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Paper 9260/1

General Comments

Most candidates found this paper straight-forward and were able to find at least two questions on which they could write at length, often choosing from questions 1, 3, 4, 5 and 7. The other questions, namely 2, 6, 8 and 9, tended to be answered well when popular with a particular Centre but were less well done by other candidates. On the whole, subdivisions within a question had been arranged well in separate, lettered, paragraphs and diagrams had been spaced and labelled sensibly, although by no means all candidates had provided captions for their figures. There was a wide variation in the standard of English and of presentation but many candidates scored maximum marks for lucid expression.

Question 1

Almost all candidates attempted this question but, despite it being based on a syllabus topic treated in depth in most text books, many showed a surprising lack of understanding of basic aspects of DNA structure and protein synthesis.

(a) Comprehension of this part of the question seemed to be particularly difficult. It had been expected that a gene would first have been defined chemically: being shown to consist of a portion or unit (not a whole molecule) of DNA made up of a particular sequence of triplets of bases (not just a single triplet). Each triplet, a codon, specifies a particular amino acid, the sequence of triplets, in turn, determining the order in which the amino acids are bonded together to form a specific polypeptide: hence one gene is determining the synthesis of one particular polypeptide. Only after individual polypeptides have been formed does further bonding occur to produce proteins/enzymes. Few candidates said all this in *(a)* however, and marks for this section were therefore awarded in *(b)* if any of the relevant points had been made there instead.

(b) In answering this part of the question some detail of DNA structure (but **not** chemical formulae) was required. DNA is more than a double α-helix of deoxyribose nucleic acid; it is composed of two chains of nucleotides, the bases of which are attached to deoxyribose sugar molecules (which are attached to one another by phosphate groups) and are linked to one another by hydrogen bonds in an appropriate pairing relationship. Names of DNA and RNA bases, not just their initial letters, were expected and weak spellers should be reminded that adenosine, cystine and thiamine are **not** involved here. During transcription (not replication) hydrogen bonds break over a specific portion of the DNA molecule (not along its whole length) and free (i.e. separate, not vacant) *nucleotides*, (not free bases alone nor preformed lengths of mRNA arriving from the cell cytoplasm), become attached to appropriate positions on one of the two DNA strands (not both). These mRNA nucleotides then condense to form a chain of mRNA with an arrangement of bases

complementary to that on one of the two DNA strands (replacement of DNA thymine by RNA uracil having been mentioned earlier). The sequence of events leading to the assembly of proteins on the ribosomes, following the exit of mRNA through nuclear pores, was often well known although weaker candidates did not understand the precise structure and function of tRNA nor did they refer to the need for enzymes and ATP. Some reference to stop/start codons was expected but a detailed account of protein structure gained no credit.

Question 2

In this question most candidates appreciated the requirements for an efficient gaseous exchange surface (viz. large surface area, moist surface, easily permeable membrane, an entry point, diffusion gradients and a means of movement of gases for example) but often failed to indicate how these were achieved in the specific examples given. In discussing the need for a large surface area it was necessary to mention that insect tracheoles are numerous and finely branched, mammalian alveoli ('lungs' were not an acceptable surface) and palisade mesophyll cells are small and numerous, whilst for each example the features that make the surface moist and permeable should have been specified. The actual point of entry of air was often ignored as was the way in which the entrance passage was protected, strengthened with a named material or controlled: mention of spiracle or stoma was insufficient without a brief explanation of how the diameter of the entry point could be altered. Some candidates referred to the importance of abdominal/thoracic pumping or change of ribs/diaphragm positions in aiding ventilation but only a minority indicated that any *muscular* action was involved in these movements. There was also some confusion between insect tracheae and tracheoles and too few candidates seemed to realise that the latter serve individual cells. Some reference was made to the osmotic implications of lactic accumulation during insect muscular activity but only a few candidates gained an additional mark by commenting on the importance of surfactants in maintaining alveolar shape.

