C A R I B B E A N E X A M I N A T I O N S C O U N C I L

REPORT ON CANDIDATES' WORK IN THE SECONDARY EDUCATION CERTIFICATE EXAMINATION MAY/JUNE 2010

MECHANICAL ENGINEERING TECHNOLOGY

GENERAL COMMENTS

Sixteen hundred and ninety eight candidates were entered for the 2010 examination compared with 1808 for the 2009 examination. This represented a 6.08 per cent decrease in the number of candidates entered.

Of the 1698 candidates who wrote the examination, 66 per cent of them earned Grade III and above. This represented a 5 per cent increase in Grades I – III over that of 2009.

Candidates continue to do well on the practical project for the School-Based Assessment (SBA) component, but there is still need for improvement on the written component.

DETAILED COMMENTS

Paper 01 – Multiple Choice Items

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

1. Heat treatment procedures
2. Types of iron ore
3. Lubrication of bearings
4. Properties of Tungsten and other alloying elements used in steel
5. Mechanisms used to connect mechanical devices
6. Machineability of various steels
7. Sheet metal work involving the development of cones

Paper 02 – Essay/Structured Response Questions

Section A

Question 1

This was a compulsory question and candidates showed improved performance when compared with 2009. This improved performance could be as a result of increased attention being paid to Module B8 of the unit as suggested in the various yearly subject reports to schools.

Candidates were required to complete the design of a pressure juicer to be used for squeezing juice from fruits. The cylinder and plunger of the juicer were made from stainless steel while the column and base were made from aluminium alloy.

The arm of the mechanism was to be attached to the column and plunger and was expected to move up and down as indicated in Figure 1 by arrow A–B. The arm should have been able to be pulled down towards ‘B’ to squeeze the juice and was to return to the top of the arc while at rest. The cylinder was to be supported by a bracket that should be attached to the column for easy removal of the cylinder and to allow for the disposal of the pulp after each squeeze.

Candidates were then asked to use sketches to clearly show the following:

(a) A means of attaching the plunger to the arm at a point designated 'C' so that they both move up and down together.

This could have been done by using a nut and bolt to provide a 'pin joint' to facilitate the movement. Some candidates provided neat sketches of this solution. However, others simply drew the plunger in place but did not indicate how it would be attached. Some candidates welded the components together which was not a plausible solution as the plunger could not be contained in the cylinder if the joint was fixed.

(b) A means of attaching the arm to the column at a point designated 'D' thus allowing the arm to move up and down.

This could have been done by using bolts to fit a small bracket to the column, and a nut and bolt to provide a 'pin joint' to facilitate the movement. Some candidates provided neat sketches of this solution. However, others simply drew the arm in place but did not indicate how it would be attached. Some candidates welded the arm to the column even though one material was aluminium and one was stainless steel. This was not a plausible solution as the arm and the column were made of different metals which could not be welded together. Some candidates indicated that they welded an aluminium bracket to the column and then fitted the arm with the nut and bolt; this was a good solution to the problem.

(c) A bracket supporting the cylinder.

(d) A means of attaching the bracket securely to the column at a point designated 'E' while allowing the cylinder to be removed for the easy disposal of pulp.

This could have been done by using bolts to attach the bracket to the column. Some candidates used bolts to attach the bracket to the column while others welded them together.

(e) A mechanism for lifting the arm back in the raised position after each squeeze.

This could have been done by incorporating a spring in the mechanism. Most of the candidates that attempted the question included the use of springs in their solutions.

Section B

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

Question 2

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

(a) (i) list the steps of procedure for producing a component on the centre lathe to the desired specification.

(ii) use sketches to assist in explaining the procedure to follow when producing the threaded end of the component to ensure the thread was started squarely.

(b) differentiate between a 'rake' and a 'clearance angle' as used on a lathe cutting tool.

(c) calculate the spindle speed to be used to produce the 20 mm diameter section of the component if given the cutting speed for mild steel as 30 metres per minute.

(d) determine ways in which the work on a centre lathe may be secured and driven.

(e) identify safety precautions that should be observed when using the centre lathe.

This was a fairly popular question as it was attempted by over 60 per cent of the candidates.

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

- Calculation of the spindle speed
- Identifying safety precautions that should be observed while using the centre lathe

Aspects of the question that were not well done related to the following:

- Procedure for starting the threading squarely. Some candidates outlined the procedure for threading on the lathe even though it was supposed to be a bench operation.
- Explaining the difference between a rake and a clearance angle on the lathe cutting tool.

