GCE A LEVEL EXAMINERS' REPORTS

BIOLOGY
A LEVEL

SUMMER 2018

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COMPONENT 1

Many responses to questions showed a real understanding of biology and the ability to apply that knowledge in questions. Time did not appear to be a problem since most questions were attempted, no particular question proved problematic and the essay was completed in almost all cases.

The same comments are relevant as in previous papers.

- Lack of reading the question, particularly the stem, where very often a lot of the information required to answer the question is to be found (Q1, Q2, Q3, Q4). If the candidate is struggling with a question they should go back and read the stem again. If the question asks for an explanation, then there will be marks given for that explanation. Simply stating the stem of the question again will not gain marks.
- Not looking at the information in diagrams/text particularly if they are on the opposite page to the question (Q2, Q4, Q5, Q6).
- Poor/incorrect use of biological terminology (Q3).
- Truly appalling writing in some scripts which is almost impossible to read; if markers cannot read what is written, then no marks can be awarded.
- Written communication is poor in many cases with many failing to get marks through lack of clarity eg use of 'it'. (Q3(e)(i))
- In calculations, candidates should be able to work things out from first principles.
- If the question asks for a quantitative conclusion, candidates must use the data in some way, not just quote the figures they have been given/calculated. If they are asked to use the data, it requires some manipulation.

Q1. This was a simple question which was poorly done in too many cases. Usual problems: labelling adenine as adenosine, not labelling ribose, incorrect drawing. Not reading the stem of the question led to many confusing responses in (d); some thought that this was three different types of exercise carried out on different occasions. Too many stated that most energy for exercise came from stored ATP and that it was a better ATP source than aerobic oxidation.

Q2. (a) (i) Many stated that eukaryotes did not have cell walls, (b)(ii) responses often showed knowledge, understanding and an ability to apply this to the question. The majority correctly identified C as *E coli*, but confused A and B, probably because of not reading and interpreting the graph correctly. Many think that sweat is 25% sodium chloride. (iii) only required the mention of a Gram stain with the colours and shapes seen. This is a frequent type of question and it was surprising that this caused problems for some. The maths in (c) was well done by the majority but responses to (ii) and (iii) were variable, showing poor understanding of the significance of carrying out serial dilutions and what Standard Deviations tell us about the resulting data. The calculation of the number of bacteria in an original sample, using the results of serial dilution plates, is another regular question. Perfect answers were given by many, but a significant number had not the slightest idea what to do with the data or how to convert it into standard form correctly. All that was required was a simple $72 \times 4 \times 10^9$, but many did not use the mean, forgot to x 4 or decreased the superscript to 7 rather than the correct 10^{11}.

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Q3. For those that read the stem and thought about it, this was a straightforward question which was routinely answered well; parts (a), (b) and (c) are simply the nitrogen cycle. (d)(i) gave a lot of problems; clearly there are many candidates who have not the slightest idea of the appropriate method to use in ecological investigations. Large numbers wanted a line or belt transect which was fine, but then wanted to place a quadrat every 5 metres. They are told in the stem that this is a footpath not the something the width of the M6, so were not thinking about the size of the habitat being investigated. Some went for a grid with random number generation; clearly not appropriate. There is confusion over the terms transect and quadrat. There is also confusion of where heat is coming from in (ii). From the breakdown of food – could be digestion, from metabolism – how? This really needed explaining correctly to gain full marks.

Q4. Those that read and understood the diagram routinely scored almost full/full marks; these responses were a pleasure to mark. Revision of the core biology was evident.

Q5. The graph was surprisingly poorly plotted, given that was all that needed to be done as the scales and axes were given. Too many got all plots wrong. In (a)(iii) there were few responses that used the biochemical pathways to explain the compensation point – a simple recall of CO_2 production in the link and Krebs cycle balanced by CO_2 use in the Calvin cycle was all that was needed; it was rare to see this. The rest of the question was largely good and those who had learned the effects of high nutrient input into bodies of water, routinely scored 5 in (e).

