the ionic equations)
3. the reactions of Group 1 metal with water make them unsuitable ions.

(b) Most candidates could not state the oxidant as being the silver ions, incorrectly preferring to use *silver* or *silver nitrate*.

Question 14

On the whole this was well answered. The majority of candidates correctly named C_2H_2OH and were able to write the formula for octane. Some confusion arose over use of the term *importance* in reference to octane, with a significant number of candidates referring to octane as *a fuel additive* or *a gas*. Rarely did candidates recognise H_2NCH_2COOH as glycine. Many, however, identified this as an amino acid. A number of candidates were confused between *glycine* and the components of *DNA*. It was this part of the question that most candidates found difficult.

Question 15

(a) This was generally well answered.

(b) There was a lack of understanding of the forces acting on the skier which led many candidates either to:

- use incorrectly F = mg = 490N

OR

- calculate nett force (25N) incorrectly as the opposing force.

There was some confusion with units and many candidates seemed to be unaware that

work done against friction = Fs = $E_{P(initial)}$ - $E_{K(final)}$, and

gave the answer as F = 12,200 joule.

Question 16

This question was generally well answered, with adequate working being shown. A large number of candidates failed to convert data to S.I. units.

(b) Many candidates failed to *explain* how this heat energy was *lost*, and used one word, eg *impact*, which was inadequate.

Question 17

(a) Some very poor circuits were drawn, although most candidates realised that the unknown resistor needed to be put in series.

(b) Many candidates failed to distinguish between total resistance of the circuit and the resistance of the lamp. Hence they failed to realise that the required resistance was **not** the resistance of the lamp.

Question 18

This was well answered by the majority of candidates.

(a) Most candidates were able to recall the equation for kinetic energy although a small number failed to square *v* when substituting. A significant number failed to convert velocity from kmh^{-1} *to* ms^{-1}.

(b) A significant number of candidates failed to see this part of the question as an application of the law of Conservation of Momentum, using, instead, Conservation of Kinetic Energy.

(c) The majority of candidates correctly calculated final kinetic energy and determined the kinetic energy lost.

Question 19

This question was poorly answered in parts (a) and (b). The majority of candidates were unable to identify the cause of the changes in the graph. Few associated the change with either respiration or photosynthesis. Most incorrectly identified the reason for change as movement of water in and out of the seed caused by either osmosis, change in environment, age of the seed or action of the oven. Many of these candidates assumed it was the same sample of seeds being measured each time. A significant number also attributed the weight change to mitosis.

Question 20

The majority of candidates were able to identify water content as the unwanted variable. Answers here were generally good.

(a) Most candidates could readily correlate all beds except the mudstone containing the mollusc/leaf in the RH column. Many incorrectly correlated this with either the mudstone containing the echinoid bed or the limestone bed in the LH column. A small but significant group simply linked identical fossils, ignoring sediment types.

(b) Candidates correctly responded here with a range of geological principles often including an explanation/definition in addition to the name. The most frequent response was *the Principle of Superposition.* A significant number of candidates gave contradictory definitions of their named principle, while an even smaller number stated vague *principles* such as stratigraphic correlation, or else wrote an obscure explanation of no specific named principle.

(c) The concept of an index fossil was generally well understood and applied. A small but significant number of candidates, when referring to the columns illustrated, were vague or ambiguous in their use of terms such as *beds, strata, layers* and *sediment.*

SECTION III

Question 21

(a) The majority of candidates could write the balanced equation.

(b) This was generally well done. Some candidates, however, failed to use the mole ratio from the equation they had written.

(c) Although the question asked for a prediction of *pH*, a number of students did not state a numerical value or possible range of *pH*. Many failed to realise that it was the oxides of carbon and nitrogen which made the solution acidic.

Question 22

(a) A number of candidates contradicted themselves when giving electron dot and structural formulae. Students did not realise that the octet rule could be obeyed by using co-ordinate covalent bonds.

(b) (i) It is important to note that many ionic compounds have higher *M.P*s than SiO_2.

(ii) A number of candidates failed to describe both structure and bonding as being distinct from each other. The majority showed some confusion about the nature of the structural units, ie molecule, ion, atom. Many failed to explain clearly that M.P. depends on the energy required to break up the structure.

