CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE SECONDARY EDUCATION CERTIFICATE EXAMINATIONS

JUNE 2005

MECHANICAL ENGINEERING TECHNOLOGY

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TECHNICAL PROFICIENCY EXAMINATIONS
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GENERAL COMMENTS

There was a slight increase in the number of candidates who were entered for the 2005 examination compared to the 2004 examination. Sixteen hundred and ninety six (1696) candidates were entered in 2004, while the total entry for 2005 was seventeen hundred and eighty seven (1787), an increase of approximately 5.37%.

Of the 1781 candidates entered for the examination, 51% of the candidates earned Grade III and above. This represented a decrease in performance over that of 2004.

The performance on the SBA showed a decline over previous years. This could be as a result of teachers not giving the guidance and support that students need to assist them in completing the exercise. There is need for improvement on the written component of the SBA as some candidates continue to see this project as group work and therefore submit identical reports to be assessed. There is also the need for urgent attention to be paid to Question 1 on Paper 02, which requires candidates to demonstrate knowledge and application of the work done in Module B8 of the Unit.

DETAILED COMMENTS

Paper 01 – Multiple Choice

This paper consists of 60 items testing the theoretical aspects of the Syllabus. There were 30 items testing the Knowledge profile and 30 items on the Application profile. The topic that most candidates found difficult was:

1. The composition of high speed steel.

Paper 02 – Structured Restricted-Response Essay Questions

Paper 02 (2 1/2 hours) - A free response paper divided into three sections. Each question will receive equal weighting for the profile dimensions, Knowledge and Application.

Section A—One compulsory design question based on Module B8 of the Unit. The question will be worth 40 marks. Candidates should spend approximately 50 minutes on this question.

Section B—Five questions based on Modules B2 to B5 of the Unit. Candidates are required to answer three questions. Each question will be worth 20 marks.

Section C—Three questions based on Modules B6, B7 and B9 of the Unit. Candidates are required to answer one question. The question will be worth 20 marks.

The mean score on this paper fell far below 50 per cent of the total mark of 120.

Section A

Question 1

Candidates were required to complete the design for the mounting of a drill press table to the column. The table was to be mounted to the column in such a way that it satisfied the following conditions:

(a) The table should be able to rotate 360 degrees about the column.

(b) The table should be able to slide up and down the column and locked in any position along it.

(c) The table should be able to swivel 30 degrees to the horizontal as indicated by the arc XX and locked in any position.

The major design considerations were:

(i) The means of allowing the table to rotate through 360 degrees. This could have been done by attaching the table to a split housing which had a close fit on the column.

Most of the candidates that attempted the question drew some sort of a housing unit that would indeed rotate through 360 degrees. Some candidates incorporated bearings into the housing unit which was not necessary in the assembly. These candidates associated anything that had to rotate with a bearing thus the inclusion of the same in the housing.

(ii) The mechanism for locking the table in any rotated position.

This could have been done by attaching a bolt and nut through the back of the split housing and using a spanner to tighten the unit on to the column. In attempting to lock the table, some candidates placed a bolt through the column which would prevent the unit from rotating. Others used grub screws or bolts to lock the table against the column. This would in effect damage the column and would not be very effective in holding the table against the downward pressure of drilling on the table.

(iii) A mechanism that allowed the table to slide up and down the column.

This could have been done by simply releasing the clamp on the housing unit and move the table up or down as desired and then tighten the clamp to hold the table in place.

(iv) A means of locking the table in any position along the column.

(v) The mechanism that allowed the table to swivel 30 degrees to the horizontal as indicated by arc XX.

(vi) A means of locking the table in the swivelled position.

On the whole a large number of candidates did not handle this question very well, even though the question was based on the drill press which is present in most workshops. Candidates for the most part were unable to present reasonable interpretations of the question. The following are some of the problems that stood out in the solutions.

– Bearings were used for the rotation which was not necessary.
– The system of locking was not effective in most cases.
– The 30 degrees rotation in the horizontal plane as indicated by XX was interpreted to mean 30 degrees in the vertical plane.

In addition to these problems, the ability to sketch seemed to be a major problem for most of the candidates as the clarity of details and proportionality of the sketches left much to be desired. Some candidates did not attempt the question even though it was compulsory and worth forty marks.

This compulsory question continues to be a problem for quite a number of candidates. The ability to interpret the drawing and provide suitable sketches of the solution seems to be beyond a number of these candidates. It appears that candidates are not given enough exposure to the concept of design and are therefore unable to apply the principles involved to the various scenarios presented to them. The need to give candidates the desired exposure to designing has to be addressed if there is going to be any improvement to the performance of candidates on the question.

Section B

Question 2

The objective of this question was to assess the candidates' knowledge and understanding of:

(a) (i) The type of file that should be used to file a shoulder.

(ii) The reason for using this type of file.

(b) (i) The sequence of operations to produce a thread in a blind hole.

(ii) The tools to be used in the process.

(iii) Precautions to be observed when threading a blind hole.