Q6. Question (a) required candidates to look at data given in a graph and analyse it. Most looked at the over, fully and under fished sections and correctly identified what was happening, however very few went on to say what effect this would have on unsustainable and unsustainable fishing. Some did not use the data. The rest of the question was largely good, although large numbers of candidates wanted to kill parasitic lice with antibiotics and few recognised that resistance to pesticides was a problem.

Q7. Very many good essays were seen, but some simply read the question as ‘write everything you know about respiration’. This meant they wasted a lot of time going through glycolysis, only touched briefly on the link reaction/Krebs Cycle and some did not even cover the ETC or an explanation of the relationship between eukaryotes and mitochondria.

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COMPONENT 2

General comments:

The paper allowed all candidates to access marks and had a very low occurrence of candidates making no attempt to answer questions.

The quality of written communication was again an issue for some candidates. A significant number lost marks because they gave answers that simply did not make sense or lacked clarity. Examiners are not permitted to apply their own interpretation to make up for lack of clarity.

There was some evidence that where information was provided for candidates to use in their answers that some candidates were giving it cursory attention or not reading it at all. The message to future candidates should be to make sure they read any information provided thoroughly.

Question 1.

In part 1(a) Most candidates were able to label a lysosome on the electron micrograph, though there were a small number who labelled some part of the Golgi. A very small number (0.1) did not attempt this part. This might indicate poor examination technique because some candidates are reluctant to give an answer unless there is a dotted line to write it on. Very few candidates were unable to recognise the Golgi apparatus though a significant number of 'endoplasmic reticulum' answers were seen. Many candidates described functions of secretory vesicles rather than lysosomes.

Most candidates were able to complete the drawing of a neurone in part 1(b)(i), though there were some odd drawings which suggested candidates attempted to draw abnormal accumulation even though the question specified usual distribution of the myelin some did not label the myelin. Most candidates achieved at least two of the three marks available for part 1(b)(ii) indicating that saltatory conduction was generally well understood and that most candidates were able to cope with the situation where content from any of the components may be examined on any of the papers.

Part 1(c)(i) was meant to be an easy stimulus to assist candidates to be able to answer part 1(c)(ii) but caused more difficulty than anticipated with some candidates even drawing the locus on chromosome 15. In addition to incorrect answers, the quality of written communication was an issue in part 1(c)(ii).

Part 1(d) was a straightforward sex-linked genetics problem, those candidates that recognised it as such and knew a convention for indicating sex linkage scored highly; some candidates drew diagrams for unlinked alleles and there were some who made surprising mistakes at this level including diploid gametes.

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Most candidates were able to give a function of the amnion in part1(e)(i) but a significant number suggested that the amnion provides nutrition for the fetus. In part 1(e)(ii) there were some inaccurate answers e.g. candidates stated that boys would definite inherit Fabry disease; and some vague answers. Most candidates recognised the ethical dilemma of abortion.

Calculations using the Hardy-Weinberg equations in part 1(f)(i) were generally well attempted though many candidates arrived at the correct values to substitute into 2pq but still did not calculate the correct answer. Part 1(f)(ii) provided the greatest challenge, some candidates made vague references to inbreeding for the first marking point and a significant number suggested the frequency of the Fabry allele would increase in the general population.

Question 2.

In part 2(a)(i) most candidates knew that red blood cells do not have chromosomes. Those candidates who correctly paired the chromosomes in the drawing easily identified the sex chromosomes and were able to give a clear, correct answer to part 2(a)(ii). The candidates who gave wrong answers had clearly not correctly paired the chromosomes.

There were very many incorrect answers for the chromosome numbers in part 2(a)(iii) the most common incorrect answers were I- 46 and II- 23.

There was a great variation in the quality of drawings in part 2(a)(iv) and it was clear which candidates correctly paired the chromosomes in the given chromosome drawing, most candidates were able to draw and label spindle fibres.

