CARIBBEAN EXAMINATIONS COUNCIL

REPORT ON CANDIDATES' WORK IN THE CARIBBEAN ADVANCED PROFICIENCY EXAMINATION MAY/JUNE 2008

GEOMETRICAL AND MECHANICAL ENGINEERING DRAWING (REGION EXCLUDING TRINIDAD AND TOBAGO)

GEOMETRICAL AND MACHANICAL ENGINEERING DRAWING

CARIBBEAN ADVANCED PROFICIENCY EXAMINATION

UNIT 1

PAPER 01

Question 1

This question was clearly stated and generally tested the candidates' ability to reproduce drawings as well as finding the centroid. The question had more than one approach to finding the solution.

Over 90 per cent of the candidates attempted this question with 55 per cent giving satisfactory performances. A majority of the candidates were able to identify the individual steps of the solution but had difficulty moving beyond the half-way point and finding the centroid. Many of the solutions were incomplete. A major hindrance in the completion was the step linking the ratio to finding of the centroid.

The candidates who used the computer had problems in producing the correct size print and sometimes there was a solution without the steps towards this solution.

It is suggested that candidates should be exposed to the different methods of finding the solution.

Question 2

This question was divided into two parts: 2 (a) and 2 (b). These two parts were similar and tested the candidates' ability to recall and sketch. The question was clearly stated with over 90 per cent of the candidates attempting this question. However, it was generally not well handled; the candidates had the ability to sketch and they had the knowledge of the general topic but showed a lack in the area of specific knowledge and the question was specific.

The candidates should be exposed to all aspects of cam design so that they can differentiate between them. A large percentage of candidates did not attempt the written aspect of the question as they attempted to answer with a sketch.

The practice of writing descriptions should be introduced.

Question 3

This question tested the ability to construct an ellipse and a parabola as a template. Approximately 80 per cent of the candidates constructed the ellipse correctly; however only about 30 per cent of candidates constructed the parabola by applying the correct technique. This question was done generally good with well outlines and construction lines.

Additionally, some candidates drew the shape without any construction lives which produces a low quality drawing. This should be discouraged. The correct drawing practices should be encouraged.

Question 4

This question tested candidates' understanding of the Oblique Cabinet Projection and the ability to draw a circle on the Oblique plane.

It was attempted by over 75 per cent of the candidates, of which only 50 per cent approximately were able to draw in the projection required.

This question was clearly stated and presented no language problems. Marks were fairly allocated.

However, most candidates were unable to draw in the plane and to produce the circle required.

The response shoed that candidates who performed poorly displayed an inability to

a) Recognize the oblique plane.
b) Reproduce a circle on this plane.
c) Draw in the oblique projection.
d) Recognize the difference between the cabinet and the cavalier projection which was not being tested.

Question 5

This question tested the candidates' ability to draw a front elevation and plan of a pyramid with an auxiliary view of a surface on the pyramid, truncated at 45 degrees. From a sample of the scripts, 60 per cent of the candidates attempted this question.

Most of the candidates were able to project lines at 45 degrees from the auxiliary view and from the elevation vertically downward for the plan. However in many cases, the candidates either oriented the plan incorrectly or when the plan was oriented correctly, the length of the sides was incorrect.

At the end of the question, the word 'pyramid' influenced how the candidates interpreted the question in about two per cent of the cases and resulted in incorrect evaluation and plan reproduced.

Question 6

This question was generally well done. From the sample of scripts, about 90 per cent of the candidates attempted it; of this sample, 80 per cent of the candidates achieved scores ranging from 9 – 10 marks out of __ marks.

The errors that candidates made were as follows

a) Projecting from the elevation at an angle other than vertical. Example, diagonally at some angle
b) Projecting along a circular path
c) Development from a seam other than the "A" resulting in a different shape

Question 7

This question presented candidates with an enclosed sheet showing details of the parts that make up an English Type Lathe Tool Post. The question was designed to test candidates' proficiency and skills in orthographic drawing, assembly drawing and candidates' ability to produce neat freehand sketches.

Most candidates that attempted this question lacked the ability to produce well proportioned neat freehand sketches of the component. Candidates were able to assemble the components that make the lathe assembly and produce the required views.