Question 23

(a) (i) Fewer than 50% of candidates used the systematic form of phosphorus (V) oxide in their answer. This was despite the use of systematic naming used in Question 21.

(ii) Few candidates found this section difficult. A significant number, however, did not use subscripts even though 'solid P_2O_5' was stated in the question.

(b) (i) Most candidates could calculate the number of moles of P_2O_5, but many did not then connect the 1 : 2 mole ratio from the equation to find the molar concentration of the H_3PO_4 acid.

(ii) The majority of candidates could calculate the number of moles in the 25 mL sample of acid. Writing a balanced equation then assisted many to recognise the 3 : 1 mole ratio of *NaOH* and acid.

Question 24

(a) (i) This was generally well done. A small number of candidates failed to convert centimetres to metres and a few candidates tried to use the relationship $v^2 = u^2 + 2as$ which gives the numerical answer to the problem.

(ii) Answers here were poor. A minority of candidates recognised that, from release to impact, the first ball constituted an isolated system in which there was no energy loss. The majority of candidates answered the question by stating that this is an elastic collision and so all energy is conserved.

(b) (i) The majority of candidates were able to start correctly by writing an expression using the conservation of momentum as directed. A significant number, however, failed to recognise the fact that the final velocities had opposite directions and so failed to find the correct answer.

(ii) Most candidates successful in (b) (i) were also successful here. Those with an incorrect value from (b) (i) found that the KE values were not equal. Many simply stopped, making no effort to resolve the situation, while others explained the inequality or *fudged* the correct result. A significant number simply stated $E_{K(before)} = E_{K(after)}$ without performing any calculation.

Question 25

(a) (i) This was generally well done although a significant number of candidates failed to convert mass to kilograms.

(ii) This was very well done.

(b) This was well done by the majority. The most common error was to write *area = spring constant* or *area = pressure*. Many candidates assumed that the graph was for the particular situation described in the question and referred to the bullet and block in the answer.

(c) Answers here were quite poor. Many candidates referred to compression of the spring as the cause of the loss of mechanical energy. A significant number attributed the loss of energy to friction between the block and the smooth surface, while some candidates used the graph to calculate the work done on the spring and compared this to the initial energy of the bullet.

Question 26

(a) This question was well done by the majority of candidates, the most common error being a failure to invert 1/R when calculating the resistance of the parallel section.

(b) Most candidates were able to calculate the total current and potential difference across the 10 Ω resistor. The most common error was to find the potential difference across the section and then either divide equally (6V each) or in proportion (4V and 8V).

(c) This was well done by those successful in (a) and (b), the most common errors being:

- using current as 0.3A for all resistors
- using 15V across all three resistors (even those who had correctly calculated part (b) did this).

Question 27

(a) (i) Labelling of axes was excellent. Scales on axes chosen varied, with some candidates using cumbersome numbering systems. Points were well plotted but many candidates were unable to draw a smooth line of best fit without extrapolation.

(i) This was generally well done. A significant proportion of candidates, however, failed to describe the complete relationship between temperature and photosynthesis. Some attempted to describe, inaccurately, a mathematical relationship between the variables.

(b) Many candidates did not score full marks for this question. Errors included:

- failure to understand the meaning of *controlled* experiments
- using temperature as one of their controlled factors
- giving generalised answers rather than specific points.

(c) Some excellent responses were provided by a number of candidates, with many merging chemical/physical/biological/geological concepts to produce a detailed response. The most common error was repeating a factor already given as an answer from part (b).

Question 28

(a) While most candidates showed that they had a good knowledge of plate tectonics, many failed to answer the question, referring to continental evidence rather than evidence from the Southern Ocean, as was required.

(b) A majority of candidates answered poorly, giving as the answer *mid-ocean ridge*, others cited minor local geological features.

(c) A significant number of candidates calculated the rate of Australia's spreading from the ridge, ie half the rate of continental separation. Many were either careless in making the required measurement or used an illogical measurement.

SECTION IV

Question 29

(a) (i) Most candidates answered correctly, although a significant number gave *copper* which is the least easily oxidised.