Ability to make hypotheses and design experiments were tested in part 2(b) and most candidates made a good attempt at this. Where candidates lost marks, they did so because they did not specifically identify the variables they were asked for, or because they did not give the full range of values they were asked to give.

Part 2(c) was demanding because candidates were expected to extract information from the question and as well as apply knowledge to it. There was evidence that candidates had not read the information carefully, e.g. for part 2(c)(ii) many candidates gave answers referring to changes to the cell membrane to prevent polyspermy even though the passage made it clear that there would be no other spermatozoa available.

Question 3.

Interpreting the photograph in part 3(a)(i) was generally well done though a significant number confused the anther and stigma and a small number could not name the floral parts. There was confusion in calculating the size of the anther in part 3(a)(ii); candidates remain unsure about the meaning of a scale bar with some candidates giving answers which were implausible. Many candidates treated part 3(a)(iii) as strictly recall and gave answers relating to pollen even though the question specified ‘shown in the photograph’.

In part 3(b)(i) many candidates showed that they knew that the ovary wall forms the pericarp of a fruit but often quality of written communication was the issue and no explanation was offered. Similarly, there was plenty of evidence that candidates had been taught the details of the double fertilisation in part 3(b)(ii) but some candidates struggled to give a clear accurate account.

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Parts 3c(i) and (ii) were the easiest questions on the paper with facility factors over 90. Part 3(c)(iii) was a greater challenge with fewer candidates scoring both marks for nutrient storage.

Lack of clarity was an issue with part 3(d)(i) where some candidates made vague references to DNA; or mentioned common ancestors not recent common ancestors. Most candidates correctly completed the tables in parts 3(d)(ii) and (iii).

Question 4.

Quality of written communication was an issue in part 4(a), candidates lost marks because of lack of clarity. A significant number lost the mark for giving examples with some giving odd answers like “variety A is an example on continuous variation”.

Almost all candidates correctly calculated the sample size in part 4(b)(i); most candidates correctly chose the more likely value for the ‘mode’ but many were unable to give a clear reason for their choice which was related to the graph. A minority of candidates used the information about the mean of the sample and the information about the mean of parental type B in part 4(b)(iv) this is a particular skill tested as part of AO3. Candidates generally did not appear to understand that Students’ t test is used to compare means whereas the chi squared test is used to compare observed results with expected results.

Candidates who read the introduction carefully and used the information presented in their answers to the question in part 4(c) scored highly. Too many candidates attempted to answer the questions with pure recall and completely missed the point.

Part 4(d) was intended to the ability to estimate, which is a required mathematical skill. This skill is tested on non-calculator papers in mathematics papers. It is difficult to test this on a paper where candidates are allowed calculators. In part 4(d) candidates could have rounded the values to 1000 bushels x 20 trucks / 500 acres and worked out the answer in their heads. A minority of candidates made a true estimate, most clearly used a calculator; they were awarded the mark unless they failed to round their answer to the nearest bushel.

Question 5.

In part 5(a), most candidates were able to give an example of density dependent factors but many missed hunting of seals as the obvious example of a density independent factor. There was some confusion and inaccuracy relating the factors to the correct dates. Quality of written communication was an issue.

Part 5(b) was generally well answered though quality of written of communication was an issue.

Almost all candidates named PCR as the technique in part 5(c)(i). Fewer candidates appreciated the problem with sample size in part 5(c)(ii). Part 5(c)(iii) was generally well answered but the effect of the bottleneck on symmetry in part 5(d) was less well understood.

For candidates who read the information carefully part 5(e)(i) was easy, many candidates who had not read all the information struggled to give an answer related to common features or ancestors. Many candidates recognised that southern seals represented a control group, in part 5(e)(ii), however some gave a vague description such as “to compare with” many candidates incorrectly referred to a larger sample size. In part 5(e)(iii) most candidates were able to recognise that southern elephant seals would have symmetrical jaws but the quality and accuracy of the lines were variable. Part 5 (f) required higher level thinking and proved to be the most difficult. Quality of written communication was an issue.