It is recommended that teachers spend more time developing the fundamentals of sketching; since this is a very important topic in the language of graphic communication and a very important skill.

Question 8

This question required candidates to apply symbolic representations in dimensioning a fabricated component. Candidates were therefore required to demonstrate knowledge of machined, knurled, threaded and welded components. They were also required to produce a neat sketch.

Over 80 per cent of candidates attempted this question. Respondents were generally able to produce a fair sketch. However, only 20 per cent of those who attempted it were able to produce satisfactory responses.

This question was divided into four parts: (a), (b), (c) and (d).

In Part (a), candidates demonstrated qualifying this knowledge of machining. However, the majority were unable to accurately represent machining symbols.

In Part (b), the majority of candidates demonstrated no knowledge of knurling and therefore were unable to apply the representation.

In Part (c), candidates demonstrated qualifying this knowledge and application of a threaded component, but the weaker candidates failed to show the dimensioning standard (ms x 1).

In Part (d), the representation of the welded joint was inconsistent. The majority of candidates either did not attempt this part or were unable to accurately represent the weld.

Candidates MUST be made aware of conventional methods of dimensioning and be able to apply these methods.

Question 9

This question required candidates to sketch and explain four methods of locking a nut. It was attempted by 65 per cent of the candidates with 14 per cent producing satisfactory responses.

The majority of candidates demonstrated qualifying this knowledge of locking devices; however the weaker candidates were unable to show clear applications of the devices.

Neat freehand sketches were required; however, a number of respondents represented the component in CAD using templates. This shows a misunderstanding of the requirements of the question. Ten per cent of the candidates produced sketches of spanners etc. which also indicated a misunderstanding or lack of knowledge.

The majority of candidates also failed to use written explanations with their sketches. Their explanations would assist in cases where the sketches are unclear.

Candidates MUST be exposed to the application of locking devices and must be engaged in discussion on the selection of application of devices.

PAPER 02

Question 1

This question tested candidates' ability to:

a) Reproduce the given figure.
b) Construct the first and second derived curves.
c) Determine the area of these curves graphically.
d) Compute the height of the centroid of the figure above x – x and the second moment of area.

All candidates attempting Question 1 completed task (a) successfully. A few did not complete task (b) successfully. Some candidates used the correct method to determine the area of the curves but forgot to multiply by 2 when half the figure was used. Some candidates attempted to determine three areas on a single diagram, making it difficult to trace their work. Most candidates who attempted task (d) did so successfully; however, a few either used the incorrect formulae of brought forward incorrect data. Some candidates answered without stating formulae, and entering the correct data before they produced the final results.

Question 2

This question tested candidates' knowledge of the function of a cam and their ability to produce the performance graph of a specific cam in relation to the direction of rotation. Candidates' response to this question was about 60 per cent to 70 per cent. A fair number of candidates would get about 50 per cent of the mark or above.

The problem candidates faced were to divide the cam into equal angular dimensions from the rotating center 'o'. Some candidates divisions were from the center of the larger circle which was wrong and caused them to lose a significant amount of marks. Perhaps candidates observing a cam in operation in relation to its performance curve may help them to minimize this error.

Question 3

This question tested candidates' knowledge of engineering curves (ellipse) and their ability to plot the locus of a point on a link mechanism.

Of all the candidates who attempted this question, some gave incomplete responses; many others only drew the ellipse and the link mechanism but did not complete the locus of the point 'B' as required.

Part (a) of the question was generally well done, with only very few responses showing candidates inability to correctly construct an ellipse.

Part (b) was generally well done by the candidates who performed well in Part (a). The weaker candidates showed an inability to correctly mark off the focal points F_1 and F_2.

Part (c) posed a great difficulty. Few candidates were able to plot the locus of point B correctly. Some responses showed candidates obtaining a second ellipse for the locus of 'B'.

In cases where this question was done using CAD, most of the responses showed dimensions that did not compare to those given in the question. Some candidates even drew the ellipse twice full size.

