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(former Cambridge linear syllabus)

A 9264

BIOLOGY

REPORT ON COMPONENTS

TAKEN IN JUNE 2000

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BIOLOGY

GCE Advanced Level 9264

9264/01 Biology: Options

General Comments

Candidates were spread across the range of marks with many very high scoring scripts with excellent answers to all questions on all of the options. Some of the poorer candidates seemed to be ill prepared to answer the questions on either of their selected options.

The extended mark scheme of this paper allows candidates to write in depth from several different viewpoints in answering a question, so full marks on a section can be obtained without every single marking point on the mark scheme being included. Inevitably, better candidates will give more detail than weaker candidates and may as a consequence have difficulty in fitting their answers into the allotted spaces on the question paper. In the construction of the question paper, one line usually approximates to one mark, so candidates who go beyond the number of lines available may not be using their time profitably. For example, a two mark section with two lines commonly requires a candidate to make two valid points; if the candidate writes six or seven lines he or she may be going beyond what is required. Examiners will, of course, mark all work written by a candidate even if it goes beyond the space provided.

Examiners noted with pleasure that the majority of candidates had bothered to structure their free response answers in a sensible fashion, using biological terms and principles with appropriate language and accuracy of statement.

One area that Examiners frequently commented on was the carelessness with which many candidates tackled data questions. Marks were frequently lost by candidates who failed to distinguish between the questions that asked a description of the data, comparison of the data and an explanation of the data.

On Option 4, Fig 1.2, the horizontal axis was missing as a result of a printing error; it should have read duration of pregnancy (weeks). No candidate was disadvantaged as a result of this omission. It was clear that many candidates ignored the units on the axis of the graphs in all of the options and this resulted in a loss of marks, to those candidates.

Marks obtained on the pairs of options offered by candidates were generally similar, indicating that both options had been taught to a similar standard.

Option 1 – Biodiversity

Q1

(a) Generally this was well answered, candidates supplying two or three appropriate suggestions. Weaker responses lacked detail with a mere list and no clarification of the points.

(b) X and Z were mostly recognised and named correctly. Y proved to be more difficult. The polyploid nature of X was referred to in better responses, together with good detail of Z's structure and function.

(c) In the main, this was correctly calculated. Some candidates, however, experienced difficulty converting from one unit to another.

(d) (i) The majority stated the kingdom correctly; the most common misunderstanding being that it was a prokaryote.

(ii) Chlorella was the most frequent example given, while algae did not score unless qualified by a named organism.

(iii) Most candidates understood that these were largely unicells that could not be placed in any other kingdom; some excellent answers when well prepared.

Q2

(a) This was generally well done, candidates scoring two or three marks.

(b) Although answers rarely noted the overall effect over the time scale, they recognised a gradual drop up to 1981 or steeper drop later and on the whole gave accurate figures. However, a surprising number of errors were made considering the easy scale of the graph.

(c) (i) The percentage was calculated correctly by many, but weaker candidates used incorrect figures or failed to use the figures correctly.

(ii) Candidates frequently gave very simplistic answers. These referred to more timber being cut down without appreciating that the more valuable/useful timbers were being used increasingly from virgin forests as they had already been removed from non-virgin forests.

(d) An increased number of control measures and a change in demand for this type of wood were correctly suggested, along with reduced availability of the remaining trees.

(e) Candidates had few problems here.

(f) This proved more difficult, although many answers correctly referred to habitats being gained or conserved, together with references to income as an incentive. Candidates did not appreciate that only the most desirable trees could be grown or that productivity would be much greater per given area.

Q3 This was the more popular question.

(a) (i) Although there were many examples of good comparison especially when a table was used, some still find this difficult, merely producing a description of each. Too often, common features were described at great length rather than differences.

(ii) Far too many answers included complete life cycle details instead of concentrating on feeding. A few candidates appeared to be describing a hybrid cestode/trematode, some even a turbellarian.

(iii) This was well done by those who used a logical approach, first describing the relevant structural features followed by a sequence of events. Only better candidates mentioned the importance of coelomic fluid,nervous/mechanical stimulation or lubrication. To be of value diagrams must be well drawn and clearly labelled.

(b) (i) A good response making comparative statements was easily able to reach maximum marks. However, many ill-prepared candidates seemed unfamiliar with the common features of these two.

(ii) Many repetitious uses of agar/alginates were supplied. A wide range of uses and therefore marks was available.

(iii) Bryophytes were rarely discussed with any degree of clarity. A good answer set out positive adaptations and limitations clearly, while coming to the overall conclusion that they are not as well adapted as other plants.

Option 2 – Applied Plant and Animal Science

Q1

(a) (i) Most candidates could identify the optimum temperature range for photosynthesis in rice but a significant minority gave a range that was wider than that shown in Fig. 1.1.

(ii) The majority of explanations focused on the curve for barley in terms of a standard enzyme controlled reaction, missing the details of rubisco and the Calvin cycle of the light independent stage. Limiting factors were only touched on by the better candidates and the idea of $Q_{10} = 2$ hardly ever mentioned.

(iii) Poorer candidates tended to suggest the likely worldwide distribution of sorghum in terms of countries with unacceptably diverse climatic conditions, rather than tropical or equatorial regions. Very few candidates thought to refer to the data that indicated sorghum could maintain high rates of photosynthesis above 40°C.

(b) (i) It was pleasing to see that most scripts contained the idea that the temperatures used in the investigation were the optimum for each crop.

(ii) Many answers made no reference to details of C_4 photosynthesis. Comments on photorespiration were rare, and although efficiency of carbon dioxide use was mentioned, the utilisation of specifically low concentrations of carbon dioxide hardly ever written about.

(c) This subsection was poorly answered. Many candidates had not read the question that referred to one leaf. Too many candidates described weighing the same leaf of similar sized leaves rather than taking leaf discs or other samples. Dry mass descriptions, if given, were usually correct, though many candidates missed the idea of using replicates and taking average results.

Q2

(a) Most scripts contained two sensible reasons why some countries are not self-sufficient in food. Answers commonly focused on cash crops, investment and education while references to the unsuitability of land, smallness of land holdings and climate were less common.

(b) (i) Nearly all answers contained reference to fertilisers, herbicides or pesticides, but candidates lost the mark for not saying these came from outside the farm.

(ii) The idea of self sufficiency was generally appreciated, but there was only an occasional mention of composting or recycling.

(c) There were many good answers recognising the lower nutritional status from a limited variety of foodstuffs. Few candidates went on to elaborate examples of specific deficiencies of vitamins or minerals.

(d) This section was well answered with many candidates giving full detailed explanations of the advantages of using leguminous crops. The only common omission was a failure to comment on the decomposition of the roots of leguminous plants, left in the soil, increasing the nitrogen content of the soil and reducing the need for nitrogenous fertilisers.

Q3 Either

(a) (i) Answers ranged across the spectrum of marks. Many candidates homed in on just one or two aspects of the diet of either intensively reared pigs or cattle rather than considering the range of ideas encompassed by the question. The requirement of protein for growth was appreciated, but few candidates went on to elaborate this in terms of essential amino-acids being limited, the use of protein concentrates and supplements. Similarly, many candidates wrote that energy was needed for growth, but failed to discuss digestible energy, metabolisable energy, daily rations, dry matter intake and the idea that energy was needed to maintain body temperature. Comments on minerals and vitamins were rare.

(ii) This section was pleasantly high scoring, with many candidates making good common sense points about animal housing. Temperature was usually discussed, though ventilation was often ignored. Hygiene and disease were often mentioned, though precise examples were usually lacking.

(iii) Many candidates got sidetracked into the details of eutrophication and failed to consider problems of weed seeds, need of machinery, effluent ponds, heavy metals and the spread of disease involved in the disposal of farmyard manure.

Or

(b) (i) Few answers scored maximum marks on this section, because candidates were unable to consider more than a few points. There were only occasional references to the removal of crops at harvest depleting the soil, soils being naturally deficient and crop residues not being returned to the soil. Mention was made of leaching, but few explained this in terms of the mobility of the nitrate ion. Many candidates did realise that ammonium salts or nitrates were needed in large quantities, but ignored decompositions and recycling while they concentrated on the role of nitrogen, for which there was only one mark. Hardly any references to grain yield occurred, perhaps the most important point with cereals.