Question 3

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

(a) (i) the steps in the procedure for marking out a sheet metal template.

(ii) the tools to be used for marking out the template.

(b) (i) the correct sequence of operations to be performed at the bench when cutting out a slot in the template

(ii) the tools to be used for cutting out the slot.

(c) precautions that should be observed when cutting out a slot in sheet metal to ensure it is done accurately.

(d) safety precautions that should be observed when using laying-out tools.

This was a very popular question as it was attempted by over 80 per cent of the candidates.

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

- Identifying tools to be used for marking out the sheet metal template
- Precautions to be observed while cutting out the slot

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

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

Question 4

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

(a) sketch and name a milling cutter that could be used to produce a slot in a component on a horizontal milling machine.

(b) use sketches to indicate the direction of the feed, and the rotation of the cutter while outlining the steps in the procedure for producing the slot using conventional or 'up cut' milling.

(c) calculate the desired spindle speed for cutting the slot using a 100 mm diameter cutter, given the cutting speed for the material as 30 m/min.

(d) explain briefly what was likely to happen in cases where the

(i) spindle speed was too fast

(ii) feed was too fast

(iii) work was not securely fastened for a machining operation

(iv) arbour nut was tightened without the arbour support in place

(e) identifying precautions that should be taken while working on the milling machine.

This was not a very popular question as it was attempted by less than 35 per cent of the candidates.

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

- Calculation of the spindle speed for the operation
- Precautions that should be observed while working on the milling machine

Aspects of the question that were not well done here as a result of candidates' inability to:

- differentiate between conventional 'up milling and climb' or 'down milling'. They failed to indicate the direction of feed and rotation of the cutter correctly.
- differentiate between a horizontal and a vertical machine. They attempted to carry out the operation on a vertical machine even though it was clearly stated in the question that the operation should be performed on a horizontal machine.

Question 5

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

(a) identify different types of sheet metal that could be used to make a baking pan.

(b) (i) determine properties that the materials named in (a) would be expected to have.

(ii) explain why the properties listed in b (i) are important.

(c) make a sketch of the development of a pan indicating the allowances for the seams and wired edge to be used in the process.

(d) use sketches to aid with the description of the procedure necessary for producing the pan.

(e) identify safety precautions that should be observed when working with sheet metal.

This was a fairly popular question as it was attempted by over 55 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 baking pan
- Safety precautions that should be observed while working with sheet metal.

Aspects of the question that were not well done were as result of candidates' included the ability to

- determine the properties outlined in Part (b) of the question which were not related to the materials selected. In addition, candidates could not explain why the properties were important.
- sketch the development of the pan as well as the procedure for producing it. Candidates who made sketches of the development did not indicate the allowances for the seams and wired edges.

Question 6

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

(a) illustrate with a neat diagram:

  (i) a permanent joint

  (ii) a temporary joint

(b) determine circumstances under which hard soldering or brazing would be preferred to soft soldering.

(c) determine the approximate tin-lead composition of the following soft solders that would be used for

  (i) general sheet metal work

  (ii) soldering electrical components

(d) Differentiate between an 'active soldering flux' and a 'passive soldering flux'.

(e) Give examples of each type of flux named in (d) above.

(f) Use sketches to aid with listing the steps of procedure for completing the following types of joints using snap head rivets:

  (i) double-strap butt joint

  (ii) double riveted lap joint

This was not a very popular question as it was attempted by less than 15 per cent of the candidates.

Overall, this question was poorly done. The results appeared to indicate that not much time was spent on this section of the syllabus.

Candidates who attempted the question did not score many marks. The best performance was on Part (a); performance in Part (b) was average. Those who attempted Part (c) of the question appeared to have misinterpreted the question by stating the use rather than the tin–lead composition in terms of percentages. The responses for Parts d, e and f were very weak as only a few candidates were able to answer anything correctly.

Section C

Candidates were required to answer one question from this section. Each question was worth 20 marks. They were required to attempt either Question 7A or 7B.

Question 7A

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

(a) (i) use sketches to assist in explaining how to align and secure two cylinders having unequal internal and external diameters and ensuring that the holes remain in alignment after the pieces are welded together using oxyacetylene welding.

(ii) outline the procedure for welding the pieces together.

(b) use a sketch to assist with explaining the leftward method of welding using the oxy-acetylene torch.