Question 4

This question tested candidates' knowledge and ability to construct the curve of intersection between a right cone and a cylinder. The question proved to be fairly popular among the candidates, however many did not successfully complete the question. In many instances candidates failed to divide the base of the cone and to connect the points from the base to the apex of the cone. As a result many were unable to complete the plan or the end elevation. Not many of the few candidates who completed the question gained full marks.

Question 5

This question tested candidates' knowledge of orthographic projection and their ability to project an auxiliary view to obtain the true shape of a sloping surface. Most of the candidates who attempted this question were able to correctly identify the front view of the bracket to produce the required elevation. However, there were difficulties in candidates being able to obtain the radiused corners. Some candidates failed to indicate the correct line types (center, hidden etc.) in the required views.

Part (a) of this question showed few candidates incorrectly drawing the slant face A as the front of the bracket. The majority of the responses showed the hole (m 20 x 2.0) going all the way through the bracket.

In Part (b), many responses highlighted candidates' inability to project lines to obtain the true shape. Many responses also showed either no radii for the fillet or incorrect ones.

Question 6

This question tested candidates' knowledge and ability to draw an isometric view of a component described in orthographic projection. This included the construction of multiple circles and curves and non-isometric lines. Most candidates attempted this question, approximately 90 per cent. Difficulty was experienced by candidates with respect to the correct layout of the solution. Particularly challenging was the constructing of non-isometric lines and reproduction of similar curves and circles. Less than 10 per cent of candidates completed this question. The quality of line-types was below what could reasonably be expected at this level.

Some challenge was noted with respect to the orientation of the drawing, i.e. recognition of lowest point. About 10 per cent of candidates had this challenge. There was difficulty in recognizing the correct plane (vertical or horizontal) of the drawing and a few candidates placed the component on its side. This question was moderately done and was attempted by nearly all of the candidates.

Question 7

This question tested candidates' knowledge of assembly and working drawing and their ability to assemble and produce orthographic views of mechanical components. Seventy-five per cent of the candidates attempted it. However, most of these candidates failed to complete all three views. Twenty per cent of the candidates who attempted this question scored between 18 – 25 marks, while 30 per cent scored between 10 – 17 marks. The question was worth __ marks.

The majority of the candidates knew how to assemble the components. However, most of them lacked knowledge of the components to be sectioned, thus hatching lines were not well placed. Most candidates went on to hatch the roller (Part 2) without cutting it.

Question 8

This question tested candidates' ability to produce working drawings. The question was not very popular with the majority of candidates, but still received reasonable attention. Very few of the candidates that attempted it did it well. Many of them made the following errors:

a) Many produced a sectioned drawing of the jack
b) Quite a few of them simply reproduced the drawing as shown in the booklet,
c) The omission of dimensions
d) The omission of engineering symbols

It would appear based on the responses, that candidates were not adequately prepared in the production of working drawings.

Question 9

This question tested candidates' knowledge of a household flashlight and the materials the parts were made of and their ability to design a flashlight. It was a very popular question, seeing approximately 90 per cent of the candidates responding to it. It was obviously clear that candidates (95 per cent) knew where each component should be placed.

Part (a) of the question required candidates to assemble the various components of the flashlight. Instead of producing a sectional assembled view, the majority of the candidates drew an exploded view of the components. Some candidates assembled the flashlight without showing the internal components.

Part (b) of the question required candidates to suggest appropriate materials for each of the components. The majority of candidates (90 per cent) had knowledge of the type of materials that should be used.

REPORT ON INTERNAL ASSESSMENT

Approximately 70 per cent of the Unit 1 Internal Assessment was completed with a high level of accuracy. Candidates displayed good understanding of what the Internal Assessment requires in regards to the objectives to be tested in each module.

There was an alarming deficiency on the part of the teachers where 30 per cent of the internal assessments were submitted without the list of questions, list of commands for question four and the three sketches for the design solution (#5). Twenty-one out of the fifty-four schools (37 per cent) continue to submit the six assignments using traditional methods of drawing, ignoring the fact that at least one question from each module MUST be CAD based.