(ii) Many answers were insufficiently specific about either the timing or the method of fertiliser applications for either maize or wheat. There appeared to be a complete ignorance from some candidates that fertilisers could be applied in different ways at different stages in growth of the cereal.

(iii) In light of the previous subsection (ii), it was not surprising that the majority of candidates considered the availability of soil nutrients as being one of the problems. Many candidates did additionally consider pests and diseases, but failed to mention overwintering and spread to the next year's crop, though the idea of wholesale destruction of a monoculture did occur. Few references were made to the loss of wildlife habitats, soil compaction, lack of crop rotation and the humus content of the soil. Some businesslike candidates sensibly discussed the problems of having to use all one's resources at one time and being at the mercy of a single commodity price.

Option 3: Applications of Genetics

General

Many candidates showed a very pleasing ability to use their knowledge in new situations as requested by the syllabus. There were virtually no rubric infringements and almost all candidates laid out their answers to question 3 in the appropriate subsections. Some candidates lost sight of the requirements in question 3(a) to relate the roles being described to selective breeding.

Q1

(a) Most candidates were able to apply their knowledge of how resistance arises and spreads in this context. The question was answered well by many candidates, with reference to random mutations. Few actually used the term *natural selection*.

(b) (i) Answers to this question were often not clearly expressed, but made the point that the triplet code for one amino acid was changed to that for another. Candidates should note that the term *codon* applies to mRNA, not DNA. Weaker candidates referred to frame-shift mutations (additions and deletions), ignoring the need to change just one amino acid in the protein.

(ii) Many candidates appreciated that a change in shape of the protein could lead to the herbicide being unable to bind to it. Some candidates talked only of a change in the primary structure of the protein, failing to relate that to a possible shape change.

(c) Again, many candidates answered this question very well. Some mentioned a nutrient medium, but failed to specify sterility. Some mentioned hormones/plant growth substance, but these were rarely associated with the stimulation of cell division.

(d) (i) Weaker candidates tended to opt for both **N** and **C** being 'controls' without any clear explanation of how they acted as controls. Stronger candidates tended to say, correctly, that **N** showed that genetic engineering itself did not have any effect on resistance and that **C** showed that maize cells did not show resistance.

(ii) This was answered poorly by a number of candidates whose vague answers did not include reference to the relative size of callus in different concentrations of herbicide. However, a pleasing number of candidates were able to conclude that the gene concerned was responsible for resistance.

Q2

(a) Most candidates were on strong ground here, but a distressing minority thought that cystic fibrosis was a sex-linked condition or that it was caused by a dominant allele. Needless to say, many candidates confused the terms *gene* and *allele.*

(b) (i) Most candidates were able to identify the missing base triplet in **Q**. The minority made vague statements such as *some bases are missing in Q.*

(ii) Some candidates missed the point and referred to changes in amino acids (plural), but many candidates confidently answered that one amino acid would be missing.

(iii) Fewer candidates were successful in answering this section. Only the better candidates seemed to be aware that cystic fibrosis may be caused by a large

number of different mutations and that therefore **P** could have a mutation elsewhere in the gene.

(c) A pleasing number of candidates were able to apply their knowledge of a selective advantage of heterozygotes in this context.

(d) Most candidates realised that presence of the mutant allele reduced the number of bacteria taken up, but a number did not comment that uptake of all three strains of bacteria was affected. The log scale presented problems for the weaker candidates, but the stronger candidates quoted comparative figures. Very few candidates commented on the fact that bacterial uptake by cells expressing the mutant allele is reduced, but not prevented.

(e) Many candidates used their knowledge of the properties of gut mucus in cystic fibrosis patients in their answer. The better candidates referred to the ion channel encoded by the gene. The best candidates realised that bacteria cannot fit through an ion channel.

Q3 Alternative (a) was slightly the more popular choice across the range of candidate ability. Weaker candidates tended to lose sight of the wording of the question and wasted time and space with references to human reproduction in (a)(i) and (ii). Some candidates wasted time in answering (b) (iii) by referring to blood groups.

(a) (i) A few candidates thought that progeny testing was the interbreeding of promising-looking offspring, but for the majority of candidates, errors were of omission rather than misunderstanding. Those who scored well usually did so in the context of selecting bulls for milk yield, but candidates should be careful to distinguish between *sex-linked* and *sex-limited* characters. Some candidates found it hard to explain that the test was of an individual's genotype. Very few candidates mentioned the importance of progeny testing for polygenic traits.

(ii) A few candidates confused artificial insemination with *in vitro* fertilisation, but in general the question was answered well.

(iii) Excepting those candidates who wasted time considering the human context, many well-informed answers were seen here.

(b) (i) Problems with terminology reduced the marks in some answers. The candidate who wrote that *linked alleles are on the same gene* was plainly confused. Some descriptions of crossing over failed to score because it was not plain that exchanges were being made between non-sister chromatids of homologous chromosomes. Few diagrams purporting to show crossing over were labelled and some showed crossing over between sister chromatids. Candidates should also note that *alleles* are exchanged, and that a chiasma is the visible result of the process of crossing over.

(ii) Many candidates referred to parental and recombinant phenotypes, but some did not mention their relative numbers. The stronger candidates referred to the changes to the standard Mendelian ratios produced both by total linkage and by linkage with crossing over.

(iii) A pleasing number of excellent answers with very good factual detail was generated by this question.

Option 4: Growth, Development and Reproduction

Q1

(a) (i) Structure A was usually correctly identified as the germinal epithelium, but B was often incorrectly identified as connective tissue, rather than stroma. Many candidates missed giving C as the Coronna Radiata, but most got D as the Zona Pellucida.

(ii) Most candidates could calculate the diameter of the secondary oocyte correctly, but some candidates then gave inappropriate units for their calculation.

(iii) The diploid nature of the germinal epithelium compared to the haploid nature of the secondary oocyte was stated by the majority. Few candidates went on to explain this in terms of meiosis I being complete and that crossing-over and independent assortment had occurred. Some candidates did sensibly give the number of chromosomes present in each of the structures.

(b) This was a high scoring question with many candidates scoring all of the three available marking points. Commonly mentioned were the effect of LH on ovulation, development of the corpus luteum and the stimulation of progesterone production, less well understood were the ideas that LH acted with FSH to stimulate follicle growth and that the theca was activated to produce oestrogen.

(c) (i) Candidates frequently lost a mark here for failing to give the correct units.

(ii) Examiners ensured that the missing weeks on the horizontal axis did not disadvantage candidates. Candidates lost marks because they either failed to use the correct vertical scale for either one or both of the hormones or omitted to make suitable comparisons.

(d) Candidates often mistakenly stated that hCG was produced by either the pituitary gland or the ovary, rather than the chorion. Many candidates stated that the ovary produced progesterone, instead of specifically stating that either the corpus luteum or the placenta was responsible. The functions of the two hormones were usually dealt with adequately.

Q2

(a) (i) Although candidates realised that vegetative reproduction was asexual, they failed to stress that a piece of plant tissue was involved.

(ii) The term axillary bud was not well understood, though many examples of asexual reproduction, familiar to candidates, involve an axillary bud.

(b) (i) The better scripts contained references to reserves being laid down in bulbs to promote flowering in the following spring, the poorer candidates suggested that the warm summers caused flowering in the particular summer of stimulation, rather than the following spring, ignoring the information they were provided with.

(ii) Most candidates found this question difficult. Many candidates on otherwise the right track, spoiled their answers by referring to buds or seeds instead of bulbs. In retrospect these two suggest questions might have been better placed at the end of question 2, instead of the beginning.

(c) (i) Too many candidates gave an answer of 0.75g/week, failing to notice that the growth of the bulb clearly started well above the zero of the horizontal axis.

(ii) This section was well answered with the majority of candidates making a couple of sensible points as to how the growth in leaf area was related to the change in mass of the old bulb.

(iii) It was generally appreciated that reserves were being used for growth, but respiration and the evolution of carbon dioxide were only mentioned rarely. Only the very best candidates related the upturn in dry mass to the point where photosynthesis exceeded respiration.