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Question 6.

This question assessed quality of extended response (QER). The best answers here considered details of all the indicative content; gave an accurate account of relevant techniques and an articulate account of the ethical issues. Some candidates gave a very detailed account of PCR or genetic profiling and not much else. Many candidates gave very cursory answers lacking any scientific content. Quality of written communication was an issue.

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COMPONENT 3

1. (a) Most candidates described adaptations of the alveoli to gas exchange rather than reading the question carefully and describing how an oxygen concentration gradient is *maintained*. The lack of careful reading of the question and the information provided also resulted in many stating that the oxygen increased from point A on the capillary to point C. If they had looked at the diagram, where paO_2 at A = 11.7 kPa and paO_2 at C = 5.7 kPa, this should have been a straightforward mark. Many good suggestions were given as to oxygen saturation not reaching 100% but poor recall and lack of precision cost marks when asked to state forms in which carbon dioxide is transported to the lungs.

   (b) Most candidates correctly identified the spongy mesophyll correctly but did not appreciate that the lack of a circulatory system for gas transport or an active ventilation mechanism would reduce the rate of gas exchange in leaves compared with the alveoli.

2. (a) To answer this question correctly required full understanding and knowledge of the blood vessels in the human double circulation. Most students were unable to answer all three parts of the question correctly; pressure being maintained by elastic recoil and blood flow maintained by skeletal muscle contraction caused most difficulty.

   (b) Many candidates calculated the answer correctly. However, the following errors were common:

   - not reading the instruction to give their answer to 3 significant figures
   - not multiplying the cross-sectional area of 1 capillary by the total number of capillaries
   - not dividing the diameter by 2 to obtain the radius
   - not using the formula πr^2 as given- many squared π and not the radius

   Questions on tissue fluid formation continue to be answered poorly. There were quite a number of excellent answers but on the whole there was a lack of understanding of the role of plasma proteins in the reabsorption of water into the capillaries and as a result they could not apply their understanding to what happens when there is a lack of protein in the diet.

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3. The basis of this question is in the core content as applied to transport in plants.

(a) There is a requirement for 15% of the marks to be based on practical work. A surprising number could not identify the independent and dependent variables for this investigation and, again, candidates either did not read or did not understand the command word *justify* which was given in the question. As a result, most candidates only described two control variables and gave no reason as to why they should be controlled. In addition, some just repeated the independent and dependent variables or gave variables which they were told had been controlled.

(b) The interpretations of the data given were, on the whole, disappointing. There was much confusion as to how ions cross cell membranes; many believed that it was oxygen or nitrogen that actually transported the phosphate ions. In addition, there were many answers which did not link oxygen to ATP production as needed for active transport.

(c) Most candidates identified the endodermis, however, some names tissue S as the epidermis, epithelium or even endometrium! Again, candidates did not pick up on the clue that the need for oxygen shows that active transport as needed to transport the ions into the cell from the apoplast route.

4. (a) There continues to be a significant number of A-Level Biology students who cannot calculate a percentage change. This is a basic KS3 / KS4 skill and should not be causing problems for A-level students.

Clues were given as the role of the lacteal and capillary but few were able to identify both structures correctly. Furthermore, I do not believe that enough students are reading the information provided or using this information to provide reasons for their answers. Few made the link that capillaries deliver glucose / oxygen to tissues for respiration and that this has to take place at all times, unlike lacteals not being needed if there is no lipid to absorb.

(b) Most students recognised that the microvilli of snakes that are fed are longer and thinner and could then relate this to an increase in surface area for absorption. Most did not link thinner to a shorter diffusion distance.

