CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE ADVANCED PROFICIENCY EXAMINATION MAY/JUNE 2010

GEOMETRICAL & MECHANICAL ENGINEERING DRAWING

GENERAL COMMENTS

Five hundred and twelve candidates were entered for the 2010 examinations in Unit 1 and 312 for examinations in Unit 2. In Unit 1, 79 per cent of the candidates earned Grave V or above. In Unit 2, 82 per cent of the candidates earned Grave V or above. A large number of candidates continue to display poor drawing skills, limited design ability and a poor knowledge of ISO conventions. Candidates need to improve their knowledge of engineering components, materials and the manufacturing process. The performance on Internal Assessment continues to be very good.

DETAILED COMMENTS

UNIT 1

Paper 01 – Short Answer Questions

Module 1

Question 1

This question tested candidates' ability to produce an ellipse using the auxiliary circles method. It was very popular, with 90 per cent of candidates attempting it. Generally, the question was very well done with the majority of candidates successfully drawing the ellipse.

Question 2

This question tested candidates' knowledge of the function of a cam. Approximately 98 per cent of the candidates attempted the question with less than half of them being able to correctly draw the diagrams. The majority of candidates were able to correctly define the cam. However, diagrams drawn were incorrectly labelled by most candidates. Many candidates did not show the appropriate construction methods for the displacement diagrams of the given cam motions.

Attention must be given to accuracy and the correct labelling of the various types of displacement diagrams for the cam motions.

Question 3

This question tested candidates' ability to construct a resultant trapezium from a truncated right angle triangle and subsequently to find its centroid. Approximately 90 per cent of the candidates responded to the question using various methods. The most popular methods used were the trapezium method and resolving the shape into composites. Most of the candidates who used these methods were successful. Some candidates used the first derived area and the formula; however, they had difficulty locating the centroid. Approximately ten per cent of the candidates misinterpreted the diagram and found the centroid for the entire triangle. The candidates who used AutoCAD also had difficulty printing their drawings to scale. Special instructions must be given to centres that use AutoCAD reminding them to print all drawings to the correct size.

Module 2

Question 4

This question tested candidates' ability to construct the curve of intersection of two hexagonal prisms. The question was attempted by approximately 95 per cent of the candidates. The majority of them were unsuccessful in their attempt to correctly show the intersection of the two prisms. Most candidates, though able to reproduce the given drawing of the prisms and show the projection lines, were unable to plot and join the points correctly to show the intersection.

Question 5

This question tested candidates' understanding of a helix and their ability to construct two turns of a left hand system. Ninety per cent of the candidates attempted the question but half of them had challenges defining a helix. Those who gave a definition were only able to do so partially. Seventy per cent of the candidates demonstrated good knowledge and skill in the construction of the desired plotting of the curve.

Question 6

This question tested candidates' knowledge of auxiliary projection. It was attempted by approximately 98 per cent of the candidates with about 45 per cent of them giving satisfactory answers. Parts (a) and (b) tested candidates' knowledge of orthographic projection. This was done fairly well, but there were problems with regard to producing the plan from the given auxiliary elevation and subsequently the projection of the plan to produce the front elevation.

Module 3

Question 7

This question tested candidate's knowledge of limits and fits. It was compulsory and 52 per cent of the candidates responded. Many of them demonstrated knowledge of the meaning of clearance, interference and transition fits.

For Part (b), 30 per cent of the candidates showed full knowledge of basic sizes and tolerance.

Question 8

This question tested candidates' knowledge and skill in freehand sketching of various hand tools. The compulsory question was attempted by 90 per cent of the candidates, with the majority selecting and satisfactorily sketching Choice (i). Choices (ii), (iii) and (iv) were not well answered; the majority of candidates either opted not to sketch the mechanical devices or sketched them incorrectly.

Question 9

This question tested candidates' knowledge, application and drawing skills in the field of Mechanical Engineering Drawing. Candidates were required to draw a front view of a Pipe Clamp Bracket and a pipe secured by a U-Clamp with nuts. Sixty-one per cent of the candidates attempted this question.

The following observations were made:

- Fifty-nine per cent of the candidates were able to reproduce the Clamp Bracket and insert the pipe correctly.
- Twenty-five per cent of candidates were able to draw a U-Clamp.
- Twelve per cent of candidates were able to insert the nuts.
- Candidates had major difficulties drawing the U-Clamp and inserting the nuts correctly.
- Candidates had difficulty interpreting projection views (first angle and third angle).
- Candidates drew bolts instead of nuts.