(d) Most candidates scored well on this section with a maximum of four marks not being uncommon. One error that occurred repeatedly was a comment on the decrease in leaf area with an increase in planting density being of significance, when it was actually trivial.

Q3

(a) (i) Most candidates noted that the stamen consisted of an anther and a filament. The better answers also noted the presence of vascular tissue and four pollen sacs. Few mentioned other details of anther structure, such as the epidermis, fibrous layer or tapetum. Good answers noted that wind and insect pollinated flowers differed in stamen structure and gave examples.

The structure of a pollen grain was generally well described, with the two nuclei usually named correctly and pits often noted, although few provided any detail concerning the structure or function of either the exine (often given as 'extine') or the intine. Again, the better answers discussed differences between pollen from wind and insect pollinated flowers.

Diagrams supplemented many answers, although these often added nothing to the written descriptions.

(ii) Many answers noted that pollen mother cells undergo meiosis to form a tetrad of pollen grains but there was much confusion about what happened next, i.e. mitotic division to produce generative and vegetative nuclei with subsequent mitotic division of the generative nucleus to produce two male gametes. Hardly any candidates referred to the consequences of meiosis, in terms of independent assortment and crossing-over.

(iii) Many answers made reference to hay fever sufferers, although fewer noted either the need to take appropriate drugs or to avoid exposure. The implications for crop growers were rarely appreciated. Some candidates noted that somebody might wish to achieve cross–pollination, although few could give examples of the likely circumstances, e.g. in greenhouses or as part of a plant-breeding programme.

(b) (i) Most candidates achieved a high mark on this section. The sequential nature of the material made it relatively easy to recall the facts and structure of the answer. That said, much irrelevant material was often included, most often accounts of spermatogenesis and the route taken by sperm before reaching the epididymis.

Marks were often missed for failing to include the process of capacitation, the contractions of vas deferens and urethra, the co-operative action of sperm and the

role of chemotaxis. Many made incorrect reference to the action of cilia in the uterus. The presence of cervical mucus was often noted; candidates apparently learning from questions in earlier examinations.

(ii) This section also scored highly, the sequential nature of the topic aided the candidates, once more. Even the weaker answers noted the role of digestive enzymes in gaining entry to the oocyte, the prevention of entry of later sperms and the completion of meiosis II in the oocyte following fertilisation. The fusion of acrosome and sperm membrane was often confused with the later fusion of oocyte and sperm membranes, whilst details of the binding of sperm to receptors on the zona pellucida were not widely known.

Many answers included diagrams in this section, but again few of them added significantly to the written answer because labelling was inadequate.

(iii) Few candidates scored full marks here, but most gained two or three. Blocked oviducts, low sperm counts and poor sperm motility seemed to be widely recognised as reasons to use IVF. Cervical mucus often appeared again. Many referred, incorrectly, to impotence.

9264/02 – Multiple Choice

Question Number	Key	Question Number	Key	Question Number	Key	Question Number	Key
1	B	11	A	21	C	31	A
2	D	12	B	22	C	32	D
3	A	13	D	23	D	33	B
4	B	14	B	24	A	34	A
5	C	15	B	25	B	35	D
6	C	16	D	26	A	36	C
7	B	17	B	27	B	37	A
8	A	18	D	28	C	38	C
9	B	19	D	29	B	39	A
10	A	20	C	30	B	40	C

General Comments

The mean score was 24.9 (62%) and the standard deviation was 6.44. Qs. 1, 9, 13, 18 and 24 were the easiest with more than 80% of candidates answering correctly. The most difficult were Qs 15, 16, 22, 26 and 31, where fewer than 40% of candidates answered correctly.

Comments on Individual Questions

Q.3 This item was a good discriminator. The weakest candidates chose option C, the reverse of the correct sequence.

Q.10 Weak candidates thought that Benedict's test gives a positive result with sucrose.

Q.11 Many candidates recognised option B as a familiar curve but did not appreciate the significance of the statement that there is an excess of substrate. If substrate availability is not limiting, then the concentration of product will be directly proportional to the concentration of enzyme.

Q.14 The popularity of option A indicates that the principles of meiosis remain a mystery to many candidates.

Q.15 This proved to be a difficult question because many candidates chose telophase, the stage in mitosis when the quantity of DNA per nucleus is half that of the original nucleus. The quantity of DNA per cell decreases by a half only when cytokinesis occurs.

Q.19 Many candidates, including some of the more able, did not read the question carefully and chose option B, the percentage of either adenine of uracil, rather than the percentage of adenine plus, option D.

Q.20 The majority recognised that this question required application of knowledge of the sequence of taxa. The most common error, particularly amongst the weaker candidates, was to confuse class and order.

Q.22 This question was more difficult than had been intended because it failed to state that red-green colour blindness is a sex-linked condition. While sex-linkage is frequently

taught using red-green colour blindness as an example, this is not specified in the syllabus and the information should have been given in the question. However, few candidates answered as if the man were homozygous dominant (option A) or homozygous recessive (option B) for the colour vision locus. The most frequent error with questions such as this is the failure to multiply the probabilities of all three events.

Q.25 The majority knew that blue and red light are most effective for photosynthesis but there was much guesswork as to whether an electron acceptor or electron donor is required.

Q.26 This was a difficult question because it required understanding of the results of the experiment as well as manipulation of numbers. After 30 minutes, 0.9 cm^3 carbon dioxide has been produced. In one hour, 2 g animals produce 1.8 cm^3 carbon dioxide, so 1 g animals produce 0.9 cm^3 per hour. The popularity of option B was perhaps due to failing to take into account that there were 2 grams of animals.

Q.30 Most candidates realised the word 'greatest' in the question indicated either option B, the greatest rate of growth or option C, the greatest population size. The question had poor discrimination because too few of the more able knew that the greatest mean rate of ethanol production per cell would occur while the cells were growing and reproducing at their fastest rate.

Q.31 Candidates found this question surprisingly difficult. The popularity of option D can be explained on the basis of candidates choosing a pyramid of numbers rather than a pyramid of biomass. Those who favoured option B, including many of the better candidates, had a poor understanding of ecological energetics. Over a period of a year, the biomass of producers would be greater than the biomass of primary consumers.

Q.32 The popularity of option C shows that there is a common misconception that an organism's niche includes only the biotic components of its environment.

Q.33 More of the weaker candidates chose option C than chose the correct option, B. Again, this reflects a poor understanding of ecological energetics.

9264/03 Biology: Core Content

General Comments

This paper was of equivalent standard to the corresponding component set in June 1999. There were sufficient marking points to allow candidates to demonstrate their ability and most candidates appeared to have sufficient time. There were many excellent scores and disappointingly there were some low scores. It was encouraging to see some real evidence of good understanding and thorough revision. In answering the free response question in Section B, the majority of candidates were able to obtain three or four quality of language marks in addition to the biological content of their answer. Most candidates were credited for using good grammar, punctuation and spelling, answering in appropriate sub-sections, expressing themselves clearly and fluently with relevance and without repetition. If candidates did lose a quality mark it was usually for giving irrelevant information.

Comments on Individual Questions

Section A

Q1 This question was answered very well by able candidates.

(a) In naming the structures labelled A to C on the high power photomicrograph of the kidney cortex, few candidates had difficulty in naming A a capillary/glomerulus, B the Bowman's capsule / corpuscle and C the proximal convoluted tubule. Weaker candidates confused the above structures or referred to the nephron, loop of Henle, the cortex and medulla in their answers.

(b) Most candidates correctly indicated ultrafiltration as occurring in the area of the glomerulus. Several incorrectly labelled the area in the capsule around the glomerulus and some even indicted the proximal convoluted tubule area. A few did not attempt to mark an X anywhere.

(c) In stating two structural adaptations of the region of the kidney tubule adapted for reabsorption of glucose, many able candidates made reference to the brush border/microvilli providing a large surface area for reabsorption and to the many mitochondria required for active transport. Occasionally the more able candidates named tight junctions, channel/carrier proteins and referred to the proximity of the capillaries to the tubule as structural adaptations and gave appropriate explanations. Weaker candidates misinterpreted the question and made simple reference to other regions of the kidney tubule, for example the loop of Henle or collecting duct and even to ultrafiltration in their answers indicating they did not know which region was involved in the reabsorption of glucose or its structural adaptation to assist with reabsorption from the glomerular filtrate.