(c) complete a table indicating causes and methods of correcting the following common faults that could occur when performing oxyacetylene welding:

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

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

This was a fairly popular question as it was attempted by about 40 per cent of the candidates.

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

- Part (b) which required a sketch of the leftward method of welding. It was not attempted by many candidates but those who did answered well.

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

- Parts (a) (i) and (ii) in which the candidates had difficulty aligning the two different diameters. Some used the idea of clamping in a vice and welding the pieces together. This attempt however could not guarantee the alignment during the welding process. Many of the candidates confused gas welding with arc welding in their responses.

Question 7B

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

(a) (i) use sketches to assist in explaining how to align and secure two cylinders having unequal internal and external diameters and ensuring that the holes remain in alignment after the pieces are welded together using electric arc welding.

(ii) outline the procedure for welding the pieces together.

(b) state purposes of the electrode coatings used in the arc welding process.

(c) complete a table indicating causes and methods of correct the following common faults that correcting could occur when performing electric arc welding:

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

(d) use a sketch to assist with describing the procedure for striking and maintaining the arc during the welding process.

This was a fairly popular question as it was attempted by about 40 per cent of the candidates.

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

- Part (b) where candidates were asked to state two purposes of electrode coatings used in electric arc welding.

- Part (c) which addressed issues dealing with defects that could occur during the arc welding process. Some candidates however confused the defects with those occurring in oxyacetylene processes.

- Part (d) which had to do with striking and maintaining the arc during the welding process.

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

- The alignment of the pieces posed difficulty for the candidates, similar to what happened in the oxyacetylene welding

Question 8

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

(a) illustrate with a neat diagram each of the following forging processes:

(i) upsetting the end of a bar

(ii) bending a right angle

(iii) drawing down a piece of round stock to a point

(b) state major advantages of forging a component to shape rather than machining it from a solid bar.

(c) use diagrams to assist with describing how to harden and temper the point of a centre punch made from 0.6 per cent carbon.

(d) explain the difference between the following:

(i) hardening and tempering

(ii) normalizing and annealing

(e) (i) differentiate between sand casting and die casting

(iii) use examples to explain when die casting is preferred to sand casting

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

Overall, 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 terms associated with heat treatment to answer questions satisfactorily. Thus most candidates 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' ability to

(a) determine the responsibilities of a laboratory technician as they relate to the maintenance of machines in the school's laboratory.

(b) indentify reasons why it was important to have a preventive maintenance schedule.

(c) differentiate between 'preventive maintenance' and 'corrective maintenance'.

(d) indentify different types of lubricants commonly used in the school workshop.

(e) indentify ways in which lubricants could be applied to machines in the workshop.

(f) indentify procedures for applying lubricants to machines in the workshop.

This was a fairly popular question as it was attempted by about 40 per cent of the candidates.

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

- Part (a) which addressed issues relating to the completion of a maintenance schedule. Some candidates however placed ticks and numbers in the columns to indicate the activities rather than explaining what would happen in each case.

- Part (d) which dealt with different types of lubricants commonly used in the school workshop. Some candidates gave the names of different oils rather than types of lubricants.

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

- Part (c) which tested the difference between preventive and corrective maintenance.
- Ways in which lubricants could be applied to machines in the workshop.
- Procedures for applying lubricants to machines in the workshop.

Notes to Teachers

- Unit B8 of the syllabus which focuses on the compulsory design question continues to be a problem for most of the candidates who attempt the question. However, there was an improvement in the performance of candidates for the 2010 examinations. Many more candidates 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, candidates that do not attempt the question are at a disadvantage. Teachers, therefore, need to spend more time on this unit of the syllabus and should try to address the major issues that prove problematic for students. This could be achieved by addressing the following suggestions.
- 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.
- Students should be given exercises in designing which involve sketching such aspects and making models.
- Students can be taken on field trips to various industries where aspects of mechanical devices/mechanisms not seen in the school's workshop can be seen. There are video clips available with some of these mechanisms that could be shown to students in the computer labs in the various schools.
- Students could be pointed to websites that have information on the various mechanical components/mechanisms used in industry for them to interact and familiarize themselves.
- Teachers should assist students in examining and reporting on mechanisms and other things relating to machines in the school's workshop. This process might involve the taking down of machine parts. It is important to remember however that machines should be shut down before these operations can be 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 demonstrating the uses of these machines.
- Students should be encouraged to provide sketches to assist with their explanations in answering the various questions.
- Candidates 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 suggest ways in which answers may be presented.