Question 3

Knowledge of pathways for water movement was often sound although there was sometimes a lamentable ignorance of the unicellular nature of a root hair (and therefore its relationship to the rest of the epidermis) and there were some candidates who failed to appreciate that the route was root hair, then across the root cortex and endodermis and into the xylem before passing into the xylem of the stem and finally into the leaf. The mechanism of water uptake was reasonably well known (and rarely confused with mineral ion uptake) but many candidates gave no clear explanation of osmosis ('weak to concentrated' for example must be qualified) nor did they indicate that whilst cell walls are fully permeable, cell and tonoplast membranes are only semi-permeable. More than one mechanism of transport across the cortex was often referred to but rarely was a particular mechanism related to cortical cell structure. The structure of the endodermis was often well done and credit was given to candidates who discussed ion secretion and root pressure in the right context as well as to those who drew or explained precisely where in the cell the Casparian strip was found. In discussion of xylem structure mention should have been made of the tube-like nature of vessels resulting from a loss of cytoplasm/living contents whilst the loss of end walls and the lignification of longitudinal walls should also have been stressed; there were disappointingly few references to lignification being responsible for prevention of inward collapse of vessels and tracheids subject to negative pressures or to the relationship between adhesion and lumen size. Accounts of the transpiration stream were sometimes

spoiled by a final reference to the lifting force being due to capillarity. Movement of water in the leaf was less well understood, about half of the candidates failing to stress that evaporation occurs from mesophyll cells into the internal air spaces, rather than merely evaporating from the leaf surface or at the stomata.

Question 4

This was a popular question which often scored high marks.

(a) Despite the wording of this part of the question, backcross and test cross are not synonymous terms, although candidates were not penalised if they illustrated only one term. An example referring to a test cross was usually chosen, that is, a cross between an individual of uncertain genetic constitution, but showing a dominant phenotype, test crossed with a homozygous recessive. If the unknown was homozygous dominant the test cross generation would all show the dominant phenotype but if it was heterozygous then the offspring would show a ratio of 1 dominant phenotype: 1 recessive phenotype (or, if tall versus short pea plants were chosen as an example, this means not that 1 plant would be tall and 1 plant short but that the many plants from a test cross would be in the ratio of 1:1). In providing an example the crossing schemes should have been feasible (e.g. not white coat colour dominant to black), with recognised and not invented symbols preferred, and both phenotypes and genotypes of parents and offspring in the two crosses should be shown together with the constitution of the gametes, clearly labelled as such.

(b) Whilst most candidates were familiar with the names of **X** and **Y** chromosomes, fewer indicated that, in Man, at least part of the **Y** chromosome is genetically inert or went on to show that it is this difference in structure between the **X** and **Y** chromosomes which leads to masking of the sex-linked character in the heterozygous female (who is therefore a carrier) but to its expression in the male. A minority of candidates referred to sex genes instead of to genes on sex chromosomes, but most were able to quote examples of sex-linked characters and to produce a genetic scheme, although few candidates showed or discussed a reciprocal cross.

(c) This part of the question was often poorly done, with little reference to when or how crossing over occurs, poor diagrams with no chromatids shown and often with incorrect alleles (e.g. homologues with **ABc** and **DeF**). Crossing over involves the exchange of corresponding segments between chromatids of homologous chromosomes during prophase 1 of meiosis (not metaphase 1 or anaphase 1 as many candidates thought), the exchange resulting from breakage and incorrect rejoining of non-daughter chromatids and being seen visually due to the formation of chiasmata and inferred genetically from the recombination of linked genes.

(d) Multiple alleles, occurring when a particular gene at a specific locus exists in more than two alternative forms, any two alleles being present in one individual, were often confused with polygenes (multiple factors), where several non-allelic genes occur, all affecting the same character, (e.g. height in Man or skin colour), often additive in effect and resulting in more or less continual variation. Candidates who correctly chose **ABO** blood groups or rabbit coat colour as their example usually explained the hierarchy of dominance well but comparatively few gave a scheme of genetic cross by way of illustration.