According to the syllabus (page 30), each candidate is required to produce SIX ORGINAL DRAWINGS. Failure to do this, all assignments will normally result in NO MARKS being awarded for the internal assessment (page 29). The trend found this year was that, candidates are completing five drawings and marks are allotted to six assignments. One of the drawings in marked for two assignments. This was evident with question four (Auto CAD) and question six (Assembly drawing) being submitted as one assignment.

As usual, the drawings were relatively clean and displayed the relevant information required in terms of candidates' number, centre number and the number of drawing submitted.

RECOMMENDATIONS

- Schools should print their work on CD's instead of 3½ floppy.
- Schools should indicate the CAD used for their projects.
- Revise the gmed 1-3 and the gmed 2-3 forms to indicate the marks allocated for each criterion.

UNIT 2

PAPER 01

Question 1

This question tested candidates' knowledge and ability to determine graphically the reactions and the resultant of a loaded beam. A number of candidates used inappropriate scales such as 2.75: 1, 2.5: 1 etc rather than a whole number. Too many candidates were unable to correctly apply Bow's notation and opted to draw the load line without paying too much attention to lettering. This created a problem for them since they drew the link polygon lines in the incorrect spaces. Candidates need to be aware of the relationship between the force (load) diagram and the space diagram.

Question 2

This question tested candidates' knowledge of gear teeth terminologies and their ability to insert them on a sketch of the gear teeth. Although this question was compulsory a few candidates did not score well. This is due to poor labeling of diagram and failure to give clear definitions. A few candidates whose definitions were not clear, showed an understanding in the labeling. More practice in sketching and labeling of the actual gear or diagram would help candidates relate more in defining parts of the gear.

Question 3

This question tested candidates' knowledge and ability in finding the true length of a skewed line. Most candidates were able to meet the first requirement. In meeting the second requirement a fair amount were not able to do so. Requirement three was natural for most candidates to produce. However, a fair attempt was made at this question but more practice is needed in a wide area for using this method for a solution.

Question 4

This question tested candidates' knowledge and understanding of manufacturing processes. Most candidates attempted it. In most of the cases, candidates were only able to indicate the welding process correctly. Very few responses indicated candidates' knowledge of press as a manufacturing process. While many candidates were aware of casting and forging as manufacturing processes, they incorrectly indicated these two processes for the five products that were given.

Question 5

This question tested candidates' knowledge of shaft seals and the application of a splash lubrication system. This was a popular question. The majority of the candidates (approx. 90 per cent) who sat the exam responded to it; however this question was poorly done.

Part (a) of the question was generally well done. Most of the candidates knew the purpose of a shaft seal.

Part (b) posed a bit of a problem. Approximately 30 per cent of the candidates scored seven marks and above. Forty-five per cent scored three to four marks.

Part (c) posed great difficulty. Only 10 per cent of the candidates who responded to this question attempted this section. This meant that the majority of the candidates did not know what a splash lubrication system was.

Question 6

This question tested candidates' knowledge of a drill bush and twist drill and their sketching ability. Approximately 95 per cent of the candidates attempted it. Most responses gave an orthographic presentation. Challenges were noted in correctly sectioning the bush by about 20 per cent of the candidates and about 20 per cent had difficulty in representing a twist drill. A few candidates reproduced the exact figure and a few candidates inserted a power drill in the figure. This question revealed some challenges in recognizing drills and drill bushes.

Question 7

This question tested candidates' knowledge of the use of an idler gear in a gear system and an idler pulley in a belt drive system. Also tested was candidates' knowledge of a coupling that was capable of accepting angular misalignment. A large number of candidates attempted this question; however, the responses were not generally of a high level. Few of the candidates were able to successfully complete all three aspects of the question. Candidates' lack of knowledge of the use of an idler in a transmission system was quite evident. Even more evident was the candidates' lack of knowledge of a coupling that should be used when there is an angular misalignment.

Question 8

This question tested candidates' knowledge of hand tools and their ability to produce good quality free hand sketches of them. Most of the candidates who responded showed an ability to produce good free hand sketches in good proportion. A few were unable to produce sketches of any of the tools listed. Some responses were void of ergonomic considerations, while a few responses confused ergonomic and aesthetic considerations. A few candidates included mechanical considerations in their responses.