Paper 02 – Essay Questions

Module 1

Question 1

This question tested candidates' ability to plot the locus of a point associated with a link mechanism. It also required candidates to fully label the diagram.

This question was generally well done by 80 per cent of the candidates who responded to it with the majority of them being able to correctly reproduce the given figure. However, after obtaining the attachment 'CD' on the given link, some candidates drew parallel lines for its alternate positions on the link 'AB', rather than obtaining independent 60-degree angles at each point.

A few of the responses showed candidates incorrectly drawing all the alternate link positions through 'B' as a fixed point rather than having 'B' moving in a horizontal straight line. Among the candidates that did not do well on this question were those who were only able reproduce the given figure and nothing further. Many candidates lost marks due to the inappropriate or non-labelling of the diagram as requested.

Question 2

This question tested candidates' ability to construct a cam diagram and cam profile. Candidates were required to produce an SHM, dwell, UV and UR using an inline, knife edge follower, the motion being anti-clockwise.

The question was attempted by approximately 92 per cent of the candidates with almost all giving satisfactory responses. Many of the candidates were aware of the cam displacement diagram and its function and relationship in creating the cam profile. There was also an awareness of the importance of the type of follower and the direction of rotation. Weaker candidates seemed to confuse the type of follower. Many candidates were unable to produce an accurate graph for uniform retardation, hence,

their cam profile was inaccurate. Some candidates were confused by the rotation of the cam. Even though they produced an accurate cam displacement diagram, a few candidates could not transfer the points accurately to produce the cam profile.

It is recommended that greater emphasis be placed on the accuracy of work produced, even in the practice of printing when using AutoCAD.

Question 3

This question tested candidates' knowledge of centroids and ability to locate the centroid of a given figure and determine the second moment of area about its base (X-X). Approximately 25 per cent of the candidates attempted this question. Most candidates experienced difficulty constructing the given figure as a few dimensions were not specified. Three figures were possible using the available data, hence, candidates generally offered solutions within these ranges.

Module 2

Question 4

This question tested candidates' ability to determine and draw the curve of intersection between a cylinder and a cone and to further draw the development. Approximately 95 per cent of the candidates attempted this question. More than 50 per cent of those candidates were able to divide the circle into equal divisions. Some candidates did not draw the lines from the base to the apex of the cone. Almost all candidates did not know that they had to draw an auxiliary view in order to locate points for the curve of intersection. It appears as though candidates were not exposed to this type of intersection. Candidates who showed some understanding of the development of a cone were able to draw an arc equal in length to that of the cone. In addition, they were also able to make correct divisions to this arc. This set of candidates showed that they had knowledge of intersecting solids because they divided the cylinder in the given view and projected lines to the intersection area on the cone. There appears to be some confusion with regard to this topic. Some candidates drew a plan and then went about drawing the curve of intersection. This particular application, where there was a need to draw an auxiliary view in order to be able to plot points for the curve of intersection proved challenging for many candidates. Overall, the question was poorly done.

Question 5

This question tested candidates' knowledge of a helix and their ability to construct one. It was attempted by approximately 44 per cent of the candidates. Candidates were required to produce two coils of a square section right-hand spring. Most candidates understood the requirements of the question but lacked the graphical skills to produce a satisfactory response. However, those who understood and were able to perform scored in the range of 21–25 marks. Far too many candidates were unable to progress beyond producing a single helix. This indicated that candidates lacked the required level of practice necessary to give a satisfactory response. Candidates need to be given more practice exercises.

Question 6

This question tested candidates' ability to produce auxiliary views. Approximately 65 per cent of the candidates failed to show mastery of orthographic to auxiliary projection. Approximately 34 per cent of the candidates demonstrated that they had knowledge of converting orthographic projection to auxiliary whereas approximately 64 per cent of the candidates showed knowledge of the concept of how an auxiliary view looks. Generally, greater practice is needed in converting orthographic projection to auxiliary.