(d) (i) In explaining how dialysis differs from ultrafiltration, knowledgeable candidates referred to only waste products/urea/excess salts being passed in dialysis with therefore no need for reabsorption. Occasionally reference was made to pressure being involved with ultrafiltration which takes place all the time in the kidney whilst dialysis itself involves diffusion and is periodic. Weaker responses were characterised by a description of dialysis with no comparison with ultrafiltration.

(ii) In suggesting two advantages of kidney transplantation over dialysis as a treatment for kidney failure, the most favoured responses from the majority of the candidates

included reference to a permanent treatment allowing a better/normal lifestyle, less chance of infection with reduced long term costs. Weaker responses were characterised by vague references to machines and hospitals, freedom and mobility or were very brief without sufficient qualification.

Q2 Knowledgeable candidates did produce some excellent answers but overall a disappointing level of response.

(a) In explaining why the cell surface membrane is described as a fluid mosaic, able candidates made suitable reference to the phospholipids, even proteins, being free to move, with a random arrangement of proteins floating within the membrane. A significant number of candidates clearly had not heard this description of the cell surface membrane and made vague reference to phospholipids having hydrophobic tails, hydrophilic heads and no mention of globular proteins. Several described the components as moving or scattered without referring to phospholipids or proteins.

(b) In describing how the channel surface of a pump protein differs from its surface next to the phospholipid tails, only the more able candidates made appropriate reference to the hydrophilic / polar channel and the hydrophobic/non-polar outer surface. Few candidates made reference to the distribution of the amino acid R groups. There were many weak and biologically incorrect responses, often involving the phospholipid tails themselves.

(c) Only the good candidates, in explaining why Na^+ and K^+ cannot pass freely across the phospholipid bilayer, made reference to the ions, carrying a charge, being soluble in water and therefore unable to pass across the hydrophobic region within the membrane. Weaker candidates based their answers on the size of the ions or the phospholipids being so tightly packed in the bilayer. Others simply explained how the ions could cross the membrane using protein channels (i.e. they described the membrane).

(d) Regulating membrane fluidity and occasionally permeability/stability were suggested as functions of cholesterol in the cell surface membrane by good candidates. Vague reference to a structural function characterised many weaker responses. Able candidates stated that the glycolipids in the cell surface membrane were involved in the cell (to cell) interaction/binding/adhesion/recognition. Incorrect responses made reference to receptor sites for hormones and several suggested that the glycolipids were used as a source of energy.

Q3 This proved to be a low scoring question with even better candidates struggling to achieve full marks.

(a) (i),(ii) Many candidates were able to correctly draw and label a diagram to show the structure of a triglyceride. There were some excellent full structural diagrams, other candidates gave simplified version with appropriate labelling of fatty acids and glycerol. Both types of diagrams were given full credit. Weaker candidates gave diagrams of carbohydrates or amino acids or indicated there was one fatty acid and three glycerides. Some did not attempt this part of the question. A considerable number of candidates were not able to precisely indicate on the diagram a site where hydrolysis takes place and even some able candidates labelled the site as being on the glycerol side of the ester bond, or on the oxygen (-O-) rather than the position of the bond itself.

(b) In explaining the differences in solubility between triglycerides and the products of their hydrolysis, some weaker candidates simply stated the products were more soluble with no mention of water. Good candidates stated that the triglycerides were insoluble with the named products of hydrolysis, fatty acids and glycerol, being water soluble. A few good candidates made reference to the –OH groups, or to the groups responsible for water solubility being exposed. Some candidates stated that glycerol was soluble in water, but fatty acids were insoluble.

(c) This section was generally poorly answered by many candidates. Only the most knowledgeable made appropriate reference to more hydrogen, more C-H bonds or less oxygen or a greater ratio of hydrogen to oxygen being the reason why triglycerides release twice as much energy on oxidation compared with an equivalent mass of carbohydrate. A vague reference to triglycerides having more bonds or being lipids/fats and therefore releasing twice as much energy as carbohydrates with no explanation as to why, characterised weak responses.

Q4 There were good quality answers to this question.

(a) In listing three ways in which transcription differs from translation, many referred to transcription occurring in the nucleus, with translation taking place in the cytoplasm/ribosomes. Several referred to the synthesis of RNA (from DNA) and protein (from mRNA) in transcription and translation respectively. Other correct responses involved transcription linking nucleotides, translation linking amino acids, though few made reference to phosphodiester bonds and peptide bonds respectively in these linkages. A significant number of weaker candidates lost marks because they did not give comparative responses, simply describing transcription/translation, often confusing both terms with DNA replication.

(b) The majority of candidates scored at least two marks here naming, B the mRNA and C the protein/polypeptide. Few candidates referred to A as the large subunit of the ribosomes. Weaker candidates merely referred to A as the ribosome and C an amino acid.

(c) Only the good candidates in naming two molecules in addition to those given in fig. 4.1 mentioned ATP, tRNAase or amino acids. Exceptionally, amino acyl tRNA synthetase was given. Several correctly named protease/peptidase. Weaker responses included reference to DNA, organic bases, free nucleotides, tRNA itself, codons and even organelles such as mitochondria.

(d) The majority of candidates referred to the anticodon and amino acid binding site as structural features which adapt tRNA to its role in translation. Exceptionally good candidates made reference to the anticodon complementary base pairing with the codon on the mRNA and made appropriate reference to the amino acid corresponding to or being specific to the anticodon. Weaker responses included incorrect reference to the size of the tRNA molecules and the fact that it was single stranded, as structural features which enabled the molecule to leave the nucleus and be involved in translation in the cytoplasm.

Q5 This proved to be a difficult question for many candidates. Weaker candidates did not appear to be able to interpret the graph. Fig 5.1 was a graph showing by two curves the effect of increasing light intensity on the rate of photosynthesis in two groups of plants, one grown under high illumination, the other under low illumination.

(a) (i) Candidates were asked to explain the effect of light intensities above 200 x 10^{-4} J cm^{-2} s^{-1} on the rate of photosynthesis in plants grown in high illumination. Only the more able candidates clearly explained that light was no longer a limiting factor and that some other factor e.g. CO_2/temperature was now limiting. Weaker candidates were often able to indicate the levelling off at this light intensity but few quoted figures in support e.g. 1500 CO_2 uptake (µmol h^{-1} dm^{-2}).

(ii) In stating two ways in which the two curves differ at light intensities below 75 x 10^{-4} J cm^{-2} s^{-1}, even able candidates did not always appreciate that the compensation point was reached at a lower light intensity for plants grown in low illumination. Many candidates did occasionally make correct reference to a steeper gradient/faster rate of photosynthesis for plants grown in high illumination. Even able candidates in attempting a comparison of the initial starting points for both curves failed to appreciate the lower rate of respiration in low illumination plants.

(b) In suggesting why plants growing in shade on the forest floor are able to survive, again many made no reference to the compensation point being reached at a low light intensity. If marks were awarded it was usually for some appropriate reference to greater leaf area/more chlorophyll. The vast majority of candidates did not seem to be able to make any plausible suggestions.

Q6 There were few difficulties with this genetic question with the majority of candidates including the weaker ones scoring very well.

(a) Almost all candidates stated that the alleles for yellow and round were dominant and suitably explained their answer with correct reference to usually cross 4, or occasionally cross 2. There were however quite a few candidates that gave wrinkled as a dominant allele.

(b) Almost all candidates used suitable symbols to write down the genotypes of the parents of each cross in the table given. It was disappointing to see several candidates illogically using G = yellow, g = green, W = round and w = wrinkled, paying no attention to the convention in the Biological Nomenclature book. The majority of candidates scored most of the marks available. However, there were a number of candidates who did not do well in this section, failing to give correct symbols or put in all the alleles or who changed the symbols used part way through the table. Credit was given for candidates who incorrectly identified the dominant alleles in (a).

Section B

Q7 This was a popular free response question with the weaker candidates. There were some high scores but many disappointingly low scores due to candidates failing to answer the actual question set in (b).