This question was compulsory and was attempted by most (approx. 95 per cent) of the candidates. It was fairly well done by the candidates although the deficiency in recognizing ergonomic factors by a few candidates is of some concern.

Question 9

This question tested candidates' knowledge of engineering materials, manufacturing processes (fabrication) as well as ergonomic and aesthetic factors.

Some candidates suggested cast iron for the frame and consequently casting as a means of forming the shape of the frame. The majority suggested some type of steel or aluminum for the frame. A significant number of candidates confused ergonomic considerations with aesthetic considerations.

PAPER 02

Question 1

This question was clearly stated and tested the candidates' ability to calculate the parameters necessary for the construction of gear tooth profile and using parameters to construct the gear tooth profile.

This question was attempted by approximately 70 per cent of the candidates but was inadequately handled by more than half of them.

The calculation of the parameters which represented the first part of the question was adequately done but some candidates had problems in calculating all of the parameters.

The actual construction of the shape of the gear posed some problems to the candidates as many of the solutions were incomplete.

A major recommendation is that there should be more practice of this topic from calculation to construction.

Question 2

This question tested candidates' ability to determine graphically (i) Reactions R1 and R2 and (ii) the magnitude and types of the force for each member for a roof framing truss.

A relatively large percentage of candidates attempted this question. The majority of them were unable to determine the reaction of R1 and R2 graphically through the use of the force diagram and link polygon.

The second part of the question posed the most difficult with the majority of the candidates being able to construct the force diagram and those that were able to complete the drawing found difficulty extracting data from it.

The majority of the candidates were unable to construct simple vector diagrams for each member and those that were able to construct vector diagrams, confused compression members with tensile members and vice versa. Some candidates also found difficulty converting the measurement of the scale drawing to the magnitude of the force.

The average score obtained by most of the candidates was seven marks.

It is recommended that teachers need to ensure that candidates understand the fundamentals necessary for the construction of the force diagram.

Question 3

This question was structured to test the knowledge and analytical skills of candidates. Of the sample of scripts that was corrected about 70 per cent of the candidates attempted this question. Sixty per cent of the candidates answered this question well attaining a score in the range 20 – 25 marks.

From the sample, 30 per cent of the candidates were able to reproduce the given skew lines in proper orientation and label it accurately; this was enough to secure a score of seven marks.

In addition, 10 per cent of the candidates were able to reproduce the drawing of the skew lines in proper orientation and to label them correctly. Furthermore, the candidates were also able to draw the first auxiliary axis and label the resulting projections correctly. This was enough to attain a sore of 13 marks.

The problem was treated as one in which the objective was to find the true length of the lines, rather than find the true length of the shortest distance between them.

Question 4

This question tested candidates' knowledge and application of casting and moulding processes. They were required to describe processes and identify similarities and differences. Candidates were also required to justify the use of the drop forging process for the manufacture of a component.

It proved unpopular as it was attempted only by one-third of the candidates. Less than half of this number gave satisfactory responses.

The stronger candidates were able to clearly explain the casting and moulding techniques. However, most respondents failed to identify or differentiate between the use of metal and plastics.

Responses for Parts (b) and (c) were not clear. Most candidates failed to give clear reasons in each section.

It is suggested that greater attention be paid to exploring casting and moulding processes and the terms associated with these processes.

Question 5

This question tested candidates' knowledge and application of aspects of the transmission of the motion component of the syllabus. Candidates were required to identify components of drive system for a winch as well as to apply seals and explain a method of lubrication.

Eighty per cent of candidates responded to this question with more than half providing satisfactory responses.

The majority of candidates provided a clear sketch with parts correctly identified. The average candidate showed three of five parts correctly identified, while the very weak candidates were unable to identify any parts.

Candidates' responses to Part (b) were not done well with only 10 per cent being able to represent satisfactory application of a sealing system. Most candidates seemed to misunderstand the requirements of this section.

The majority of candidates demonstrated knowledge of lubrication. Forty per cent were able to clearly show the correct lubrication method. The weaker candidates however, failed to correctly apply the knowledge of lubrication.

It is clear that the majority of candidates were well prepared for this aspect of the syllabus. Greater attention can, however, be paid to sealing and the application of the lubricant.