(c) Again, there was a lack of detail in students' answers to this question. Many could link mitochondria to ATP production but did not extend their answer to the need for active transport / protein synthesis (of enzymes for digestion). Cells arranged in a single layer was commonly linked to an increase in surface area and not a decrease in diffusion distance. Together with maintaining concentration gradients, increasing surface area and decreasing diffusion distance are some of the most important principles in biological systems but this does not seem to be understood by many.

(d) This question was well answered, if a little vehemently by some!

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5. (a) While many candidates recognised which neurones are part of which reflex arc, many could not use the diagram to answer the question correctly. Similarly, many candidates could not express the ideas that the reflex arc innervating the hamstring contains more neurones and more synapses thus resulting in a delayed response.

(b) Most candidates could provide a correct account of the generation of an action potential. However, a large number ignored that the word **generation** was in bold and proceeded to explain resting potential, depolarisation and repolarisation, and in some cases, saltatory conduction.

(c) The ability to choose a valid statistical test is a required maths skill. Very few could explain that a t-test is used to test the significance of differences between the means of normally distributed data sets or that the Chi-Squared test is used when data is discontinuous or where you can calculate expected results. Many students stated that Chi-squared is only used in genetics. Students must appreciate that statistical tests are used wherever there is a need to determine the significance of differences between sets of data.

However, the vast majority could apply their understanding of the results of the t-test and use the probability table to reject the null hypothesis.

6. Some parts of this question tested knowledge and understanding of Components 1 and 2. Quite a few students wrote comments on their answer papers questioning this and some teachers have also contacted the Subject Officer raising concerns. The inclusion of synoptic material across the three components and from the Core Concepts in assessment materials is a requirement and has been clearly communicated in CPD and previous examiner reports.

(a) The main problem with this part of the question was explaining why plasmolysis of cells occurred. Many students could not explain this and confused plasmolysis with lysis and explained that wilting occurred due to the cells bursting.

(b) Most candidates scored well on this part of the question.

(c) The inclusion of a question on human impact and planetary boundaries caused some concern. While most could give some idea of human activities that would affect the climate change boundary they could not relate this to the distribution of *E. chrysanthemi* in the UK despite the information provided in the stem of the question.

(d) Again, the inclusion of synoptic material on gel electrophoresis was a concern. Hardly any students gave a fully correct explanation of the purpose of the DNA ladder even though this is stated in the Teacher's Guide ["Fragment size can be estimated by running a DNA ladder (which contains fragments of known size) alongside."]

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There is a reluctance to give answers that are inconclusive. Only a few students concluded that the gel gave evidence for 3 or 4 possible species of *Erwinia* or commented on why the blurring of the bands would make it difficult to give a definitive answer.

7. Many very good answers were seen demonstrating an excellent knowledge and understanding of urine production and the ability to apply this to an unfamiliar situation. However, there were also many answers in which incorrect science were given to explain urine production. This was especially true when explaining the effects of furosemide with many errors made when describing the role of ions and the ascending limb of the loop of Henle in urine formation.

Option A – Immunology and Disease

Many very good answers to parts of the questions on this option but also quite a few misconceptions and lack of detail provided which cost marks.

(a) Most candidates gave 'vector' as the correct answer but many did not then explain that the preventative methods described either reduced the risk of mosquitoes biting humans or being exposed to mosquitoes at their breeding grounds. Plasmodium / Malaria were common inclusions in answers where candidates were not applying their knowledge to the transmission of Zika virus.

(b) Poor communication was the main problem here with extensive use of 'it' and 'they' making it difficult to differentiate between the virus and the host in many answers.

(c) Many candidates gained full marks on this question. However, there was much confusion regarding their understanding of artificial passive immunity with many misunderstanding that immediate short-term protection would be given using antibody injections. Few described the placental transfer of protective antibodies; those that did describe protection of the foetus referred to colostral transfer even though treatment would be given to pregnant women before birth.

(d) Many candidates continue to make simple errors in these types of calculation in addition to errors in measuring a diameter in mm then measuring the length of the scale bar in cm and not converting to the same units.