(a) Good candidates in describing the main components of mammalian blood made reference to the plasma being mainly composed of water, to the presence of named dissolved solutes/ions, plasma proteins or named examples and nutrients. Almost all described red blood cells/erythrocytes with suitable reference to their size/shape and to the lack of a nucleus. They mentioned that white blood cells/leucocytes were fewer in number, larger than red blood cells and contained a nucleus. The presence of platelets as an essential component of blood was appreciated by many but not all candidates. Weaker candidates inappropriately described, often in detail, the functions of red blood cells in this part of the question and consequently as they did not repeat the information in (b) lost marks.

(b) Candidates were asked to explain how both oxygen and carbon dioxide are transported by the blood. Many candidates made appropriate reference to oxygen being carried as oxyhaemoglobin with more able candidates appreciating the transport of 4 molecules of oxygen per molecule of haemoglobin / four sub units of haemoglobin. They made further reference to reversible binding, to the S-shaped dissociation curve and to co-operative binding. Most candidates explained the transport of carbon dioxide with suitable reference to carbon dioxide dissolving in the plasma, as carbamino-haemoglobin (though several referred to carboxyhaemoglobin) and as hydrogen carbonate ions. The more able candidates explained how carbon dioxide dissolves in water to form carbonic acid, with suitable reference to carbonic anhydrase in red blood cells. They then described its dissociation into hydrogen and hydrogen carbonate ions with appropriate reference to haemoglobonic acid and to the release of oxygen, with mention of the Bohr effect. They further explained how the hydrogen carbonate ions pass out of the red blood cells and into the plasma with appropriate reference to the chloride shift. Weaker candidates irrelevantly described the breathing system and gas exchange in their answer and several even gave details of the circulation of blood through the heart.

Q8 This was a popular free response question with some excellent answers.

(a) Good candidates answered the question and described the behaviour of chromosomes during meiosis. Weaker candidates simply described the whole process of meiosis and even cytokinesis without highlighting the behaviour of chromosomes. Able candidates made reference to the replication of DNA and to the chromosomes being made up of two identical chromatids during interphase. They then described the chromosomes shortening/thickening during prophase with the homologous chromosomes pairing up to form bivalents during synapsis. Most candidates made reference to chiasmata formation and crossing-over although this was not always correctly explained or qualified. Knowledgeable candidates described the random orientation of bivalents on the equator at metaphase 1 and to independent assortment but only a few explained the significance of this in terms of the number of possible chromosome combinations being 2^n. Almost all candidates referred to whole chromosomes being pulled apart by microtubules and later in metaphase II to the chromosomes being lined up separately. They then made reference to the centromeres dividing and to the sister chromatids being separated and becoming chromosomes. Weaker candidates irrelevantly described the associated changes in the nuclear membrane, nucleolus, centriole and spindle in their answers. Several confused the details of the first and second stages of meiosis or

placed events in the wrong phase and often lost marks through lack of preciseness, referring to 'chromosomes' rather than 'homologous chromosomes' or 'chromatids' rather than 'sister chromatids'. Many gave a whole series of diagrams showing the stages of meiosis, but without detailed annotation they often contributed little to the overall answer.

(b) In explaining the similarities and differences between homologous chromosomes, the majority of candidates made reference to homologous chromosomes having the same genes coding for the same characteristics but possibly having different alleles as each chromosome has come from a different parent. Additionally the more able made appropriate reference to the same loci, genes being in the same position but with different sequences of bases/nucleotides. Weaker candidates although they gained credit restricted their answers to those based on size and length and appearance.

Q9 Good candidates produced some excellent answers to this popular free response question.

(a) Candidates were asked to explain the structure and function of a sensory neurone and a motor neurone in a reflex arc. Exceptionally good candidates made reference to sensory neurones as having a single long dendron, a shorter/similar length axon, the cell body being towards the centre of the cell and found in the dorsal root ganglion. They also referred to the sensory neurones transmitting impulses from a receptor to the central nervous system/brain and spinal cord. Good candidates further described a motor neurone in comparison as having short dendrons/dendrites, a long axon, the cell body being in the brain/spinal cord and transmitting impulses from the central nervous system to an effector such as a muscle or gland. Weaker candidates failed to link the structure of the neurones with reference to their roles in a reflex arc via the intermediate neurone. Where candidates used diagrams of both neurones in answering the question, it was apparent that they were not clear as to the structure of the sensory neurone and several candidates confused sensory and motor neurones. Too many candidates vaguely referred to 'messages' being transmitted rather than impulses/action potentials. Several irrelevantly described in detail the transmission of the nerve impulse.

(b) Few difficulties here. Even weaker candidates were able to fully explain in good detail how a nerve impulse is transmitted across a synapse. The majority of candidates made reference to the diffusion of calcium ions through the pre-synaptic membrane into the neurone, causing vesicles of transmitter to fuse with the membrane emptying the acetylcholine into the synaptic cleft. They further described the diffusion of the transmitter across the cleft, its binding with receptors onto the post-synaptic membrane, sodium channels opening with Na^+ diffusing in, depolarising the post-synaptic membrane and setting up an action potential resulting in the impulse being transmitted. Occasionally weaker candidates demonstrated vagueness in their response by making no reference to the fusion of vesicles with the pre-synaptic membrane prior to exocytosis or the transmitter moving/passing across the synaptic cleft and often showing confusion between Na^+ and Ca^+ ions. Good candidates began their explanation with the depolarisation of the pre-synaptic membrane though many candidates finally and inappropriately describe the inactivation of the transmitter substance.

9264/04 - Extended Investigation

Once again it is pleasing to be able to record that the overall standard of the Extended Investigation remains high. Several candidates produced excellent and original ideas for investigation and as in recent years there were many high quality investigations based on more conventional and popular themes. A small number of candidates chose topics that were too open-ended to be appropriate for investigation by A level candidates, but generally the weaker studies suggested insufficient effort on the part of the candidate rather than a poor choice of subject matter.

A small number of Centres continue to allow their students to investigate almost identical problems in very similar ways despite cautionary comments made by the Biology Assessor on Outline Proposal Forms submitted for approval. Supervisors should encourage candidates to investigate different problems or different aspects of a subject. Students must plan and carry out their practical work independently and of course write their report individually. This applies both to investigations involving fieldwork and laboratory work.

Most candidates now appear to be aware of the syllabus criteria and follow the recommended format when they write up their work. However, a minority continues to omit one or more of the required sections of the report and this invariably reduces the total mark awarded. All Centres should ensure that candidates are fully aware of the assessment criteria as well as providing guidance about the form of the written report.

This year there was a marked improvement in the organisation of the work submitted for moderation, with the great majority of Centres meeting all the syllabus requirements. The Moderators appreciate that there is a great deal of paperwork required, but emphasise that their task of moderating the standard of marking between Centres can only be achieved satisfactorily if the samples sent for moderation contain all the relevant information.

All Centres are reminded that, along with the A level results, they should receive a Report on the Teacher Assessed Practical, containing Centre specific comments. These are intended to provide Centres with some guidance about any improvements that may be necessary. These comments should be circulated to all the appropriate teaching staff.

Some comments on specific criteria are given below. Centres new to the syllabus should consult previous Principal Moderator's Reports that have emphasised other points that characterise good practice. All Centres are reminded that guidance on the assessment of all three skills is to be found in the 'Handbook of Teacher-Assessed Experimental Skills', copies of which may be obtained from OCR.

Skill A

A1. The background knowledge must be relevant to the planned investigation. Many of the weaker candidates failed to demonstrate their ability to determine what was or was not appropriate and either introduced their report with a brief outline of the planned work or wrote three or four pages of unrequired information.

A2. Many candidates produced a very wordy hypothesis. It is expected that the candidates should include a precise, yet carefully worded statement of their hypothesis, based upon their background knowledge of the topic under investigation. The hypothesis should be quantitative if at all possible. A lengthy prediction about the outcome of the investigation is not required.

A3. The variables were often vaguely suggested with little clear indication about how they would be controlled. In particular, the variables for ecological investigations were almost invariably poorly treated, with students failing to discuss the relative merits of different sampling techniques and/or size of quadrat.

Centres also showed some variation in the way they assessed this subskill; some awarded two marks to candidates who had simply listed the variables, others correctly restricted this mark to students who had not only listed the variables, but also provided full reasons for their control.