(ii) Most candidates could write the correct oxidation half-equation, but a significant number gave the half-equation for reduction of sulfate ions. Some gave the hydrogen ion as $H_2^{+}{}_{(aq)}$. It should be noted that the charges on ions are significant; there was evidence of carelessness here.

Many gave the correct equation, but it was clear that a number produced this without the half-equations.

(iii) This was well answered, although some candidates gave the formula rather than the name as required.

(b) (i) The half-equation for the reduction of copper ions in $CuFeS_2$ to copper ions in Cu_2S was poorly done and many candidates failed to recognise that the Cu^{2+} ions were only reduced to the Cu^{+} ions in this reaction.

(ii) Most candidates answered this well.

(iii) This was reasonably well done, although a number of candidates were unable to give an explanation of the 'term' *oxidised*.

(iv) This was generally well done. Many candidates, however, failed to take into account the mole ratios between copper and sulfur dioxide.

(v) Answers here were good.

(c) Step 1 — This was well done; some candidates, however, failed to include states of matter on all reagents.

Step 2 — A significant number of candidates did not answer this part well because they did not give the correct formula for tin (IV) oxide. They did, however, balance the equation correctly.

Question 30

(a) Some candidates had difficulty in distinguishing *origin of life* from *evolution of life* on earth. Others confused *origin of life* with *origin of earth*.

Those who chose to describe a cosmic origin theory gave very general answers which scored poorly. Students should attempt to list specific elements and compounds involved and describe the conditions necessary to explain their chosen theory.

(b) Candidates were sometimes able to guess that 40K was the preferred isotope to use but could not supply a valid reason for their choice; they needed to explain the useful range of isotopes. Answers were not given on the basis of half-life but rather incorrectly focused on the organic nature of fish.

PAPER 2 — ELECTIVES

In answering the electives many candidates failed to indicate which parts of the elective they were answering and failed to follow the lettering and numbering of part-questions. This made it extremely difficult to mark the responses.

GROUP I — BIOLOGY ELECTIVES

Elective B1 — Flowering Plants and Animals

Question 1

(a) Many candidates failed to recognise that transpiration does not rely on metabolic processes but on physical factors.

(b) (i) A number of candidates simply restated the observations and failed to draw meaningful conclusions. Candidates used information from outside the question and complicated their answers to their own detriment.

(ii) The term *control* was well known; the significance of the shoots marked (a) was less well understood, however.

(c) The majority of candidates were aware that hormone responses are slow but had difficulty in explaining why this is so.

(d) (i) This was reasonably well done.

(ii) Difficulty occurred here in distinguishing between *absorption* and *transportation*.

(e) (i) This part was very well done.

(ii) Answers here were good.

(iii) Candidates tended to write generalisations in answering this rather than specific comments about cellular chemistry

(iv) This was well understood.

(f) Here candidates displayed very poor diagram-drawing skills. Labelling, detail, scale, sequencing were all of a lower standard than expected.

(g) This was generally well done.

(h) Answers here lacked structure and systematic development of the relationship between plant growth and the method of correction.

Elective B2 — Reproduction and Genetics

Question 2

(a) (i) Most candidates answered this question satisfactorily.

(ii) Many candidates failed to note that mutation is a source of genetic variation in asexually reproducing organisms.

(b) Many candidates did not identify sexual reproduction as the source of genetic variation; some tended to write Lamarckian explanations for the inheritance of variation.

(c) (i) This was generally well answered.

(ii) 1. Some candidates confused the type of cell division with *crossing over*.

2. Drawings were poor and often did not show the end of the specific cell division.

3. Students confused linkage with gene proximity on the chromosome.

(d) (i) and (ii) Most candidates described features of bacteria reproduction but did not say how these were similar to or different from plant and animal reproduction.

(e) Some candidates assumed that the characteristic was sex-linked. When the correct pedigree was selected the explanation was often verbose instead of using a labelled punnet square or diagram.

(f) (i) and (ii) Most candidates answered these questions well. Some, however, confused genes with chromosomes.

(g) Most candidates produced appropriate diagrams with the correct pairing; the descriptions of the process, however, were often too general, failing to give specific information.