(e) Candidates are advised to learn definitions as they appear in the guidance notes.

Most candidates gained marks and showed an understanding of the mode of action o erythromycin but many insisted on confusing this with penicillin and many gave vague reasons for why it does not affect human protein synthesis.

(f) No problems were observed with this question on the validity of the trial.

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Option B – Human Musculoskeletal Anatomy

(a) (i) Most pupils could correctly identify the sections as transverse sections

(ii) Although many were able to identify the region of the sarcomere the sections came from, marks were lost for not explaining their reasoning which was explicit in the question. There were some very good well-answered responses to this question.

(b) (i) Many candidates failed to state that different people and muscles would be different. Many answers simply stated “to compare”.

(ii) Most candidates got the idea of less force generated, but most did not look at the diagram to conclude that the actin was damaged or that there was less actin.

(c) (i) There were some good answers here, the best answers used the information given in the text and discussed osteoblast and osteoclast activity.

(ii) Few candidates got the idea that mobilisation would aid recovery because it promotes healing and reduces complications. This was from the specification.

(d) Many candidates correctly identified the order of levers and there were some very good responses to the explanation for the difference in type of lever during flexion and extension of the arm.

(iii) Mainly good answers here

(iv) Most candidates correctly rearranged the equation to give the correct answer.

Option C – Neurobiology and Behaviour

(a) There were some very good responses to this question. Many candidates correctly identified what they showed. Some candidates failed to compare them when identifying the major differences. The explanation of the differences was missing in many responses.

(b) (i) Although most candidates could identify what fMRI was for, they failed to compare it with CT and MRI scans. There were many good responses to what had happened in the brain during stroke recovery.

(ii) Most candidates answered this question correctly.

(iii) Few candidates identified the damaged area as the Left motor cortex, although many correctly said what had happened in the fMRI during recovery.

(iv) Most candidates gave strong responses to the question about the effect of a stroke in Wernicke’s and Broca’s areas. Some candidates got them the wrong way around.

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(c) There were good responses in response to dominance hierarchy and sexual selection in the lion, although some candidates stated that male lions were bigger so they could catch prey, missing the point about sexual selection.

(d) (i) Some candidates tended to give general answers relating to meerkats not being scared by observers rather than exhibiting normal behaviour.

(ii) Most candidates correctly identified positive correlation.

(iii) Most candidates correctly stated that the investigation could be improved by using more meerkats or more mobs, but few also identified that they should be of a similar age or gender.

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PRACTICAL ENDORSEMENT

General

September 2017 saw the commencement of the second cycle of Monitoring visits. Each monitoring cycle lasts two years and therefore some centres allocated to EDUQAS will be visited in the 2018-19 academic year.

So far, just over 90% of centres passed on the first monitoring visit in the second cycle. This is compatible with the outcome from the first cycle of visits and also similar to other Awarding Bodies. Centres which failed the first monitoring visit were given support and were visited a second time in the same subject. All centres which failed the first visit made by EDUQAS subsequently passed the second visit. In the event that a centre fails a second visit then the other Awarding Bodies are informed. A first visit is then triggered in all the other science subjects offered at A level.

Centres need to be commended for the way in which they have approached Practical Endorsement. Centres have embraced the philosophy behind Practical Endorsement and taken the opportunity to widened the scope of practical work they do with candidates. There was a lot of evidence of good practice and assessment.

The Monitor is required to examine the following evidence during the visit:

- plans for completing and assessing practical work. The centre should have planned to complete the necessary range of practical work required by the specification.
- records of candidate assessment
- a sample of candidate laboratory books
- observe a practical class in which assessment of CPAC is taking place. The Monitor will also need to speak to the teacher about the assessment.

Monitors are asked to monitor the evidence from a year 13 class (i.e. a 2nd year A level group) whenever it is offered in a school/ college.