Question 5

(a) Most candidates knew the names of the hormones involved in the oestrous cycle but did not always stipulate what caused the secretion of each nor what each did. There were few mentions of the hypothalamus releasing factors and

many candidates failed to specify that it was the *anterior* pituitary that was involved in the secretion of FSH and LH. FSH was sometimes said to stimulate the production of a follicle without any detail being given as to what was growing there, and similarly oestrogen was cited as being 'produced in the ovary': more detail was expected. Likewise, *reasons* for stoppage of follicle growth, fall in LH, corpus degeneration, fall in progesterone and the onset of menstruation were looked for. In the event of a pregnancy, maintenance of the corpus luteum and the role of the placenta in taking over gonadotrophin secretion were accepted as valid points but many candidates wasted time discussing in detail all the hormones of pregnancy and parturition.

Sensible suggestions were made in answer to *(b)* although points of comparison concerning, for example, length of stimulation time required or the need to stimulate more than one organ simultaneously were not always detailed enough.

Question 6

Whilst some Centres wrote very good answers to this question, others avoided it.

(a) One of the main weaknesses of candidates in this part of the question was to describe various parasites rather than to discuss their adaptations, for example, to describe scolex hooks and suckers in *Taenia* but not to state that they are used to adhere to the gut of the host in order to prevent expulsion during peristalsis. Adaptations described included those of finding, entering and adhering to the host, for absorbing food or resisting digestive enzymes and/or antibodies (some confused *Taenia* and *Ascaris* here and others had not thought out how *Taenia* could be said, 'to have a thick cuticle', and yet also be able to 'absorb digested food all over the surface'), for anaerobic respiration, for effective reproduction (but not for asexual reproduction in *Taenia* as some claimed), for dispersal and survival outside the host and for the reduction of unnecessary features. Reference was expected to at least one parasitic example from each of animals, plants, fungi and bacteria but most scripts contained more examples than this though surprisingly, considering question 8, there were hardly any references to viruses as parasites.

(b) This part of the question could be interpreted in two ways, both of which were acceptable. On the one hand attributes of certain taxonomic groups could have been contrasted and suggestions made as to why parasites occur within one group but are rarely found in the other, for example in fungi rather than in algae or in nematodes rather than in mammals. Alternatively, differences could be noted in the incidence of parasites within a particular organism on the basis of solitary or gregarious habit, the nature of the external environment (e.g. aquatic or terrestrial), the level of hygiene or the external morphology of the host under discussion.

Question 7

(a) Whilst the average script showed that candidates were reasonably familiar with the basic internal structure of a chloroplast, it was not always realised that there are two chloroplast membranes (comprising the envelope), an outer one and an inner one invaginated to from the grana; *both* of these membranes are composed of phospholipids i.e. they are both *double unit membranes*. There was also some confusion between the meaning of grana, thylakoids and quantosomes and it was rarely possible from diagrams to see any evidence of the 3-D structure of the chloroplast, although occasionally suitable terms such as 'saucer-shaped', 'discoid' or 'lens-shaped' were used. Most candidates included starch grains in the stroma and sometimes lipids and enzymes but only rarely were ribosomes or DNA mentioned; it should also be noted that where size of chloroplast is being given, units

of measurement are all-important.

(b) Function of the chloroplast was the least well done part of the question. Some candidates dismissed it with a bald statement such as 'photosynthesis' whilst others described the light reaction only, apparently believing that the dark reaction, being independent of chlorophyll (a term sometimes used erroneously as being synonymous with all the pigments) occurred outside the chloroplast. Many candidates however showed a thorough knowledge of the process of photosynthesis, referring to cyclic and non-cyclic photophosphorylation and/or to photosystems 1 and 11 as well as accurately describing the Calvin cycle and showing the incorporation in it of the products of the light reaction. A minority of candidates referred here, and in parts *(a)* and *(c)*, to C_4 plants, drawing attention to differences in chloroplast structure, function and distribution in these plants.

In part *(c)* distribution was often shown by means of a diagram. Most candidates knew that chloroplasts were found mainly in palisade mesophyll cells and in guard cells but often failed to record that they are not present in the epidermis (although some included them here) or in the veins, but do occur in the bundle sheaths of C_4 plants and are present in petioles (sometimes incorrectly called stems?). A detailed drawing of one cell often showed clearly that the chloroplasts occurred in the cytoplasm but more mention could have been made of chloroplast movement within a cell in response to changes in light intensity.