(h) (i) Most candidates knew the process well.

(ii) Often candidates described the significance of cloning, but were unsure of the details of technique.

(i) Candidates satisfactorily drew the punnet squares to explain crosses but failed to identify *genotype*, *phenotype* and *gametes* as required by the question.

Elective B3 — Micro-organisms and Disease

Question 3

(a) Many candidates were unable to apply Koch's postulates fully to this example. They either repeated Koch's work, making only slight reference to the question, or ignored him altogether. The latter stages of applying Koch's postulates to this question were rarely understood. Many candidates used incorrect terminology.

(b) (i) The majority of candidates were aware of the *relationship* between antigens and antibodies, but some were unable to demonstrate clearly how one influenced the other.

(ii) Most candidates were aware of the specific nature of the relationship between antigen and antibody, but were unable to extend this relationship to respond fully to the question. A significant number of candidates were confused over the definition of *disease*, *antigen* and *pathogen*.

(c) (i) and (ii) Most candidates responded to this section satisfactorily.

(d) (i) The majority of candidates were aware of the arguments *for* and *against* viruses being classed as living things.

(ii) Most candidates could supply one reason to show why it is difficult to treat viral diseases once they have been contracted. Fewer candidates were successful in supplying more than one reason.

(e) (i) A large number of candidates could supply the name of a bacterium that causes a human disease.

(ii) Many candidates could not explain how the disease-causing organism is brought to the actual site of infection on or in the human body.

(iii) The majority were able to supply a number of measures to prevent the spread of disease. Many candidates, however, failed to show how the measure selected can prevent the spread of disease.

(f) (i) A number of candidates failed to explain fully how the micro-organism they chose is of positive economic benefit.

(ii) Candidates were more successful in explaining how economic loss is caused by their specific micro-organism than in answering part (i).

(g) The majority of candidates could list a number of measures that could be taken to prevent the establishment of disease in Australia, but fewer were able to explain satisfactorily how their specific measures would do this.

Elective B4 — Coordination and Control

Question 4

(a) (i) A – most candidates recognised *resting potential*, although few could explain it.

B and C – both areas were quite well done by the candidature.

(b) (i) The majority of candidates recognised structural differences, although very few could state two different functional differences.

(ii) Most of the candidates understood how the autonomic nervous system controls homeostasis directly, although the majority did not relate the autonomic nervous system back to the central nervous system.

(c) This was very well answered by all candidates.

(d) The majority listed differences between the action of the nervous and the endocrine systems; very few stated any similarity.

(e) Almost half of the candidates were able to show the interaction between the nervous and the endocrine systems; the rest stated one or the other, but showed no interaction.

(f) (i) Hormones that produce a short-term effect were well known by the majority of candidates.

(ii) Few were able to explain how the short-term effect of a hormone benefits a mammal.

(g) (i) Most candidates understood the idea of homeostasis but could not include the concept of maintaining this against disruptions in the environment.

(ii) Students did not clearly describe the situation in which the glucose level was low and many answered without reference to insulin and the diagram.

(h) Many candidates incorrectly used growth or hormonal responses instead of the nastic movements required. The function of controlling stomatal pores was poorly understood.

(i) Most students were able to answer this correctly.

GROUP 2 — CHEMISTRY ELECTIVES

Elective CH1 — Energy

Question 5

(a) (i) This was generally well done. Some candidates failed to recognise that the heat gained by the water was equivalent to the heat released by the combustion of the ethene, and were unable to complete the calculation. Care should be taken with units.

A number were confused about the term *heat of combustion* and could not decide whether ΔH_c should be positive or negative.

(ii) Most candidates decided that the experimental value would be less than the accepted value but failed to show that they had taken note of the particular experimental set-up. Many used too general an explanation of *heat being lost to the surroundings*.

(b) Generally the equations were well written, although, in some cases, candidates failed to balance the oxygen correctly.

Many candidates were unsure which of the *breaking* bonds and *forming* bonds were exothermic. This resulted in confusion over positive and negative signs. It is emphasised that care should be taken with units.