The following points describe some key features observed in centres where practical endorsement was successfully implemented:

- There was clear planning of practical work and the CPAC statements to be assessed in each practical.
- Candidates were well informed about practical endorsement and the meaning of CPAC statements.
- Practical books were used in ‘real time’ at the bench by candidates when completing a practical. In such cases we do not expect to find practical books in immaculate condition.
- The teacher targeted appropriate assessment of CPAC in the practical lesson monitored.
- Suitable feedback was given to candidates particularly about why they may have failed to achieve a CPAC statement and what they need to do next time to evidence it.
- There was use of peer assessment and self-assessment to reflect on practical work. Learners can self-annotate work to facilitate learning.
- There is evidence of good communication between staff teaching on the same qualification.
- Information from CPD was fed back to other members of the team delivering the qualification.

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CPAC statements

Centres are reminded that in order to award a pass, a candidate needs to 'consistently and routinely meet the criteria'. This means there needs to be evidence of multiple occasions where a candidate evidences a pass for each CPAC statement. Please ensure that you have built in suitable opportunities into your assessment plan to allow candidates to generate this evidence.

CPAC 1 This is generally well assessed by most of the centres visited. In a few cases, Monitors observed that candidates did not always carefully follow instructions e.g. check a temperature in a water bath when required to do so. Please ensure that you carefully observe how a candidate does his/her work.

When assessing more complex procedures consider the use of a check list to aid assessment.

CPAC 2 This is the most difficult CPAC for candidates to evidence since it involves higher level skills. Generally, we do not expect to see this CPAC assessed in the first two terms of an A level course. However, we do expect to see evidence of some assessment of this criterion by the beginning of the second year of the A level course. Some centres made use of the period at the end of the first year to introduce the assessment of this CPAC statement. Please make sure that you know where and when you are going to assess this CPAC. Make sure that you give sufficient time for your candidates to develop the necessary skills before assessing it.

CPAC 3 There is no need to assess this skill every time a practical is completed. There are plenty of opportunities to assess this CPAC so choose the occasions where there are more significant risks or hazards.

CPAC 3(a) requires learners to identify hazards and asses the risks associated with the hazards. Some centres choose to assess this by asking candidates to write a risk assessment. This is a valid means of assessment although it goes beyond what is required for the criterion. If a risk assessment is not written by the candidate then it will be necessary to consider how to assess this. A simple method used by some centres is to ask candidates to identify to the teacher the hazards / risks of a technique while they do the experiment. Successful completion could then be marked on a tick sheet.

CPAC3(b) is best assessed by observation of learners doing the practical work.

CPAC 4 There are two elements to this:

(a) making accurate observations and

(b) obtaining accurate, precise and sufficient data …….

Observations should be made directly into their practical books. They should not be written on to scraps of paper and copied up at a later time. Tables of information should have appropriate headings and units. Units were not always observed in tables. This is a requirement to achieve the CPAC statement.

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CPAC 5 CPAC 4 and CPAC 5 are still occasionally confused by centres.

- CPAC 4 is about recording data 'live' into appropriate tables.
- CPAC 5 has two main elements: (1) processing data and (2) referencing information.

There should be evidence of learners processing data using graphs and calculations. Centres should use require candidates to use software (e.g. Excel) to draw graphs and, on other occasions, to draw them by hand.

The second strand of this CPAC is also important. Candidates must show evidence of referencing sources of information. The information referenced may be, for example, a data or a quote; the information may come from a text book, journal or website. The evidence produced towards this aspect of the CPAC varies considerably among centres. Some have candidates demonstrating referencing on multiple occasions, even using the Harvard System (which exceeds our requirements), while, in other centres, it is rarely evidenced.

A few centres, and therefore candidates, still confuse referencing with a bibliography. There is an important difference.

Centres are reminded to download the following documents which provide support on interpreting CPAC.

- 'The Practical Endorsement Standard'
- 'Pen Portraits' (available on the Secure website)

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