Question 8

(a) As this question asked for features that distinguish viruses from bacteria, a list of viral characters alone did not answer the question: viral features had to be contrasted with equivalent features of bacteria. Many candidates noted that a virus contains either DNA or RNA but failed to mention that bacteria possess both types of nucleic acid and not just DNA. There was also some inaccurate recording of bacterial DNA being contained in a nucleus and confusion over the terms prokaryotic, eukaryotic and akaryotic.

(b) Perhaps somewhat surprisingly almost every candidate elected to draw the rather specialised bacteriophage as an example of a 'typical virus'. Structure of the 'phage and mode of entry into bacterial cell were generally well known but many did not explain that during reproduction of the virus the host cell DNA is no longer formed, viral DNA being formed instead. Assembly of the newly formed DNA, protein coats and other sub-components, sheath, hollow spike and tall fibres, was not often mentioned nor were the enzymes involved in breakdown of bacterial cell membrane, on entry, or of lysis of the entire membrane, on exit.

(c) Many candidates referred here to cells being killed by viruses but it was not always realised that it is the subsequent products of lysis, and not the viruses themselves, which produce toxins and therefore the fever often associated with disease. Indeed, despite reference to lack of metabolism in viruses under *(a)* toxins were often said to be excreted by the virus and there were many garbled accounts of disease, due in part to taking 'phages as examples and some misidentifications, e.g. *Plasmodium* was regarded by some candidates as a virus. Resistance of viruses to antibiotics was another valid point made and there was some mention of the ability of viruses to remain latent, maybe during several normal cell divisions, as well as to their rapid rates of reproduction on other occasions and to their effect on cell divisions in certain types of cancers.

Question 9

(a) Habitat was usually correctly defined as a place but only rarely was there any mention of it having a distinct physical environment or of being occupied by

a specific group of animals and plants. Niche was frequently confused with microhabitat and there was seldom any reference to specific aspects of role such as position in food webs or chains.

(b) Candidates who wrote from first hand experience did best here, with freshwater or seashore organisms producing some outstanding answers. But there were also some interesting accounts of organisms that had been investigated by conservation groups or which had been referred to on TV programmes. At the start of this section however, although the organisms were usually correctly named the habitat often needed a more precise definition, for example chalk downland rather than grass, or savanna rather than Africa, or a more precise location, rabbits on downland being more plausible than rabbits in a wood. The poorer answers contained only vague references to weather, food and disease, whilst better candidates discussed more factors and gave more details by referring to a *specific* disease, or food or predator for example.

(c) This part of the question was often answered with the aid of a fairly stereotyped graph. Although this did not always bear too close a relationship with the population discussed under *(b)* it did nevertheless usually show overall trends.

Paper 9260/2

General Comments

The most notable features of the paper were the low standard of the answers to Questions 1 and 2 and the use of the incorrect method by the majority of candidates in their attempt to answer the first part of Question *5(a)*. Question 4 appeared to be the easiest. There was no evidence that the paper was too long.

Question 1

Many of the answers to this question were of O-level standard. They were also often vague and imprecise. In answer to *(a)* the two reasons expected were the conversion of carbohydrate/starch in respiration to carbon dioxide and the translocation of carbohydrates to the shoots. Although many candidates gave these two reasons many others wrote vaguely of food being used up and the shoots needing energy.

Part *(c)*, on the whole, was well-answered but it was apparent that many candidates had never considered before how to measure dry mass. Some failed to appreciate that plants are killed if dried in an oven at 80–110°C. Others heated over a bunsen and still others used a series of most unlikely techniques – dehydration in alcohol, squeezing between sheets of blotting paper, drying over anhydrous calcium chloride, etc.

Question 2

The majority of answers to this simple question were surprisingly poor. Most candidates appreciated that plants store carbohydrate as a starch and have abundant cellulose in their walls. Fewer, however, seemed to appreciate the quantity of protein found in animals in muscles, connective tissues, tendons and hair, for example. As regards lipids, most candidates seemed so obsessed with the role of lipids in cell membranes that they failed to appreciate their roles as energy stores and in thermal insulation. Many candidates stated that animals are more complex than plants so have more enzymes and more membranes. Some even categorically stated that plants do not have membranes but only cell walls and that this accounted for the variations in lipid and carbohydrate contents. A few even argued that plants have more carbohydrates because they do not respire at night!