(c) This question was poorly answered by most candidates. Very few attempted to *explain* what was happening at the different stages indicated, or to refer to energy being used to overcome intermolecular bonds.

A common error was to start with liquid water and assume that *A-B* referred to the boiling and change of state from a liquid to a gas and that at *C-D* atomisation takes place when this would not be possible with the *gentle* heating indicated by the question.

(d) (i) Equation writing was generally well done.

(ii) Common errors here included the use of incorrect signs, incorrect multiplication during the calculation and carelessness with assigning appropriate units.

(e) (i) Significant numbers of candidates apparently did not understand the meaning of the term *energy transformation*, while others did not restrict their *transformation* to one involved in the combustion process.

(ii), (iii) and (iv) Candidates showed good general knowledge of pollution and alternative energy sources.

(f) (i) This was generally well done. Most candidates selected the appropriate equation from the data sheet.

(ii) Answers here were generally good.

(iii) Many candidates identified a suitable electrolyte as being *alkaline* but very few could effectively explain their answer.

(g) (i) This part was generally well done.

(ii), (iii) and (iv) Answers here were very good.

Elective CH2 — Atomic Structure and the Periodic Table

Question 6

(a) (i) Most answers here were good.

(ii) Many repeated the information given in the rubric to the question rather than mentioning the uniqueness of each element's spectrum, which is the general principle behind Crookes' deduction.

(iii) Candidates tended to explain the straight line travel of cathode rays by describing the formation of a shadow in a Maltese Cross tube rather than recognising the fact that electrons are being accelerated in an electric field. In the paddle wheel experiment the explanation in terms of mass, momentum or kinetic energy rather than just energy was needed. Candidates were confused about magnetic and electric fields in discussing deflection of electrons with the *positive* pole of the magnet often being mentioned. Only the very best candidates realised that the deflection was at right angles to the magnetic field.

(b) (i) and (ii) These parts were well answered. Pictorial representations showing shells or orbital boxes were accepted.

(iii) Poor use of terminology was common in this question, with the phrases *chloride atom* or *chlorine ion* often being used. Candidates failed to differentiate between a complete sub-shell and a complete outer shell which infers a complete *d* sub-shell also.

(iv) Many candidates did not interpret correctly key words in questions such as *how, why, explain*. Often they described similarities in the behaviour of chlorine and hydrogen rather than explaining it.

(v) Few candidates could provide more than one reason for not grouping hydrogen with chlorine.

(vi) Many answers were excellent. Some candidates, however, were unable to contrast the non-metallic properties of chlorine with the metallic properties of potassium.

(c) (i) This was well answered, with the reactivity of potassium with water or air being mentioned consistently.

(ii) Here some candidates gave physical properties rather than chemical properties. Most gave general metallic properties rather than one specific to Group 1. An equation to illustrate the given property always improves the quality of answer.

(iii) Many candidates *described* rather than *explained* the difference between the behaviour of potassium and rubidium.

(d) The majority of candidates wrote what they knew about Mendeleev's periodic table rather than relating properties to electron configuration and, so, to energy levels.

(e) (i) This part was generally well answered though a few candidates were confused as to block position because the *s* sub-shell appeared last in elements Q and Z.

(ii) Many described chemical *not* physical properties or gave a garbled mixture of both.

(f) (i) Very few answered this question by referring specifically to hydrogen. A diagram showing the discrete energy levels of the atom and the variety of different transitions possible between energy levels would have been appropriate.

(ii) Often candidates re-stated the question rather than describing the shortcomings of Bohr's atomic model.

(iii) Some excellent answers were given but many candidates had no knowledge at all of Schrödinger or else confused his contribution with that of Heisenberg.

(iv) The better students were able to state the Pauli exclusion principle, but many answers lacked precision, commonly confusing orbitals with sub-shells or shells.

Elective CH3 — Carbon Chemistry

Question 7

(a) (i) Many answers showed some confusion as to whether intermolecular or intramolecular bonds are broken when a liquid boils. This applied particularly to the benzene molecule, many candidates relating its relatively high boiling point to the delocalised electrons within the ring factors affecting water. Solubility was generally well understood.

(ii) A surprising number of candidates did not know an industrial use for benzene. Most could give a use for propane and 1,2-ethanedial.

