CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE SECONDARY EDUCATION CERTIFICATE EXAMINATION

MAY/JUNE 2011

MECHANICAL ENGINEERING TECHNOLOGY GENERAL PROFICIENCY EXAMINATION

GENERAL COMMENTS

In 2011, 2047 candidates were entered for the examination compared with 2205 in 2010. This represented a 7.17 per cent increase in the number of candidates entered.

The number of candidates who wrote the examination was 1742 and 966 or 55.46 per cent earned Grade III and above. This per cent represented an 9.80 per cent decrease in performance over that of 2010.

Candidates continue to do well on the practical project for the School-based Assessment (SBA) component but there is still the need for improvement on the written component of the SBA. Candidates did not perform as well on the compulsory, Question 1, on Paper 02 as they did in 2010. This decrease in performance was discouraging as it was felt that the gains made over the last couple of years would continue. It was felt generally that candidates did not cover enough of the syllabus to demonstrate mastery on the examination.

DETAILED COMMENTS

Paper 01 – Multiple Choice Items

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

- Heat treatment procedures
- Components made from grey cast iron
- Lubricant used in the gearbox of the centre lathe
- The difference between measuring and checking for accuracy
- Mechanisms used to connect mechanical devices
- Processes used for hardening the surface of high-carbon and alloy steels without affecting the internal structure
- Sheet metal work involving pattern development

Paper 02 – Essay/Structured Response Questions

Section A

Question 1

Candidates were given a figure with the general arrangement of a table top grinder and asked to complete the design. The grinder was to be driven by a motor running at 600 rpm. The drive to the system was to be transmitted from the motor to the headstock spindle by a V-belt pulley system. Tension on the drive belt was to be achieved by adjusting the headstock housing vertically on the headstock support bracket.

The finished assembly should have the motor firmly bolted to the machine base using four hexagonal head machine screws and washers. The headstock support bracket should be fastened to the machine base using stud bolts with nuts and washers.

The large pulley was to be assembled to the motor by using a woodruff key and set screw, while the smaller pulley was to be assembled to the headstock spindle by using a set screw. The headstock spindle should be prevented from side to side movement by using stops on either side of the housing secured to the shaft, while the abrasive wheel should be secured to the spindle using a hexagonal nut and washer.

Candidates were then asked to produce a design for the table top grinder assembly to meet the specifications by using sketches.

In Part (a), candidates were required to produce a presentation that was neat, proportional and indicated clear details on sketches. Some candidates produced fairly neat sketches while others presented some that were difficult to understand. Candidates should try to present at least two views of the details they are trying to present. Candidates could also use footnotes to further explain how their design could work.

For Part (b), candidates were required to show the motor bolted to the machine base using hexagonal head screws and washers. This aspect of the question was fairly well done. Some candidates however did not seem to know the difference between bolts and screws.

In Part (c), candidates were required to sketch the large pulley assembled to the motor shaft with a woodruff key and set screw. This aspect of the question was not well done as most candidates did not seem to know how to represent a woodruff key in the assembly.

A sketch of the small pulley assembled to the headstock spindle, aligned to the large pulley and secured with a set screw, was required for Part (d). Some candidates did not attempt to align the pulley and most did not include the set screw in their solutions.

In Part (e), candidates were required to show the headstock spindle assembled in the headstock housing with stops to prevent horizontal (side to side) movement. Most candidates who attempted the question omitted this requirement. Some of them, however, had good solutions that included spacers with set screws, while others attempted to drill into the shaft and insert pins. The inclusion of pins could work but would not be a good solution as it would weaken the shaft.

In Part (f), candidates were required to sketch the headstock housing assembled to the headstock support bracket with provision for tensioning the drive belt. This was not addressed in most of the solutions, even though simple slots fitted with bolts and nuts could do the job satisfactorily. Some candidates attempted elaborate solutions involving bevel gears and the like. Candidates should be encouraged to keep their design solutions as simple as possible.

A sketch of the headstock support bracket assembled to the machine base with stud bolts, nuts and washers was required for Part (g). Some candidates who attempted this section of the question did not seem to know the difference between a regular bolt and a stud bolt fitted with nuts.

In Part (h), a sketch of the abrasive wheel secured to the spindle with a hexagonal nut and washer was required. Most candidates who attempted this section were able to use the nut and washer to secure the wheel on the shaft.