Question 3

It has been stated before in such reports that questions on plant anatomy often draw out glaring inaccuracies. The tissue was collenchyma and Fig. 1 was an accurate tracing from a photomicrograph of typical collenchyma from below the midrib of a leaf of cherry laurel, *Prunus laurocerasus*. Some candidates may have been confused because it was not that like the much over-stylised collenchyma figured in most A-level textbooks. The candidates were expected to observe from the figure that the cells had thick walls, that they were unevenly thickened or thickened in the corners, that they were elongated and that they had tapering ends. Not all observed all these four features but many noticed two or three. The structures labelled **1** and **2** were the middle lamella and a simple pit respectively. In *(d)* (i) the answer expected was support. These points, amounting to over half marks, were allowed whether the candidate called the tissue collenchyma or not. Candidates who called the tissue sclerenchyma were not penalised in any way. Candidates should however have appreciated that the tissue was not at all like sclerenchyma. Fibres are much longer and narrower than the cells figured. They have very much thicker walls and as a consequence a relatively small cell lumen. The walls are uniformly thickened. They have more pointed ends. There is perhaps a need for more very basic plant anatomy to be taught at this level and it may not be a coincidence that in a number of Centres the majority of candidates called the tissue collenchyma and produced good answers whereas in a number of others the name given could have been taken at random from xylem, phloem, parenchyma, collenchyma or sclerenchyma. It can only be assumed that some had actually seen it and had been taught about it and others not.

Question 4

This question was answered well and parts *(a)* and *(b)* (i) were probably the easiest parts of the whole paper. In answer to *(b)* (ii), many candidates were vague but presented the idea that at low substrate concentrations, the substrate was the limiting factor and at high substrate concentrations the quantity of enzyme was limiting the reaction velocity, all the molecules working at maximum rate.

In part *(b)* (iii) the examiner was aware that the Michaelis constant is not mentioned in the syllabus. Candidates were not expected to have any prior knowledge of it. They were expected to deduce the answer from Fig. 2. Km could have been designated x or y but the examiner might have been criticised had he so done! The answer expected was that Km gives the substrate concentration at which the reaction velocity is proceeding at half its maximum rate. A simple deduction from the graph. The significance of knowing this is that it gives an indication of the velocity of the reaction. The majority of candidates realised this. Some were exceedingly explicit and elaborated further stating that it gave an indication of the efficiency of the enzyme and its affinity for its substrate.

Question 5

Questions of this type have been set frequently in the past. There was considerable confusion over how to calculate the frequencies of the two alleles. Surprisingly the majority of candidates attempted to calculate the frequency of the two alleles in *(a)* by using $p^2 + 2pq + q^2 = 1$

$$\text{i.e. } p^2 = \frac{356}{1100} \text{ therefore } p = 0.569$$

This of course, led to problems in calculating the expected Hardy-Weinberg genotypic ratios.

The frequency of the allele M is calculated as follows:

$$\frac{(356 \times 2) + 519}{2200} \text{ or } \frac{356 + 519/2}{1100}$$

$$= 0.56.$$

Question 6

Many candidates found this to be a very straight forward question and produced excellent answers with their workings clearly shown. Some candidates were careless in working out the genotypes and as a consequence obtained the wrong ratio of phenotypes.

Two faults were very common. Homozygous m_1 m_1 with M_1 or M_2 was often called purple/blue and similarly m_2 m_2 with M_1 or M_2 purple/red and the homozygous double recessive m_1 m_1 m_2 m_2 was called red/blue or colourless rather than white.

Question 7

This was usually well done and it was very encouraging to see that the candidates made reference to the figures given in Table 3 to support their conclusions as to how and to what extent the population compensated for losses.

Inability to do simple calculations often lost marks. For example, an increase in lifespan from 4.4 to 7.0 days was often given as 3.6 days. Many others were too inexact in their calculations. For example, an increase in lifespan from 4.4 to 7.2 days and an increase in mean number of viable eggs laid per day from 0.25 to 6.0 were both often said to have 'doubled'.