Module 3

Question 7

This question tested candidates' knowledge of a lathe and their ability to produce neat, isometric sketches. It was attempted by approximately 37 per cent of the candidates with less than 50 per cent being able to produce proper free-hand, isometric sketches of these components and labelling them. The responses would suggest that more emphasis should be placed on proper free-hand sketching methods, machine shop components and labelling them, as these form part of the required syllabus.

Question 8

This question tested candidates' knowledge of bearings and their ability to calculate maximum and minimum clearance and interference. It was fairly well attempted; however, most candidates demonstrated that they were unable to identify the specific bearing as a 'double row ball bearing'. With the exception of about three candidates, the vast majority of them could only identify it as a ball-bearing. The calculations of the maximum and minimum clearance and interference were also fairly well done. The responses to Part (e) of the question were also fair.

Question 9

This question tested candidates' knowledge of gears and link mechanisms as well as their uses. It also assessed candidates' ability to produce neat free-hand sketches. Approximately 33 per cent of the candidates responded. The majority of candidates demonstrated knowledge of the rack and pinion arrangement. Most respondents however, failed to clearly represent the application of the ratchet to prevent the backward movement of the pinion. Most candidates also failed to correctly use arrows to indicate the movement of the rack relative to the movement of the pinion. Fewer candidates responded to Part (b) and of those who responded, the majority demonstrated knowledge and application in representing the slide and crank. In Part (c), most respondents were able to identify at least two uses for the mechanisms.

It is recommended that greater attention be paid to the application and uses of mechanisms in engineering. There is also need for candidates to improve their drawing skills.

UNIT 2

Paper 01 – Short Answer Questions

Module 1

Question 1

Candidates were asked to sketch a pillow block bearing and use reference balloons and a parts list to identify six areas on the component. Sixty-seven per cent of candidates attempted this question but the majority of them paid attention only to the first part of the question, which was to sketch. Candidates failed to attempt the other two parts of the question which asked for a balloon reference and a parts listing of the same areas on the component. Of the 67 per cent of candidates who responded to the question, the majority scored between two and four marks because of their failure to attempt the other parts of the question.

The responses to this question showed that (1) candidates are not familiar with this component and (2) that they did not read the question carefully to see that it was asking for three things — to sketch a specific component, to label it with reference balloons, and then to give a parts listing.

Candidates need more practice in identifying what questions ask for (breaking up the question into parts) as well as in how to respond to these questions.

Overall candidates show a lack of practice in sketching and labelling as well as, types of labelling is evident.

Question 2

This question challenged candidates to reproduce the given drawing, to produce the first and second auxiliary views and then to find the true angle between the line (P, E) and the plane (a, b, c).

The question was popular, 92 per cent of candidates attempted it although some merely reproduced the given drawing. A very small percentage of candidates obtained scores between four and eight marks, while the majority of scores were between two and three marks. The few candidates who scored between four and eight marks, tried to produce the first and third auxiliary and not to find the true angle between the line and the plane figure (a, b, c).

Overall, the responses showed a lack of practice in producing auxiliary projections. Teachers need to give more practice in this area.

Question 3

This question tested candidates' knowledge and application of gears in mesh by the calculation method. Seventy-three per cent of the candidates who sat the examination attempted it. Part (a), which required candidates to find the centre distance of the gears in mesh, was well done.

Part (b) was fairly well done. Approximately 50 per cent of the candidates who attempted this part of the question had knowledge of how to find the outside diameter. However, some candidates failed to multiply the addendum by two when adding to the pitch circle diameter.

Approximately 80 per cent of the candidates who attempted this question scored between seven and ten marks.

Module 2

Question 4

This question required candidates to state and briefly explain the four machining processes used to fabricate a piece of round bar.

The responses to this question were very good, with approximately 95 per cent of the candidates obtaining an average mark of 60 per cent. The majority of candidates experienced some level of difficulty stating and defining four machining processes, some were able to state at least two of the processes but unable to properly define them.

Teachers should provide students with practical workshop exercises to get them familiar with machine shop procedure.

The majority of candidates who attempted Part (b) were not able to distinguish between ergonomics and aesthetics, most of them responded by giving answers related to aesthetic improvement. Overall, responses to Part (b) were fair.

Question 5

This question tested candidates' knowledge of brass and bronze with respect to their components of manufacture. It also required an understanding of the chemical structure of two types of plastic.