A4. A number of candidates omitted to record full details of their practical procedures, which meant that their work could not have been repeated by others relying on their account. Descriptions of apparatus and equipment used, especially in ecological studies, were often rather poor. Many candidates submitting investigations based on fieldwork failed to include Grid References and sketch maps of the sites sampled.

A6. It is expected that all candidates will have carried out some form of trial or pilot experiments and/or observations before finalising the details of their practical procedures. It is emphasised that any piloting must be clearly related to the work to be carried out; for example, simply submitting a general account of class-based fieldwork, in lieu of a pilot for an ecological study, is not acceptable.

Skill B

B5. Whilst most candidates now include tables of 'raw data' in their reports, these are sometimes incomplete or partly illegible. Tables of raw data should be easy to follow and contain individual data items, not merely average values or percentages. They should include clear headings to each column of figures and units of measurement must be given in all cases.

Skill C

C1. In general this was well assessed. However, before awarding two marks, teachers must be sure that candidates have selected an appropriate statistical test and are applying it sensibly. Candidates should also use the calculated value of the statistic to assess the validity of the results with reference to the confidence limits and degrees of freedom.

C2. For two marks, candidates are required to give a reasonably full discussion of at least two limitations of the procedures used in the investigation. This mark should not be given if the treatment is limited to a list accompanied merely by brief comments whilst 'excuses' such as 'I did not have sufficient time to carry out further replication' are not acceptable since students are expected to plan their work in relation to the time that is available.

C3. For this sub-skill, the candidate must give at least two practical improvements that could be made. These should not simply be a statement of a way of overcoming previously described limitations. Credit can also be given for sensible suggestions of possible further, yet strictly related, work.

C5. This sub-skill requires a statement of the conclusion(s), including full reference to the data obtained. For two marks the candidate is also expected to refer back to the initial hypothesis, indicating clearly whether or not the results support the statement made.

C6. Many candidates now have access to computer packages that generate charts and graphs. Whilst these often improve the superficial appearance of the written report some students appear to have difficulty in using these programmes correctly and fail to include a heading and in some instances, axis labels along with appropriate units. Quite a large number of candidates took insufficient care to ensure that the graphs included were appropriate. The use of line graphs instead of bar charts to represent discontinuous data is still a common fault.

9264/05 – Biology Practical

General Comments

Most candidates attempted all the questions. The quality of the responses to Question 1 were generally much higher than for the other two questions. Candidates still find it difficult to make observations from material that is slightly new to them, particularly when using a microscope. These difficulties are often compounded by failing to read the rubric of the question carefully enough.

Comments on Individual Questions

Q1 (a) Most candidates made relevant colour observations on the tubes, less frequently commenting on the opacity of the contents.

(b) The point on the mark scheme that was made least frequently was that the decrease in pH in tube A was due to the release of fatty acids by the action of lipase.

(c) This was well answered.

(d) A number of candidates were content to state that the tubes were controls. Better candidates explained their relevance in establishing the involvement of the enzyme in tubes A and B.

(e),(f)(i) This was well answered by most candidates. Where credit was lost it was usually due to failing to comment on the difference in the nature of the dispersion of the drops rather than on the direction of their movement.

(f) (ii) Most candidates were able to comment on the relative densities of the drops, fewer went on to relate that to the information about the fat content of the two samples established earlier.

(g) Despite the fact that similar procedures have been set in recent examinations and the shortcomings in the work of candidates has been detailed in previous examiner's reports, many candidates lost marks by failing to describe the correct methods for running these tests. In addition, in this question significant numbers of marks were lost by failing to state that valid comparisons were obtained by standardising the volumes of reagents and test samples and the boiling time in the case of the Benedict's test. To score it was necessary for these points to be made explicitly. Many candidates lost credit by failing to produce an appropriate table in which results and conclusions columns were presented separately and given headings. The requirement of the question was to compare the reducing sugar and protein content of the milks. Few candidates attempted to frame conclusions based on such comparisons and those who did so found it difficult to state unequivocally that the reducing sugar content of the samples was similar while the protein content was substantially greater in K2.

Q2 (a) This was a question where many candidates lost marks by failing to read the rubric of the question carefully enough. They were informed that the regions of the tip resulted from differences in the shapes, sizes and structure of the cells as well as

in the frequency with which stages of mitosis were visible. Additionally they were told not to draw individual cells and to ignore the root cap. Substantial numbers of candidates ignored all these instructions. One of the most frequent types of responses was to quote the textbook zones of cell division, enlargement and differentiation. Such responses gained no credit. Examiners looked for descriptions of cells such as small, square, non-vacuolated, frequent mitoses etc. The mark scheme identified twelve possible valid points that could be credited to a maximum of five annotation marks. Very few candidates gained full marks and many none at all.

(b)(i) The quality of most of the drawings was very low. Candidates simply did not draw what could be seen in the preparation which presented outstandingly clear examples of various mitotic figures. Candidates seemed more concerned to find examples of cells that represented the four stages of the textbook even though there was no requirement anywhere in the question to display this. There were many examples where chromosomes were drawn inappropriately by using single lines.

(ii) This was usually correctly answered.

(c)(i) The evidence that was available was the presence of chromosomes in some cells and that there were different stages visible. Many candidates lost some credit by stating that they could see cell division, a restatement of the wording of the question.

(ii) Most gained a mark here.

(iii) Some credit was lost by failing to make comparative statements. For example, the response, "the cells are genetically different in K4" on its own gained no marks. It was also necessary to comment on the fact that the products were genetically identical in K3. Some candidates made the interesting but incorrect point that the cells in K3 had twice the number of chromosomes as the cells in K4.

Q3 (a) Generally the impression was gained that the candidates did not do enough work on the material to locate the range of structures that were present in it. This was accompanied by drawings that were far too small in the main and frequently of the textbook variety in that they showed trachea and bronchi. The structures present were essentially filled tubes and small solid blobs. The task was to represent these structures accurately; few did.

(b) This was surprisingly badly answered. Candidates tended to ignore the statement in the question to the effect that they were to identify features that were adaptations for gaseous exchange. Hence the examiners credited responses that referred to the extensive system of blood capillaries and the thin alveolar walls.

(c) Whilst there were some excellent answers there were also some very weak ones. Few candidates seemed to realise that the latex material presented opportunities to see three dimensional aspects of the lungs such as the shape and clustering of the alveoli, the branching pattern of the bronchioles or the relationship between alveoli and bronchioles.

9264/09 & 9264/06 Teacher Assessment of Practical Skills

General Comments

The moderators were pleased to report that the majority of Centres followed the syllabus requirements and that their submissions were generally well organised. It was noted that a number of the Centres submitting coursework for the first time had attended INSET or had read the Biological Sciences Teachers Handbook and submitted work that was of the correct standard, well organised, correctly annotated and was a pleasure to moderate. A small number of Centres continue to submit work of an unacceptable standard which fails to meet the syllabus criteria in spite of being informed of the problems in previous Moderation Reports and having centre scaling applied in previous sessions. The Moderators appreciate that a lot of paperwork is required, but they point out that their job to moderate the standard of marking between Centres can only be achieved satisfactorily if the samples sent for moderation contain all the relevant information. This includes all the experimental details and a clear indication of the precise criteria that have been used to allocate marks. This means that an indication is required, normally in the form of a list of marking points, to show how a particular sub-skill has been assessed. It is not sufficient to state that the work was marked using the syllabus criteria, since each particular experiment will be different and the context in which the experiment was set will determine the expected outcome from the candidate. It is also not suitable to state that the criteria were applied using 'professional judgement'. The Centre has a responsibility to provide marks that can be fully justified (preferably by a mark scheme and tick list).

The candidates work must be very clearly annotated in the body of the work to indicate precisely where each sub-skill criterion has been achieved. It is also necessary for Centres to indicate clearly on the Student Record Card (by some form of highlighting) those marks which contribute to the candidate's final score. **When a candidate has two or more identical marks for a sub-skill, it is the responsibility of the Centre to decide which piece of work is to be used as evidence for attainment of that particular sub-skill.** Where this was not done, the work was returned to the Centre.