Paper 9260/4

General Comments

In spite of some difficulties encountered by variations in yeast activity in Question 1, the paper as a whole was generally well received although a few teachers suggested that the paper was rather long.

Question 1

(a) Most candidates recorded bubble counts by strokes as instructed but a minority did not.

(b) A number of candidates ignored the instruction "using the reagents provided and . . ." and referred only to the bubble counts and the information given about sugars **A**, **B** and **C**.

Food tests consist of relatively simple procedures but if they are not performed carefully the results are inconclusive. The recording of the methods, observations and conclusions of Benedict's/Fehling's tests was frequently badly done. The method was often restricted to 'Carry out a Benedict's/Fehling's test on sugars **A**, **B** and **C**' with no reference being made to appropriate relative volumes of sugar solutions and reagents used nor to the need to heat strongly or boil the sugar solution with the reagent.

Many candidates omitted to carry out an *initial* Benedict's/Fehling's test when testing for a non-reducing sugar and a similar number omitted to state that it is necessary to heat strongly, or boil, sucrose with dilute hydrochloric acid to hydrolyse it before neutralising and then boiling with Benedict's solution.

When recording observations for these tests terms such as 'positive' and 'negative' are inappropriate and inadequate unless they are fully qualified. A direct statement is expected such as 'a red precipitate with sugar **B** indicated the presence of a

reducing sugar' or 'the solution remained blue indicating the absence of a reducing sugar'. Note here that the red precipitate indicates the presence of a reducing sugar rather than of a specific simple sugar/monosaccharide/glucose/fructose. There was also some confusion when the term 'non-reducing' sugar was considered to be synonymous with disaccharide sugars.

(c) Most candidates correctly recorded a red precipitate indicating that a reducing sugar was now present in tube **A**; some however were misled into believing that sugar **A** contained a reducing sugar. (Sugars **B** and **C** were reducing sugars.)

(d) (f) (h) and *(j)* were well answered by many candidates.

(e) Terms such as 'cells' and 'unicellular organisms' were frequently used but they are not appropriate, on their own, when describing observations. A number of candidates correctly described the shape, size, colour etc. of what they saw.

(g) The better candidates referred to some procedure for observing reproduction using, e.g. an agar plate or haemocytometer; other variations were acceptable but it was necessary that further counts of cells were made, after an interval.

(i) Relatively few candidates recognised that sugar **A** (sucrose) is a disaccharide composed of two reducing sugars and that a 0.2 molar solution of **A** would contain twice as many monosaccharide molecules as a 0.2M solution of glucose (**C1**); the 0.2M solution of sucrose would therefore provide twice as many monosaccharide molecules for the yeast to use as a substrate as the 0.2M solution of glucose. This would account for the faster rate of reaction in tube **A** than in tube **C1**.

Question 2

(c) A number of candidates followed the instructions and displayed the insect alimentary canal neatly and completely. Others produced parts of the alimentary canal only and many were not adequately cleaned from extraneous tissue nor was the dissection well displayed. Some had not even removed the alimentary canal from the exoskeleton. It appeared that candidates from quite a number of Centres had little, if any, experience of this part of the course.

(b) A large number of candidates followed the instructions carefully and had stained and mounted the structures very effectively and been able to see a reasonable amount of detail under the high power of the microscope. On the other hand there were numerous cases when insufficient care had been taken in preparing the slide and covering the preparation neatly with transparent adhesive tape and a number of slides had not been labelled.

(d) Quite a number of candidates did not appreciate that only features which distinguished each structure from the other two had been requested. Some good answers correctly noted features such as colour; shape of the caeca; rings of thickening and branching in the trachea.

(i) The general quality of the high power drawings of a Malpighian tubule and a piece of trachea was low. In a large number of cases the features were clearly visible under the microscope but the drawings bore little if any resemblance to these features. In the Malpighian tubule, few candidates showed two or three of the clearly visible cell outlines or included nuclei of the correct relative size. The drawings of the trachea were frequently inaccurate in that no distinction was made between the thickness of the supporting bands of chitin (often incorrectly called 'bands of cartilage'), and the spaces between these bands, and the size of the nuclei was rarely correctly shown.