Part (b) sought to assess candidates' knowledge of speciality brasses and their properties. For Part (c) candidates were asked to distinguish between thermoplastic and thermosetting plastic by listing a general difference between the two.

A moderate number of responses to Part (a) were satisfactory. This may indicate a deficient knowledge base in terms of brass and bronze and their manufacture. Less than 50 per cent of candidates gave a satisfactory response to this part of the question.

Part (b) was very poorly done as most candidates responded with incomplete answers or incorrect information. Candidates' responses indicated a lack of knowledge of speciality brasses, the properties of brass as a material in general, as well as specific properties of speciality brasses.

Candidates were well up to the task of differentiating between the two types of plastic. The majority of them explained the difference in reaction to melting or high temperatures. They answered this part very well and most scored full marks. Very few candidates did not score on this section.

The overall performance of candidates on this question was poor. Far too many of them scored 20 per cent or less of the marks available. Candidates seemed to have limited knowledge of brass and bronze as engineering materials and showed even less knowledge of speciality brasses and their specific mechanical properties.

Question 6

This question tested candidates knowledge of bearings and lubrication methods along with their sketching ability. It was compulsory and the responses to the question were average. Many candidates showed lack of knowledge of the grease nipple and were unsure about how to place the bearing and cap. More exposure to real life bearings (different types) and lubrication methods would greatly improve candidates understanding of the topic.

Question 7

This question tested candidates' knowledge of mechanisms that convert rotary motion to linear motion. It was compulsory and was attempted by 76 per cent of the candidates. Of the candidates who attempted this question, most had the basic knowledge of mechanisms that convert rotary motion to linear motion but only about 50 per cent gave three examples of these mechanisms. Additionally, a major weakness was that only about 40 per cent gave examples of mechanisms that convert rotary motion to linear motion in the form of couplings and gear train. The major strength in the responses of candidates is that most of those who attempted the question gave a rack and pinion as a mechanism.

Question 8

This question tested candidates' knowledge and application of a design process. Ninety-one per cent of those who sat the examination attempted this question. The majority of candidates did not follow the instructions given. Candidates were required to list the stages of a design process and then to match each to a given step. However, approximately 60 per cent of the candidates did not do this; instead, some of them explained all the steps in the given figure while others listed the stages but did not match each stage with the given steps.

Question 9

The question required candidates to derive and illustrate a design solution for a stated set of conditions. They were required to design a low cost belt clip, as a single unit, which was capable of being mass produced.

Candidates needed to present preliminary ideas and a final design for Part (a). Part (b) required that they identify the material and method of manufacturing. Most candidates failed to illustrate a preliminary idea and lacked advanced sketching skills. Generally, good design ideas were generated and some candidates displayed a good understanding of the design process.

Selection of material was fair but the actual construction/manufacturing choice was moderately done. Candidates seemed to have a limited knowledge with respect to material and material properties. Overall, the question was fairly well done.

UNIT 2

Paper 02 – Essay Questions

Module 1

Question 1

This question tested candidates' ability to determine, graphically, the magnitude of forces acting in each member and to determine the type of force acting in each member of a loaded roof truss. Many of the candidates who attempted this question were able to complete the truss and label it using Bows' notation. However, less than 30 per cent of these candidates were able to determine the magnitude and type of forces. The responses indicated that candidates did not understand or complete the module on simple framework.

Question 2

General observations regarding candidates' responses:

1. Approximately 25 per cent failed to show mastery of the calculations related to Spur Gears.

2. Approximately 72 per cent demonstrated ability, at the knowledge level, to illustrate the shape of a Spur Gear.

3. Approximately 54 per cent demonstrated ability at the application and drawing skill level, to construct a Spur Gear with an above average level of accuracy.

4. Approximately 70 per cent demonstrated ability at the knowledge, application and drawing skills levels, to calculate the parameters and construct the spur gears.

Remedial Suggestion: Greater practice is needed in the process of calculating the parameters and accurately displaying parameters as a graph.

Question 3

This question tested candidates' knowledge of skew lines and their ability to find the distance between the two lines. Approximately 60 per cent of the candidates attempted this question. About 30–40 per cent of the candidates were able to complete both auxiliary views correctly. Two or three candidates actually drew the outline of the cylinder in the second auxiliary view. The others measured the distance between the centre lines of the pipes. Only one candidate gained the maximum of 25 marks. A large number of candidates made errors in copying the given figure.