(b) (i) The test to distinguish between acetylene and ethane was better known than that to distinguish between 1-propanol and 2-propanol. In many answers candidates were unable to distinguish between oxidation products of the 2 alcohols.

(ii) Equations were well written, although some candidates found it difficult to balance them.

(c) (i) This question was well answered.

(ii) Whilst most candidates were able to give the structure of glycerol, very few gave both the products.

(d) (i) This was well answered.

(ii) Very few answers could give three special conditions required for this reaction. Most could only give one.

(iii) A common error was the omission of H_20 from the balanced equation for this reaction.

(e) Very few candidates were unable to identify the compounds and reactions contained in the flow chart; as a result parts (i) and (ii) were well answered.

(iii) Many answers did not specify that either *potassium permanganate* or *potassium dichromate* need to be acidified or that sulfuric acid needs to be concentrated.

(iv) In most answers, although reactants and products were shown correctly, many equations were left unbalanced.

(v) and (vi) Both parts were, on the whole, well done.

GROUP 2 — GEOLOGY ELECTIVES

Elective G1 — Regional Geology

Question 8

(a) (i) and (ii) This was generally well done, but some candidates failed either to give all three methods of study or to say how the chosen method contributed to their knowledge of their specific region and often gave an answer applicable to the study of any geological subject.

(b) (i) and (ii) The name of the stratigraphic rock unit and the period of formation were well known.

(iii) A significant number of candidates gave a description of the stratigraphic unit as a whole, rather than describing a hand specimen of a predominant rock from that unit.

(iv) This question on the origin and mode of formation of rocks was answered well.

(c) Here all parts were generally well answered.

(d) This was poorly answered. Many confused geomorphology with the geological history of their specific region rather than how this has affected surface features at the present time.

(e) Most named a feature of special geological interest in their region, but failed to describe fully the geology of the feature.

Elective G2 — Mountains

Question 9

(a) It was clear to most candidates that the two types of plate interactions were divergent and convergent. The majority were able to identify either the site of their chosen mountain or a similar type of site on the map. Those who chose a *mountain range* rather than a *mountain* had less difficulty in finding examples of changes which occur during the mountain-building process. It is emphasised that carefully drawn, well labelled diagrams are an asset to a good answer.

(b) This question was generally well answered, with most candidates naming volcanoes which erupted both in the 20th century and in the past. The better responses gave a wide variety of social consequences not focussing on the nature of volcanic ejecta, but, rather, on their effect on people and their activities.

(c) Most candidates used the information in the stem of the question and the diagram to focus on the gross structure. Descriptions of vertical adjustment in response to erosion were generally good. Carefully drawn, well labelled diagrams were required by the question. Those who used dotted lines to show changes in level over time were generally more successful in communicating the concepts. The majority identified the gross structure as a shield area or crater, and could name *granite* when asked for the composition of the structure; only the better responses, however, named metamorphic rocks such as *gneiss*.

GROUP 4 — PHYSICS ELECTIVES

Elective P1 — Electromagnetism

Question 10

(a) This was generally well done. Some candidates, however, failed to convert the unit for velocity.

(b) (i) A significant number of candidates had difficulty with the use of compass directions, frequently confusing *vertically up* with North. A diagram was useful in explaining the answer.

(ii) It is not satisfactory simply to name a rule, eg *right hand grip rule*. An explanation is essential.

(c) This question was well answered. The better responses involved the substitution of B > 0.9T into the magnetic field equation.

(d) This was generally well answered, although many candidates failed to convert the area units correctly.

(e) Most answers here were good.

(f) Although a number of candidates failed to give quantitative answers to part (ii), the majority answered well.

(g) Many candidates failed to give the correct units for the *torque* of the coil.

(h) Approximately 50% of the candidature were able to give the SI definition for the ampere.

Elective P2 — Oscillations and Waves

Question 11

(a) (i) and (ii) These were generally well done. Some candidates incorrectly calculated the centripetal force on the Earth.

(b) (i) This was very poorly done. A large percentage of candidates assumed that *radio* waves were *sound* waves.