(j) Most candidates did not appreciate that staining is basically a chemical process.

(k) The isotonic nature of the saline, preventing an uptake of water by the

cells which would have led to distortion and damage, was quite well understood.

(f) Some candidates obtained maximum marks on this part of the question and many more scored high marks. In most cases the labium and maxilla had been removed quite adequately, although the labium had sometimes been confused with the labrum. The maxilla however were sometimes placed on the wrong side of the drawing or the palps directed inwards and in the wrong direction and in a few cases the dorsal instead of the ventral surface was uppermost or the mouth-part had only been incompletely removed.

Question 3

The overall standard of the answers was disappointingly very low.

(a) The plan drawing of a typical, large vascular bundle was sometimes drawn large and accurately, showing the correct position, shapes and relative dimensions and extent of sclerenchyma, phloem, cambium and xylem, but too frequently little attention had been given to these points and some preconceived and inaccurate drawings were made. A number of candidates wasted time drawing the whole section or sector whilst a few included cell outlines, in spite of instructions to the contrary stated clearly in the syllabus and in the bracketed note on the question paper.

(b) In many cases the position of the most recently formed xylem vessels seemed to have been selected at random. It should have been indicated close and adjacent to the cambium, not to the pith.

(c) The drawings here were very poor and many candidates did not show cells from three *different* tissues, as instructed. FOUR typical cells were required from each tissue; tissues were frequently not labelled and the drawings were often too small. Features expected were: large drawings, to fill the available space, relatively proportional in size, and showing the correct thicknesses of cell walls, cell shape, air spaces and cell contents.

(d) Many candidates did not refer directly to the cells they had just drawn, and it was not then clear whether they referred to cells drawn in *(c)* or to those seen in a strip **AB**. Such answers were very imprecise and not relevant.

(e) Most candidates did not answer this part well mainly because they did not read the question carefully and made no reference to previous parts of the question. It was expected that differences noted in *(d)*, such as presence of cuticle on epidermal cells/no cuticle on cells lining the air space (strip **AB**) would be related to a variable atmosphere outside the plant compared with the relatively constant and high humidity in the air space; possible differences in light intensity could also have been related to differences recorded in *(d)*.

Paper 9260/5

General Comments

The general standard appeared to be similar to that of last year, and, as in previous years, many candidates failed to gain credit simply because they did not read the instructions and then follow them carefully.

Question 1

(a) The better candidates described precisely the quantity of reagent used and the need to boil in the Benedict's test, but in a number of answers heat was not mentioned. Many candidates did not appreciate that more than a few drops of reagent were necessary and that this was a test for a reducing sugar. The biuret test was also recorded inadequately by many candidates.

(b) In the majority of cases, the readings were satisfactory but many candidates were unable to do the fairly simple calculations accurately.

(c) A most common error was to state that Vitamin C is a reducing sugar.

(d) Many candidates appeared to ignore the instructions with regard to time (three minutes in (i), immediate in (ii) and one minute in (iii)). The recorded observations were thus often incomplete. In (v), the better candidates deduced that Vitamin C was not fat soluble, reducing only the dye in the water and not that in the oil.

(e) The plan diagrams were generally most disappointing. Many candidates failed to record the prominent cuticle and the distinction between the region close to the epidermis and that below the large spaces.

Question 2

The standard of dissection in a number of centres was very high. Other candidates appeared to have had little, if any, experience in practising this skill. Most frequently, candidates did not display the anterior region of both nerves; the dorsal aorta posterior to the origin of the left subclavian; a 1 cm length of the right subclavian and the duct of a salivary gland.

A number of candidates gained full marks.

Question 3

(a) This appeared to be an easy exercise but many candidates did not record observations with a hand lens adequately or accurately.

(b) This exercise in recording observations made with a microscope and a lens continues to be difficult because many candidates appear to believe that diagrams must resemble something in a textbook and that their own observations are of no account. Quite obvious features such as vascular tissue in the parasite, a distinct epidermis, regions of collenchyma and sclerenchyma, were frequently omitted and the relative thicknesses of xylem, phoem and cambium were often inaccurately recorded.