Module 2

Question 4

Generally, candidates answered Part (a) well. Most were able to get the five marks for the list of components relating to the lubrication system. Additionally, they were able to explain the lubrication cycle, the function of each component, and what happens to a bearing with no lubrication. Approximately 75 per cent of the candidates gained 15 out of the 25 marks. There was also a noticeable percentage of candidates gaining between 9 and 14 marks for Part (a). Further, a few candidates misinterpreted Part (a) to mean a lubrication cycle in general and did not relate it to a gasoline engine.

Part (b) proved challenging to candidates. A large percentage (90 per cent) did not perform well in this part of the question. It appeared that some students were unaware of the topic. More attention should be given to the stuffing-box.

Question 5

This was not a popular question and was attempted by only 52 per cent of the candidates. Candidates were expected to produce detailed sketches of the welding processes, list safety precautions and identify and use welding symbols.

In Parts (a) and (b), candidates produced weak responses even though they possessed theoretical knowledge of the solution.

Part (c) was done but the solution proved to be a general answer.

Part (d) was attempted by most of the candidates, with some of them being confused by the terminology used in the question. Some chose to explain the features of the symbol rather than to identify them.

In Part (e), candidates were asked to produce a sketch and include a welding symbol. Those who attempted it produced poor quality sketches.

It is recommended that candidates practise this type of question using a number of different scenarios. This would result in an improvement in the quality of responses. Placing charts in the classroom would also help.

Question 6

This question tested candidates' knowledge of sheet metal work and hand forging. It was attempted by 43 per cent of the candidates. Parts (a) (iii) and (b) (ii) were poorly done by most candidates. Some candidates demonstrated limited knowledge of these processes and even fewer understood the application of the two processes. It is recommended that candidates spend more time researching the above mentioned processes. Very few candidates did exceptionally well in responding to the question.

Module 3

Question 7

This question tested candidates' knowledge and ability to reproduce isometric drawings which included circles and curves. It was very popular with approximately 92 per cent of the candidates attempting it. The general level of performance was fairly good and most candidates showed that they understood what pictorial drawings were. The question required candidates to reproduce by free hand, the pictorial drawing given. Most candidates did this fairly well. The general area of weakness was seen in the illustration of the welded joints or the redesigned drawing. Many candidates redesigned the bracket but failed to show how the components were welded together.

Question 8

This question tested candidates understanding of design concept and the application of how to apply these concepts to the designing of a can opener, fabricated from steel. The question was attempted by approximately 76 per cent of the candidates.

Part (a), which required candidates to use sketches to show three preliminary design ideas, was fairly well done. Few of the responses showed candidates' inability to sketch three appropriate preliminary designs of a can opener. In some of the sketches, candidates presented knives, scissors and cutting pliers as the design ideas.

Part (b), which required candidates to explain their final design with the use of sketches, was not generally well done. Some candidates failed to use sketches to explain their final design, and only referred to one of the preliminary designs as the final design.

Part (c) was generally well done, with most candidates being able to discuss four ergonomic and aesthetic aspects of the opener. However, the responses indicated candidates' inability to fully distinguish between ergonomic and aesthetic features of a design. A further misinterpretation of this part of the question was evidenced by candidates stating four ergonomic aspects and four aesthetic aspects of the design.

Part (d) posed the least challenge as most of the candidates were able to give suitable explanations for chrome plating the opener.

Question 9

The question tested candidates' ability to represent by sketch and to explain the operation of the hydraulic drum and brake.

Fifty two per cent of the candidates attempted the question, representing 20 per cent of the total number of respondents.

The question was generally poorly done with most candidates demonstrating little knowledge of the application of the system. Most candidates presented a representative sketch with little or no written explanation of how the hydraulic drum and shoe brake should work.

The average mark for the question hovered between eight and ten; however, there were eight candidates who gained in the 20 marks and over.

Overall, based on the responses, it can be concluded that candidates' general knowledge of brakes and braking systems is weak.

It is therefore suggested that instructors use tours of mechanics' shops in order to allow students to observe the process of installing brake pads and shoes. Students can also explore the operating manuals for some vehicles from car dealers. Reinforcement can also be done by having students do individual or group research on braking systems. This can be further enhanced by randomly sketching the components that make up the system.