(c) A method of manually producing a highly polished surface on steel.

(d) What caused each of the following problems?

(i) A drill refusing to cut.

(ii) A drill wondering from the correct centre.

(iii) A drill breaking.

(iv) A screeching noise occurring while drilling.

This question was very popular, with approximately 80% of the candidates responding. (a) (i) and (ii) were poorly handled. The name ‘hand file’ was not the popular response, but many candidates were aware that you had to use a file with no teeth on one side of the file.

Section (b) (i), (ii) and (iii) of the question were well done. Many candidates were able to give the desired responses to this section. However (b) (ii) and (iii) were better answered than (b) (i) with many candidates getting 75% of the marks.

(c) The responses to this part of the question were about average, candidates were aware that to produce a highly polished surface, file and abrasive paper / cloth should be used. Many candidates did not understand the process in using the different grades of abrasive cloth / paper and polish to obtain the best surface finish. Candidates obtained a maximum mark of 60% in this part of the question.

(d) This part of the question was well done. Eighty (80%) per cent of the candidates who responded to this section of the question received at least seventy five (75%) per cent of the marks.

Question 3

The objective of this question was to assess the candidates' knowledge, understanding and application of:

(a) The steps of procedure for marking out a sheet metal template.

(b) The procedure for cutting out a rectangular slot in 3 mm thick sheet metal.

(c) Tools to be used to cut out the rectangular slot.

(d) (i) Precautions to be taken during the marking out process to maintain accuracy.

(ii) Safety precautions to be observed while cutting out the rectangular slot.

This was a very popular question attempted by 70% of the candidates. The performance on the question was about average. The knowledge aspects of the question were fairly well handled and this included the following:

– Tools used for the operation
– Precautions to be taken while marking out
– Precautions to be observed while cutting out the slot

Candidates in some cases were marking out and cutting out at the same time, they did not separate the marking out process from cutting out the slot. In some instances there were no clear distinctions between precautions and safety precautions.

Question 4

The objective of this question was to assess the candidates' knowledge, understanding and application of:

(a) The correct shape of various lathe cutting tools for specific operations in the workshop.

(b) The difference between rake and clearance angles with respect to lathe cutting tools.

(c) The calculation of the correct spindle speed for a turning operation given the diameter of the job and the cutting speed of the material.

(d) (i) The steps of procedure for producing an internal taper in a component on the centre lathe.

(ii) Safety precautions to be observed while cutting an internal taper on the centre lathe.

This was not a very popular question as it was only attempted by 35% of the candidates. Part (a) and (b) of the question were not handled well as most of the candidates that attempted the question were unable to sketch the desired tools. The candidates also had problems explaining the difference between clearance and rake angles.

Part (c) of the question was handled fairly well. Most of the candidates were able to calculate the spindle speed required. There were however errors relating to the units involved as well as difficulties handling numerical quantities.

Some candidates interpreted taper to mean tapping and therefore explained how to tap the hole rather than how to cut the internal taper.

Question 5

The objective of this question was to assess the candidates' knowledge, understanding and application of:

(a) How to make a dimensioned sketch of a sheet metal pattern to include allowances for seams.

(b) How to calculate the length of wire to produce a wired edge.

(c) The steps of procedure required to sweat solder a component.

(d) (i) The various stages in the formation of a folded and grooved seam on a component.

(ii) The tools required to produce a folded and grooved seam.

(e) Safety precautions that should be observed when handling sheet metal.

This was not a popular question as it was only attempted by 17% of the candidates.

(a) This part of the question was not handled well; the candidates were weak in sketching the correct development showing clearly the dotted lines for bending allowances for the seams.

(b) The approach to the formula for calculating the length of the wire was correct, but the mean diameter dimension which should have been used for calculating the length of the wire was not used.

(c) Many candidates were able to identify the main points such as heat, tinning and cleaning. This section was fairly well done.

(d) (i) This part of the question was fairly well done. The candidates' strength in this part of the question was bending at ninety (90°) degrees and using the hand groover to form the seam.

(ii) This part of the question was well answered. Most candidates were able to list the tools required to produce the seam.

(e) This part of the question was well done. Candidates were able to list safety precautions to be observed while working with sheet metal.

Question 6

The objective of this question was to assess the candidates' knowledge, understanding and application of:

(a) Various types of milling cutters that could be used to produce a rectangular slot on the milling machine.

(b) The steps of procedure for producing slots on the milling machine.

(c) How to calculate the spindle speed for a milling operation given the cutting speed of the material and the diameter of the cutter being used.

(d) The result of using a spindle speed that is too high or too low.

(e) The two categories of milling machines.

(f) Safety precautions that should be observed while operating the milling machine.

This was not a very popular question. It was only attempted by 31% of candidates. The question was fairly well done by those that attempted it. Some candidates had problems with their sketching of the cutters as well as the steps of procedure for producing the slot. The TWO categories for milling machines also posed a problem for some candidates as they named different machines within a category instead of naming the TWO categories.