Question 6

This question tested candidates' skills in freehand sketching to illustrate bearings. These were to be shown by the use of freehand orthographic or pictorial sketches. A fully dimensional drawing of a bushing was also required.

The majority of candidates who attempted the question demonstrated a good general knowledge of Angular/Thrust/Double row ball bearing.

Unfortunately, the question did not provide enough information to complete the calculations necessary for the bushing specifications.

Those candidates who attempted to draw the bushing showed a reasonably high standard of competency, interpreting the data and drawing the orthographic views of the bushing.

Question 7

This question tested candidates' understanding and application of couplings in the area of transmission motion and power.

It was attempted by less than 40 per cent of the candidates of whom 75 per cent of them gave satisfactory responses.

This question consisted of two Parts (a) and (b).

Part (a) was generally well done with the weaker candidates unable to distinguish the differences between (a) (i) and (a) (ii).

In Part (b) the weaker candidates used some knowledge of what was required to create answers/designs.

Overall candidates showed a fair knowledge of couplings.

Question 8

This question tested the candidates' understanding of the systematic design process and the ways it could be used in improving upon the given product and recall of the process.

It was clearly stated and was attempted by approximately 75 per cent of the candidates with almost all of the candidates giving a satisfactory response.

Part (a) of the question was well done. Some of the weaker candidates thought the aspects of the analysis stage were the design process.

Part (b) of the question was also generally well done, however, some of the candidates failed to expand on the ergonomic and aesthetic factors.

Part (c) of the question was concise but was not adequately handled, as much of this synthesis aspect was incomplete. It is recommended that this aspect of the exercise be practiced more often.

Question 9

Forty-two per cent (42 per cent) of the candidates attempted this question. About 50 per cent of them did not describe the sand carting process with text. However, the sketches of a sand mould were reasonably well done.

Approximately 90 per cent of the candidates who attempted this question gave the advantages of die casting compared with sand casting with only a few giving the disadvantages.

In addition, some candidates mistook aesthetics for ergonomics and gave the function of the pots compared with the beauty.

REPORT ON INTERNAL ASSESSMENT

Generally, the design portfolios submitted displayed a good level of understanding by the candidates about the design process. Approximately 80 per cent of the samples received a passing grade. However, there is lots of room for improvement, especially where the design phases are concerned.

Many design aspects were unaccounted for, such as:

- The three (3) alternate preliminary design sketches
- Justification
- A Technical report comprising of a work schedule
- Limits and constraints
- Proper organization of the contents of the portfolio
- Final drawings with proper dimensions

There was a general lack of consideration for Health and Safety in the design submitted. Teachers need to put more emphasis on this aspect when guiding the candidates in the preliminary stages of the design.

Candidates demonstrated competently how their design would work showing satisfactory technical and verbal skills. However, about 25 – 30 per cent submitted designs with obvious structural design flaws that should have been corrected by their teachers during the design process.

The design assignment was to be CAD based but about 30 per cent showed no CAD in their portfolios and of those that did submit CAD based designs, only 20 per cent submitted all that was required. The vast majority of candidates did not submit list commands, electronic copies of CAD work or CAD drawings on the correct paper size with border, block and all relevant information.

About 40 – 45 per cent of candidates displayed exceptional CAD skills, producing exploded views, solid modeling (3D), and other higher level techniques. However, they fell down when it came to the written aspects of the design portfolio producing, poor design sketches, poor Project Reports and poor or no Technical Report.

Technical Report writing must be revised. Even though marks were awarded for the work programme provided by the candidates, in most cases it was not a Technical Report. A Gantt chart does not constitute a Technical Report and candidates at this level must demonstrate satisfactory Technical Report skills.

Centres must supply CXC headquarters with knowledge of the version of CAD they are using in their school. Many disks received could not be viewed because of incompatibility of software.

In terms of the marking of the internal assessment, there was a need to see a breakdown of the scores supplied, especially when it comes to the Interactive Presentation.

RECOMMENDATIONS

- Schools should print their work on CD's instead of 3½ floppy.
- Schools should indicate the CAD used for their projects.