Paper 9260/6

Question 1

Many candidates failed to interpret correctly the guidance given as to how the table should be completed. Marks were lost for guess-work as there were a number of cases where the strokes did not agree with the total recorded.

In section *(b)*, in spite of repeated comments from reports on earlier practical examinations, candidates still fail to record, in sufficient detail, the methods used. It is not sufficient to say the solution was *tested* with Benedict's solution for example. The details of the test, in particular the fact that the solution was *boiled* with Benedict's, was necessary to gain any credit even if the observation was correct. A few candidates, often from the same Centre, appeared not to grasp the underlying principle of the test in the case of non-reducing sugars and reducing sugars.

(d) Often there was confusion as to what was a 'chemical reaction'. Fermentation and respiration were not acceptable; these appeared later under 1 *(h)*.

(e) The ability to describe what was seen often evaded most candidates – shape, colour, some idea of size were all that were required. To say it was a *cell* gained no credit, but some observation of what it was that was seen that led to such a conclusion would, on the other hand, have gained credit.

(f) In spite of errors in *(e)*, most knew that this was yeast.

(g) A simple experiment to show growth was required here – plating out on agar, etc. Very few candidates explained this.

(h) This was quite well understood.

(i) This section was very badly answered. In discussing similarities and differences some idea of concentration related to molarity and structure was required here.

(j) The limiting factor was simply substrate or food concentration, another point that was very often missed.

(k) Enzyme specificity was the reason that there was no action in tube **B**. One would have thought this a basic concept, yet it was missed by the vast majority of candidates.

On the whole Question 1 was the best answered of the three questions. It showed that most candidates had an ability to carry out experiments. The failures were those of incorrect interpretation.

Question 2

(b) This part called for observation to be made under low-power magnification. On the whole the major points of size, colour, branching, if any, plus any surface features, were not adequately dealt with. As in Q.1, candidates seemed to have difficulty in applying observational skills. It might be useful to include more 'unknown' specimens for practise during the teaching course.

(f) This section was extremely badly answered by almost all candidates. Greatest difficulty was encountered with the drawing and labelling of the Malpighian tubule. More attention must be given to this sort of syllabus detail.

(g) The idea that stains react chemically with tissues on the basis of tissues having different chemical constituents, was clearly not well understood.

(h) This section was also badly answered. The use of saline because it was isotonic with the tissues was the correct answer. The fact that water was not isotonic and so would set up an osmotic movement which would destroy the tissues was missed by most candidates.

(j) This section called for measurements of the *correct* parts of the alimentary canal. There were inconsistencies between the labels on the drawings and those on the table in many cases and so marks were lost.

(k) This section was quite well answered although many of the drawings were rather like those found in major text books!

This question produced a variable response. Some candidates were obviously at home with it and scored highly. On the other hand many candidates did very badly.

Care in carrying out the drawing and labelling attracted bonus marks in this section and these were frequently awarded.

Question 3

(a) There were not many good answers in this section. Many candidates did not read the question carefully and included *cells* in the plan drawings. This not only wasted time but it also failed to gain credit. Many candidates failed to recognise the lignified sclerencyhma: some even called it the phloem. The cambium was frequently misplaced towards the phloem and greater care is needed in determining the difference between the bundle sheath and the xylem tissue.

(b) Many candidates thought that the youngest xylem was in fact the protoxylem.

(c) This was very badly answered. Some idea of the scale of the cells that were drawn was clearly required and was rarely given. Most often one had a collection of "eggs" drawn to represent cells with single lines for walls and no attention to detail. Frequently the candidates drew vascular tissue, although XY avoided a bundle in the rubric at the start of the question.

(d) Because of some of the difficulties encountered in *(c)*, it was obvious that candidates were not going to make the correct comparison called for here. Once again simple powers of observation and recording what was seen were all that was required.

(e) Hardly any candidates got this part correct. Whilst one strip (**XY**) was for protection as well as gaseous exchange, **AB** was open to the internal environment of the stem and although involved in gaseous exchange, was not subject to the external environment. This would lead to the listing of simple differences. These points were missed.

This question was very poorly handled by almost every student. More attention must be paid to observation, recording and interpretation, in particular of botanical material.