Areas of the question that were well done included part (c) the calculation of the spindle speed as well as part (f) safety precautions that should be observed while milling.

Question 7 A

The objective of this question was to assess the candidates' knowledge, understanding and application of:

(a) The preparation that should be made prior to welding a piece of pipe to a base with a hole similar to that in the pipe and maintain the alignment of both holes after the weld using oxy-acetylene welding.

(b) The rightward method of welding.

(c) The causes and possible correction of the following problems:

- Poor fusion
- Torch backfiring
- Torch not staying lit
- Flame giving off sooth

(d) Safety precautions that should be observed while doing oxyacetylene welding.

This was not a very popular question attempted by 35% of the candidates.

(a) Many candidates were aware, that the surface for welding must be cleaned, clamped and aligned. However, the weakness was in bevelling the cylindrical piece to get proper penetration.

(b) Many candidates failed to answer this part of the question properly. They had a problem with the direction of travel of the torch and the positioning of the welding rod.

(c) This part of the question was fairly well done. Approximately fifty (50%) per cent of the candidates received about seventy (70%) per cent of the marks allocated.

(d) This part of the question was very popular and well answered.

Question 7 B

The objective of this question was to assess the candidates' knowledge, understanding and application of:

(a) The preparation that should be made prior to welding a piece of pipe to a base with a hole similar to that in the pipe and maintain the alignment of both holes after the weld using electric arc welding.

(b) The purpose of electrode coatings used in the arc welding process.

(c) The cause and method of correction for the following defects in electric arc welding:

- Incomplete penetration
- Poor fusion
- Slag inclusion
- Excessive spatter

(d) The procedure for striking and maintaining the arc during the arc welding process.

(a) This part of the question was fairly well answered. Most of the candidates indicated some means of clamping the components together, however many of them did not bevel the cylindrical piece for penetration.

(b) This part of the question was well answered. Eighty (80%) per cent of the candidates who attempted this section of the question responded favourably.

(c) This part of the question was fairly well done. Approximately fifty (50%) per cent of the candidates received about seventy (70%) of the marks allotted.

(d) This section was very popular and well answered.

Question 8

The objective of this question was to assess the candidates' knowledge, understanding and application of:

(a) The steps of procedure required to produce a mould for sand casting.

(b) Precautions that should be taken while preparing the mould to prevent the two halves from sticking together.

(c) Precautions that should be taken while pouring the molten metal in the mould.

(d) Various forging processes carried out in the workshop.

This was not a popular question as it was only attempted by 5% of the candidates.

Aspects of the question that were well done included the following:

- Steps of procedure for producing the mould.
- Sketches of tools and equipment used in the process.
- Precaution to be taken to prevent the halves from sticking together.
- Precautions to be taken while pouring the mould.

Aspects of the question that were not well done:

- Description of the various forging processes
  Many candidates did not understand the forging terms especially fullering. Answers were vague for the most part and in some instances there were no responses to this section of the question.

Question 9

The objective of this question was to assess the candidates' knowledge and understanding of:

(a) Various keys used to support engineering components.

(b) (i) The differences between flat belts and v-belts.

(ii) The applications of flat belts and v-belts.

(c) The reasons for using lubricants in the workshop.

(d) Mechanisms found in the workshop on which oil or grease may be applied.

(e) Various types of seals used in mechanical devices.

This was not a very popular question. Approximately thirty (30%) per cent of the candidates attempted this question.

(a) This part of the question was not well answered. Many candidates were not familiar with the name of the keys and their applications.

(b) (i) and (ii) Many candidates were weak in answering this part of the question, according to the mark scheme. Most of the responses were centred on the shape of the two belts and the type of pulleys they were used on.

(c) This part of the question was well done; most of the candidates were knowledgeable about the use of various lubricants.

(d) Most candidates attempted this part of the question, but made reference to machines, for example drill press, shaper, lathe, etc. rather than various mechanisms as the question indicated.

(e) This part of the question was answered poorly; many candidates lacked knowledge with respect to types of seals and the various uses.

Notes to Teachers

1. Candidates need to improve their skills at sketching which is very important in answering questions on paper two of this examination. They should therefore be encouraged to sketch and given exercises that will allow them to develop the skills.

2. Candidates should be encouraged to sketch the solution to the design question (1) as a lot of time is spent by some trying to produce accurate drawings of the given views without the required solutions.

3. More time should be spent addressing the issue of designing if candidates are expected to acquire the skills required to attain the level of competence necessary for success in the examination. This question on designing is worth 40 marks on paper 2 and some candidates do not attempt the question even though it is compulsory.

4. As suggested in previous reports, mechanisms used to convey movement in machines such as chain drives, gear drives and belt drives should be introduced regularly to candidates. This process might involve taking down machine guards.
N.B. Machines must be shut down before these operations are carried out.

5. Candidates should be taught how to differentiate between page number and question number as a large percentage of candidates continue to write page number or the number of the figure assigned to a question as the number for the question.