Section B

Candidates were required to answer any three questions of four from this section. Each question was worth 20 marks.

Question 2

The objective of this question was to test candidates' knowledge of

- steps in the procedure for producing a component on the centre lathe to the desired specification
- tools to be used in the process

- the procedure for knurling a component
- problems that could occur during a turning operation and a description of a remedy that could be used to address the problem named

This was a fairly popular question as it was attempted by over 70 per cent of the candidates.

Aspects of the question that were well done included listing the tools to be used to produce the punch.

Aspects of the question that were not well done included the following:

- Steps in the procedure required to produce the solid punch
- Procedure for knurling the component
- Causes and remedies for problems listed during the operation
- Tool rubbing and not cutting
- Work climbing over tool
- Tool chattering
- Tool becoming dull frequently

Question 3

The objective of this question was to test candidates' knowledge of

- the process of cutting an M10 x 1.50 thread
- cutting a slot on the milling machine
- the meaning of M10 x 1.50
- the different types of cutters used on the milling machine
- the advantages and disadvantages of using conventional (up milling) on the milling machine
- safety precautions that should be observed while using the milling machine

This question was fairly popular, with about 40 per cent of the candidates responding. Candidates' general performance was below average.

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

- Naming two types of milling cutters
- Safety precautions to be observed when using the milling machine

Aspects of the question that were not well done included the following:

- The calculation of the tap drill size
- Definition of the term pitch with reference to Part (b) M10 x 1.5
- Disadvantages of conventional milling

Question 4

The objective of this question was to test the candidates' knowledge of

- steps in the procedure for marking out a sheet metal template
- the tools to be used for marking out the template
- the correct sequence of operations to be performed at the bench in cutting out a slot in the template by chain drilling
- the tools to be used for cutting out the slot
- precautions that should be observed while scribing arcs on sheet metal to ensure precision
- safety precautions that should be observed while working with sheet metal

This was a very popular question as it was attempted by over 76 per cent of the candidates.

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

- Identifying tools to be used for marking out
- Safety precautions to be observed while working with sheet metal

Aspects of the question that were not well done included the following:

- Listing steps in the procedure for marking out
- Listing the correct sequence of operations for cutting out the slot

Question 5

The objective of this question was to test candidates' knowledge of

- how to sketch and label a sheet metal pattern indicating bend lines and dimensions
- steps in the procedure for making the folds
- different types of sheet metal that could be used to make a sheet metal duct
- properties that named materials would be expected to have
- how several lengths of sheet metal ducts could be joined together to minimize heat loss
- safety precautions that should be observed when working with sheet metal

This was a fairly popular question as it was attempted by over 46 per cent of the candidates.

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

- Types of sheet metal that could be used to make the duct
- Safety precautions that should be observed while working with sheet metal

Aspects of the question that were not well done included the following:

- Sketch of layout indicating bend lines and dimensions
- Steps in the procedure for making the folds
- Method of joining several lengths of duct to minimize heat loss

Question 6

The objective of this question was to test candidates' knowledge of

- methods other than riveting that could be used to fasten the stock to the blade of a try square
- using sketches to assist with listing the sequence of operations for using countersunk rivets to assemble components
- how to calculate the material needed to form the head of a countersunk rivet given the diameter of the rivet and the thickness of the material to be riveted
- using sketches to assist in explaining the procedure for draw-filing a component smooth and flat
- the cuts of files commonly used in the workshop
- safety precautions that should be observed while using files

This was a fairly popular question as it was attempted by over 45 per cent of the candidates.

Aspects of the question that were well done included the following safety precautions to be observed while using files.

Aspects of the question that were not well done included the following:

- Methods other than riveting that could be used to fasten the stock to the blade
- Calculating the length of rivet required to assemble the component
- Procedure for draw-filing a surface smooth and flat
- Differentiating between cuts of files and types of files

Section C

Candidates were required to answer one question from this section. Each question was worth 20 marks.