(ii) Although the concept of wave diffraction around objects was generally well known, the relationship between wave length and diffraction was poorly understood.

(c) (i) and (ii) This was generally well done, but many candidates failed to convert the unit for displacement.

(iii) A number of candidates had the misconception that gravity affects the spring constant. Many were unaware that *smooth* implies *frictionless*.

(d) (i) Answers here were generally good.

(ii) The majority of candidates were able to draw the pattern of the standing waves, but many showed a lack of understanding of the nature of antinodes, presenting them as distinct points like nodes.

(e) (i) The general definition was poorly handled; most candidates generalised by equating *tranverse* waves with *progressive* waves.

(ii) 1. Many failed to describe the simple harmonic motion as being 90° to the direction of propagation.

2. Most answers here were good.

(iii) Candidates appeared to be unfamiliar with the displacement/distance graph.

In both (ii) and (iii) a significant number drew a single pulse instead of waves.

(f) This was poorly answered, since many candidates had a very poor understanding of the nature of reflection of sound at the end of open pipes.

(g) Answers here were not good. Many candidates had difficulty in drawing a diagram showing the refraction of waves. A significant number incorrectly showed a reduction in wavelength over the sandbar by drawing extra wave fronts.

GROUP 5 — INTERDISCIPLINARY

Elective 11 — Biochemistry

Question 13

Responses to this elective were generally of a good standard.

(a) (ii) Most candidates knew the test for distinguishing glucose from sucrose, although many answers were poorly explained and lacked precision.

(b) Answers here were generally good.

(c) This question called for a well designed and carefully planned experimental procedure, but was, on the whole, poorly handled.

(d) Many candidates failed to provide *evidence* for their choice of equation.

(e) and (f) This was generally well answered.

(g) A significant number of candidates did not include *ribosomal – RNA* in their answer.

Elective 12 — Photography

Question 14

This elective was generally well done.

(a) (i), (ii) and (iii) Answers to these parts were good.

(iv) Many candidates incorrectly chose *f8* and answers were poor.

(v) Candidates showed excellent knowledge of the nature of chromatic aberration and the means of overcoming it. Many, however, failed to explain both *coated* and *achromatic*.

(b) Choice of use for each film was well handled, although many failed to give a reason for their choice.

(c) (i) and (ii) Answers to these parts were poor.

(d) (i), (iii) and (iv) These were well answered.

(ii) The relationship between temperature and the rate of chemical reaction was not well known.

(e) (i) Candidates had difficulty in explaining the method of capture used by Landsat; many listed radiations detected instead.

(ii) Poor knowledge was shown of the nature of the false colour used by Landsat to discriminate between radiation levels.

Elective 13 — Physics in Medicine

Question 15

All sections of this question were generally well answered and reflected a pleasing standard. In some sections, however, candidates gave answers which were rather vague and lacked specific detail.

In part (g) (i) a few candidates confused the term *X-rays* with *X-ray images*.

Elective 14 — Space Science

Question 16

The majority of candidates showed that they had been well prepared in this elective and consequently, they gave thorough answers of a good standard.

(a) Most candidates scored well, the majority discussing Tsiolovsky and Goddard.

(b) A number of candidates did not relate the Biosphere project to life in a space station and on Mars, but simply discussed problems of space travel. Some answers were vague and lacked depth.

(c) A number of discoveries could be listed and many candidates scored well. There was a tendency, however, to describe features of the planet that were known before the Voyager expeditions.

(d) This part was generally well done. Many candidates, however, did not convert diameter into radii for substitution and some ignored the data given.

(e) (i) This was generally well done.

(ii) Most answers here were good; some descriptions were, however, too vague or too brief to give a clear indication of candidates' knowledge.

(f) (i) Most answers here were good. Many candidates incorrectly described the Shuttle systems and multistage rockets instead of explaining *why* they were necessary. Many were unaware that a reduced mass led to an increased velocity for a reduced thrust.

(ii) This part was very poorly done. The majority of candidates were unable to relate a change in mass to the momentum change required to provide the necessary balancing force using the impulse formula.

(g) (i) This was generally well done.

(ii) Many candidates had difficulty in explaining a theory about the origin of the Moon.