Whilst the majority of Centres are submitting work by Candidate, it would be appreciated if all Centres would follow this approach. This means that all the experimental accounts for a candidate that contribute towards the final aggregate mark should be included in one folder. Attached to the front of this work should be a Student Record Card. As already mentioned, it is essential that the best score for each sub-skill that is being used for final aggregation be highlighted. Centres are reminded that all Student Record Cards, including those for candidates whose work is not submitted, must be supplied to the moderators in case further samples need to be requested. The moderators require the Centre to send the evidence supporting the best mark for each of the sub-skills, for each candidate. Many Centres could greatly reduce their postage costs if this was the only work sent. Centres should also note that the moderators may request further work if they are unhappy with that which is submitted. Therefore the Centre must retain any additional candidates' work until after results are issued.

Centres are asked to note the following sampling arrangements for coursework:
Centres with 20 or fewer candidates should send the written work contributing to the assessment total of all candidates to OCR. Centres with more than 20 candidates should send copies of the Mark Sheet (MS1) to OCR as directed in the Administrative Instructions and wait for the moderator to request a sample of all the written work contributing to the assessment total of 20 candidates. This must include all experimental details and mark

schemes. Centres must note that each experimental skills option (9264/09 and 9264/06) requires a separate entry and separate samples for moderation. This means for example, that where a Centre has a large number (20+) of A Level candidates and only a few AS candidates, all the AS Candidate's work must be sent to OCR, whilst initially only the MS1 should be sent for the A Level candidates.

All Centres are reminded that they should have received a Moderation Report on the Teacher Assessed Practical at the same time as A level results are issued. These are intended to give the centre a degree of guidance in order to bring about any improvements that may be necessary. These comments should be brought to the attention of the appropriate teaching staff. Centres should be aware that all coursework moderation operates using a specified level of tolerance. If the Centre's work is judged to lie outside that tolerance, it is adjusted by the full amount of the difference. It is possible that where Centres enter only one or two candidates for AS and all the work is moderated, any problems may lead to a scaling adjustment. However, for a much larger A level entry if only one or two candidates' work give rise to problems, this may be balanced out by the rest of the Centre's sample of A Level work, leading to no adjustment. In a similar manner, it is possible for a Centre entering candidates for A and AS Level to over-assess candidates at the top end of the mark range, but not at the bottom. This may lead to a situation where A level candidates scoring 30+ are adjusted, whereas AS candidates scoring 25-30 are not adjusted.

The Moderation team externally moderates the different elements of the Separate Skills practical work using the same criteria and standards for all syllabuses which include this coursework option. Internal moderation must be carried out for each syllabus, by the Centre, before coursework is submitted to OCR.

Centres are reminded that guidance on the assessment of all three Skills is to be found in the Biological Sciences Teachers Handbook. Materials used for the Autumn 1998 and 1999 INSET sessions also provide further guidance and were written to provide teachers new to the syllabus with sufficient material to assess all sub-skills. These are available from OCR Publications.

Safety Issues

The moderators were concerned that a number of candidates' plans and methods were unsafe and would not meet current health and safety guidelines. Centres must ensure that all candidates are sufficiently aware of the safety and ethical implications of any work planned and carried out.
Candidates are strongly advised not to carry out human physiology experiments in which subjects are asked to smoke. It should also be noted that no living organisms should be killed unnecessarily in the course of experimental work, nor should microbiological plates be incubated at or near to 37 °C.

The following Skill-specific comments are to provide Centres with further guidance:

Skill A

Since Skill A requires the Candidates to carry out a planning exercise which can be set in a wide range of circumstances, **it is vital that Centres clearly indicate the context and time framework of the task.** This is needed in order to allow the moderators to compare; for example, two or three sides of A4 plan produced in a double lesson, with the dozen or more pages of the 'mini-project' carried out over a few weeks.

Whilst many Centres did produce a mark scheme for all Skill A exercises, it is **strongly recommended** that all Centres follow this practise. This will enable staff to identify possible marking points and determine whether the task provides sufficient scope for candidates to demonstrate A level knowledge and skills. Obviously, such mark schemes cannot be prescriptive, since the better candidates may well come up with ideas not previously considered by the staff.

The moderators felt that planning experiments based on genetic crosses were not suitable for assessment of much of skill A since there are few variables, little choice of methods and apparatus and unless Dihybrid crosses are used, no opportunity to demonstrate A level knowledge. The moderators were pleased to note that fewer Centres were using Ecological and Human Physiology tasks to assess Skill A. These tasks are often poorly carried out with little scientific understanding of the variables and detail needed to give a repeatable plan. Such tasks can be used very well to assess many other sub-skills and should not be discouraged. Where the experiment being planned is based on a standard A level practical (e.g. transcription using a potometer), the moderators expect that the candidates be asked to do a bit more (e.g. effect of aspirin on transpiration rate). This will require candidates to develop their own plans and apparatus, preventing the use of identical plans. Additionally, all quantities and concentrations should be given in such work.

A1. **Centres are strongly reminded that the background knowledge must be relevant to the planned investigation.** Indeed, those who had been asked to carry out research often wrote three or four sides of unrequired information/ knowledge, frequently copying out everything they had discovered using the World Wide Web. A common error is when candidates plan an experiment using, for example, an enzyme inhibitor and its subsequent effects. This cannot score 2 marks. The use of a specific mark scheme would enable Centres to ensure that they only credit **relevant** knowledge.

A2. Many candidates are still producing a very wordy hypothesis. It is expected that the candidates should produce a brief, precise hypothesis. This should be based upon the background knowledge and be quantitative if possible. A correctly stated null hypothesis is permissable. Whilst it is not a syllabus requirement that A2 and A6 are assessed on the same exercise, it was pleasing to note that the majority of Centres did so. The moderators consider this to be good practise and should be encouraged.

A3. Centres must ensure that any task allows candidates sufficient scope to identify a range of variables. The variables were often vaguely suggested, with no clear indication of their control. There was a large variation between Centres, with some listing the variables and others providing full details of their control. The means of control should be assessed in A4; A3 merely requiring the identification of variables. However, candidates should be expected to elaborate upon the reasons for their control.

A4. Centres must ensure that the task set allows candidates sufficient scope to produce a sensible plan. A task that is a standard A level experiment is not suitable since most candidates produce an identical 'textbook' method. The methods provided by many candidates are often lacking in one or more vital details, such as the temperature at which the waterbath is set, or the enzyme used. As such plan cannot be followed by another person, they should score no more than 1 mark. Centres are reminded that the plan should be a series of **well ordered steps**; too few candidates seem able to produce these. Centres would be well advised to provide sufficient training for candidates before carrying out assessment of this sub-skill, for example, writing a plan for a commonplace activity such as the making toast. They could then give this plan to another person to see if they can understand and follow the steps. It is also expected that candidates should use their method to demonstrate that the variables identified in A3 are fully controlled and monitored, if appropriate.

A5. Centres must ensure that the task set allows candidates sufficient scope to select suitable apparatus and volumes or quantities of materials. For example, this is not possible if a respiration experiment is planned, since in most cases, only one type of respirometer is available (therefore there has been no choice of apparatus). **Centres must ensure that appropriate volumes or quantities are selected.**

A6. Centres are reminded that this must relate to the original hypothesis. If a candidate does not carry out the experiment, the teacher should use the information found in A2-A5 to determine whether the plan would be capable of testing the given hypothesis. Centres should note that when a hypothesis compares rates, the plan must actually be devised in order to allow the candidate to **calculate** a rate. If the hypothesis states that a doubling of x, results in a doubling of y, it is expected that the candidate should demonstrate this, with at least two doublings of x, in order to score 2 marks. For experiments testing a Null hypothesis, there must be sufficient results in order to carry out the relevant statistical test.

This year there were a few Centres who set tasks related to Human Physiology. These included 'the effects of smoking on exercise' and 'the effects of caffeine on reaction times or pulse rate'. Whilst such titles are obviously of interest to many candidates, they often adversely affect the candidates potential to produce a good score for skill A.