Question 7

The objective of this question was to test candidates' knowledge of

- the steps in the procedure for welding end to end two pieces of steel pipe, ensuring strength and dimensional accuracy of the finished product
- the reasons for using coated electrodes in electric arc welding

- how to avoid the sticking of the electrode when striking an arc in electric arc welding
- the process of lighting and adjusting the oxy-acetylene torch to produce an oxidizing flame
- factors that contribute to proper penetration in the arc welding process
- safety precautions to be observed when doing electric arc welding

This was a fairly popular question in this section as it was attempted by about 55 per cent of the candidates.

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

- Safety precautions to be observed when doing electric arc welding
- Lighting and adjusting the flame
- How to avoid sticking of the electrodes

Aspects of the question that were not well done included the following:

- Listing steps in the procedure to be followed to weld pipes together, ensuring strength and dimensional accuracy
- Differentiating between gas welding and arc welding
- Factors that contribute to proper penetration
- Reasons for using coated electrodes

Question 8

The objective of this question was to test candidates' knowledge of

- the physical property that is imparted to steel when subjected to various heat treatment processes
- physical properties necessary for a punch to function properly
- heat treatment processes that could be used to harden a mild steel punch having 0.3 per cent carbon
- how the procedure for hardening the punch could be carried out in the workshop
- the working property of various materials listed in a table
- the engineering application of the materials listed in the table

This was the most unpopular question as it was attempted by only nine per cent of the candidates.

Performance was poor in all areas of the question. The results indicated that this area of the syllabus was not popular in schools. Candidates therefore did not know enough about heat treatment terms to answer questions satisfactorily, so most of them did not attempt the question. Teachers are encouraged to give more attention to this section of the syllabus.

Question 9

The objective of this question was to test candidates' knowledge of

- steps in the procedure for flattening the end of a rod by forging
- tools used in the forging process
- the process to be used to treat a work hardened component to make it suitable for further working
- methods that could be used to secure a steel bar in a tube
- safety precautions to be observed while flattening a rod by forging
- how to make neat sketches to show different types of anti-friction bearings
- the use of different types of bearings

This was not a popular question as it was attempted by only 14 per cent of the candidates.

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

- Methods that could be used to secure the bar in the tube
- Safety precautions that should be observed while flattening the rod

Aspects of the question that were not well done included the following:

- Steps in the procedure for flattening the rod
- Tools to be used in the process of flattening the rod
- Sketches showing different types of bearings
- Use of bearings
- Procedures for extending the life of a bearing

RECOMMENDATIONS TO TEACHERS

Unit B8 of the syllabus which focuses on the compulsory design question continues to be a problem for most students who attempt the question. However, there was an improvement in the performance of students in the 2011 examinations. Many more students attempted the question and the marks awarded showed a vast improvement over previous years. This improved performance could indicate that more attention is being given to this section of the syllabus by teachers in the various institutions as requested in the various yearly subject reports. Since this is a compulsory question and it is worth so many marks students who do not attempt the question are at a disadvantage. Teachers therefore need to spend more time on this unit of the syllabus and try to address the major issues that prove problematic for students. This could be achieved by addressing the following suggestions:

- Teachers must deliver the syllabus fully and not only pay attention to areas of the syllabus with which they feel comfortable.

- Teachers should try to provide the engineering drawing experiences needed by students to interpret and understand the various scenarios involving drawing and sketching on the examination.

- Teachers who may have weaknesses in this area of the syllabus should attend workshops to correct same.

- Students should be given exercises in designing which involve sketching and making models.

- Students can be taken on field trips to various industries where aspects of mechanical devices/mechanisms not seen in the school workshop can be observed.

- There are video clips available with some of these mechanisms. These could be shown to students in computer labs in the various schools.

- Students could be pointed to websites that have information on the various mechanical components/mechanisms used in industry in order to interact and familiarize themselves with them.

- Teachers should assist students in examining and reporting on mechanisms relating to machines in the school's workshop. This process might involve the taking down of machine guards and so on. It is important to remember however that machines should be shut down before these operations are carried out.

- Where schools do not have the machines required for the programme, students can be taken to centres where these are available and have suitable persons give demonstrations on the uses of these machines.

- Students should be encouraged to provide sketches to assist with their explanations in answering the various questions.

- Students seem to have difficulty explaining their responses to the various questions, even if they may have the correct ideas about aspects of the questions. Teachers therefore need to spend some time explaining to students how they should approach questions and should suggest ways in which answers may be presented.