It is felt that for A1, the majority of candidates treat such subjects at a fairly superficial level, since they have not normally acquired sufficient scientific knowledge of the topic to give a reasoned, clear account. For A2, the tasks leave little scope for any succinct, quantitative hypothesis. The discussion and control of variables is frequently very poor, with no account taken of comparative weights, ages, size or health of the subjects. Candidates also forget to take into account variables such as the time of day, seating arrangements and internal and external conditions, when investigating topics such as reaction times. There are also a number of health considerations that should also be noted by Centres. Candidates should be discouraged from carrying out comparative exercises on their colleagues where individuals might be made to feel 'different' or 'inferior'. It is also not advisable to encourage candidates to drink five or six cups of coffee over a 90 minute period. It is strongly recommended that a Risk Assessment be carried out before using human subjects for any form of experimentation. A4 and A5 also gave cause for concern. For A4, the method was often poorly described, with reference to students taking the 'Step Test' or some other fitness indicator. No other explanation was provided. This means that no other candidate could carry out this experiment without specialised

knowledge. For A5, the tasks chosen often gave little scope for choice of apparatus. For exercise, reaction times, smoking and caffeine related tasks, there are very few apparatus requirements and this is not felt to be sufficiently demanding. For example, 10 randomly selected 17 year olds, 20 cups of coffee and a reaction timer, does not compare favourably with the apparatus and materials required for a complex enzyme experiment. For A6, the candidates were often over-assessed since, for example, the inherent lack of understanding as to how levels of fitness can be accurately assessed and the limited time scales available, meant that the experiment would **not** be able to test the stated hypothesis.

Whilst Ecological work can be used for the assessment of the B and C skills, it is not recommended for the A skill. The Planning skill is often carried out as part of a field course. For A1, there is often very little A level standard knowledge. The candidate can often produce a suitable null hypothesis for A2 but for A3, the variables are often poorly explained, with students demonstrating little understanding of the need to discuss the relative merits of differing sampling techniques, random selection of sampling areas, quadrat size in addition to the time of day, time of year, or the weather conditions. The method in A4 is often very weak, with no details given of how to carry out the sampling, or, for example, at what height light meter readings are made. In A5, there is often little choice of apparatus. Most candidates may score 1 mark for A6, since a poor method may just test the hypothesis.

Skill B

B1, B2 and B3: Centres are reminded that the moderator must be given enough information – such as work sheets, mark schemes or check lists, in order to see what exercises were used and to see how the marks had been allocated to individual candidates. The Centre must be able to justify why one candidate has been awarded a score of 1 and another candidate a score of 2 for a particular sub-skill. Microscopic work does not normally lend itself to the assessment of safety or manipulative skills unless the candidates are making and staining their own slides. The moderators were encouraged to note that more centres are requiring their students to produce Risk Assessments, which can form a major part of the B2 sub-skill assessment.

B4. The moderators have noted an overall improvement in this sub-skill. This is mainly due to Centres using the suggested mark scheme in the Teachers Handbook, which is so weighted so as to ensure that all syllabus requirements are assessed. Centres are advised not to modify the published mark scheme, since this frequently leads to some syllabus requirements not being assessed.
A number of centres still need to note that annotations are taken to mean comments which enable the teacher to assess the candidate's powers of **observation**, not their ability to recall factual details. A comment such as 'many chloroplasts stained purple' is the type expected. It is inappropriate to draw plant cell walls as a single line and high power drawings of cells at different stages of cell division are not suitable.

B5. Centres are reminded that tables should follow The Institute of Biology guidelines, having a suitably informative title and units shown only in column headings. The exercises should involve the collection of **quantitative data** and no direction should be given on how the table should be arranged. The current version of the Teachers Handbook contains a suggested mark scheme for tables. This sub-skill assessment is only for the production and use of tables and Centres should not produce mark schemes which contain numerous checking points relating to the data and its subsequent transformation into other forms. Again, Centres are strongly advised not to

modify the published mark scheme, since this could lead to incorrect assessment.

B6 Centres are reminded that this sub-skill assesses the precision of the candidate's measurements and that precision should be commensurate with the apparatus being used. Candidates must not measure half or quarter bubbles; they should use more sophisticated apparatus. If the candidates are timing an event using a stop clock that records hundredths of a second, they should realise that their reflexes would not be sufficiently accurate to judge the timing to this level. Therefore they should round the units of time up or down. When using eyepiece graticules, candidates should convert eyepiece graticule units to linear units, using an appropriate number of decimal places. Expressing a result to 4 or 5 decimal places shows a lack of appreciation of the meaning of 'limits of precision'.

Skill C

C1. In general, this was well assessed. However, Centres should ensure that candidates **select** an appropriate statistical test. This is best achieved by having a prepared work sheet, with the final question in the page being 'suggest a suitable statistical test to analyse your data'. The Centre should then make it clear to the moderators that the student was provided with the means to carry out the chosen test. The moderators were concerned when no question appeared to have been asked and candidates were presented with a pre-printed sheet such as 't-test on homogenised and skimmed milk'. Candidates should be encouraged to give a suitable null hypothesis, if relevant. Centres are reminded that candidates are expected to have carried out the experiment that generates the data used for the analysis. If they fail to obtain enough results or if the group size is small, it is permissable to pool data. However, the moderators would expect to see this clearly indicated by the teacher.

C2. A number of centres do not clearly annotate this sub-skill.
In order to obtain two marks the candidate **must use both** the result obtained from C1 in order to explain the validity of the results with reference to the appropriate confidence limits and degrees of freedom **and** give a suitable discussion of at least two limitations of the procedures used in the experiment (not limitations of the statistical test). **If either element is missing, the maximum score available is 1. Both elements should be clearly annotated to assist moderation.**

C3. For this sub-skill, the candidate must give at least two practical improvements that could be made. **It is not acceptable to give different practical work or extension work.** The improvements should not be simply methods of overcoming the previously described limitations, nor should they be taking more readings to be more accurate (unless qualified by reference to statistical reliability).

C4 and C5. A significant number of Centres continue to be confused about the differences between these sub-skills.

C4 requires an **interpretation** of the data, using correct, A level standard knowledge. Anomalous results (if they occur), should also be discussed.

C5 requires a **statement of conclusion** that contains a full reference to data. This means that the figures must be clearly quoted. The same is true if statistics have been used; the candidate is expected to quote the result and significance. Centres must ensure that they credit the candidate wherever the concluding statement is made. A valid conclusion, with

data and acceptance of a null hypothesis, may be made straight after the candidate calculates the statistical test. This can be used for part of C2 and all of C5.

C6. Centres are reminded that graphs should follow The Institute of Biology guidelines, and there should be no prompting from the work sheet as to what should be used on the axes. All graphs should be hand drawn by the candidate, having suitably informative titles and with clearly labelled, correctly scaled axes. It is expected that a graph scoring 2 marks is of high quality, with no crossing out or other mistakes. The Teachers Handbook contains a suggested mark scheme for graphs, which ensures that only a high quality can score 2 marks, with gross errors such as axes the wrong way round or incorrectly scaled axes, scoring 0. Centres are also reminded that candidates are expected to draw the correct type of graph in order to fulfil the communication criteria for C6. **Centres are strongly advised not to modify the published mark scheme since this could lead to incorrect assessment. Computer generated graphs are not acceptable for the Separate Skills.**

Linear A Level Biology 9264
June 2000 Assessment Session

Component Threshold Marks

Component	Maximum Mark	A	B	C	D	E	N
9264/1	100	64	57	50	43	37	31
9264/2	40	32	29	25	21	18	15
9264/3	75	54	49	43	37	31	25
9264/4	36	33	30	26	22	19	16
9264/5	60	40	32	29	26	23	20
9264/6	12	10	9	8	7	6	5
9264/9	36	33	30	27	24	21	18

The cumulative percentage of candidates achieving each grade was as follows:

Component	A	B	C	D	E	N	Total Number of Candidates
9264/1	25.82	41.98	56.87	70.60	81.17	88.34	1657
9264/2	23.08	38.28	59.90	78.62	87.95	94.91	1657
9264/3	18.41	33.37	49.61	65.84	78.38	88.07	1657
9264/4	50.06	71.80	86.96	94.04	97.39	98.63	807
9264/5	17.73	56.36	68.18	81.36	88.18	94.55	221
9264/6	63.80	78.73	86.43	94.12	97.29	99.10	221
9264/9	44.70	68.49	82.80	93.57	97.75	98.88	622