CARIBBEAN EXAMINATIONS COUNCIL

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

GEOMETRICAL AND MECHANICAL ENGINEERING DRAWING (TRINIDAD AND TOBAGO)

GEOMETRICAL AND MECHANICAL ENGINEERING DRAWING (TRINIDAD AND TOBAGO)

CARIBBEAN ADVANCED PROFICIENCY EXAMINATION

MAY/JUNE 2008

UNIT 1

PAPER 01

Question 1

This question tested candidates' ability to define and draw a 'hypocycloid' for a 60 mm diameter rolling circle and a 180 mm base circle. The requirement of this question was to plot the path trace of a point on the circumference of the rolling circle as it rolls without slipping on the inside of the base circle.

Of the sample chosen, about 60 per cent of the candidates attempted this question. Of that 60 per cent only 5 per cent was able to complete this correctly.

The error that candidates committed were as follows:-

- The definition given was that of an epicycloid
- Most candidates reproduced an epicycloid instead of the hypocycloid
- 1 per cent of the candidates reproduced a cycloid instead of the hypocycloid

Question 2

This question tested candidates' knowledge and application of the construction steps for the Archimedean spiral. This question was attempted by approximately 90 per cent of the candidates of which 70 per cent produced satisfactory responses.

For Part (a) of the question, most candidates demonstrated knowledge of the spiral; however, the average and weak candidates were unclear of the definition. Ninety per cent of the respondents demonstrated the ability to construct the spiral with 75 – 80 per cent providing clear accurate constructions. A few candidates had problems establishing the position of the longest and shortest radii and drawing of a neat curve of the spiral. The weaker candidates failed to mark off the limit of the movement for the spiral in the correct direction and this caused problems with plotting the points. More than half of the candidates also showed the spiral moving in an anti-clockwise direction.

It is recommended that greater attention be paid to the definition of spiral curve as these terms will generally inform construction methods.

Question 3

This question was not clearly stated and needed some clarification. It tested the candidates' ability to find the centroid of a plane figure.

This question was attempted by almost all of the candidates with more than 50 per cent giving an incomplete or inaccurate solution. Candidates showed knowledge of both force diagram and finding the ratio method, but definitely lacked the practice of completing the solution accurately.

Candidates should practice a complete solution showing all calculations and construction.

Question 4

This question was clearly stated and was attempted by almost all of the candidates. The solution was generally well done. This question tested the candidates' ability to convert pictorial views to orthographic projection.

Question 5

This question tested candidates' ability to draw one complete revolution of a conical right hand helix single start.

Most candidates who attempted this question displayed a good grasp of the knowledge and principles for constructing a conical right hand helix. The majority of candidates, however, appeared to have problems in obtaining the corresponding point on the elevation. Generally, this question was well done.

Question 6

This question was clearly stated and fairly simple. The candidates were required to copy the orthographic projection and complete the plan view through the use of the cutting plane/sections.

Copying the orthographic projection which was attempted by almost all of the candidates was well done. Some candidates however, had problems in completing the plan through the use of sections. Approximately 50 per cent of the candidates either had the solution incomplete or inaccurate.

It is recommended that the candidates practice the completion of views projected from irregular-shaped cutting planes.

Question 7

This question tested candidates' understanding of functions of valves as it relates to the topic 'Transmission Motion and Power'.

It was attempted by less than 30 per cent (less than 11 per cent of all candidates), of candidates at this exam (with the question being compulsory), with about 35 per cent, of those giving satisfactory responses. Candidates also displayed an inability to sketch responses in good proportion using plane figures.

Teachers and candidates should be reminded that this topic, 'Power and Transmission', does form part of the syllabus and as such should spend some time studing its aspects.

Question 8

This question was clearly stated and required candidates to copy the given figure and apply the knowledge of machining symbols, tolerances, finishes, limits and fits.

Approximately 60 per cent of the candidates did better than average.

The first part of the question was very well done as the diagram was very simple to copy. More than 80 per cent of the candidates attempted this question. The second part of the question was not well done as the candidates showed little knowledge in terms of outlining, dimensioning accurately, applying machining symbols and tolerance.

Most candidates displayed proficiency in reproducing the circles to the correct radii and distance between centers. The principles for locating the centers of the arcs and the points of tangency appeared to have been a challenge for some candidates.

Question 9

This question tested candidates' knowledge and application of welding symbols. It was attempted by over two-third of the candidates with over 50 per cent providing satisfactory responses.

This question was divided into two parts: 9 (a) and 9 (b)

Part (a) required that candidates show the appropriate welding symbol. Candidates generally demonstrated knowledge of the symbols. The weaker candidates, however, failed to clearly show the application of the appropriate symbol.

Part (b) required that candidates apply welding symbols to a working drawing to specify the type of welding to be used. Candidates were able to show some of the symbols correctly applied. Most candidates, however, did not show that the weld should be done all around.

It is recommended that greater attention be paid to identifying types of welds and their symbolic representations.

PAPER 02

Question 1

This question tested knowledge and ability to draw the displacement diagram and cam profile from a given specification. The displacement diagram posed little problem for the majority of candidates, however, most candidates did not draw tangents to the points on the radial lines before drawing the cam profile. A significant number of candidates appeared confused by the expression "mm diameter flat follower" and drew very small tangents (The size of the follower was inadvertently omitted from question paper). A few candidates numbered the same direction as rotation but got the same result because the cam was symmetrical.

Question 2

This question tested candidates' ability to reproduce the given drawing, producing the correct elevation and producing an auxiliary view of the cut surface showing the true shape. This question was a popular question as it was attempted by most of the candidates. Candidates' performance was good, with only a few candidates unable to do or complete the auxiliary view.

Question 3

This question tested candidates' knowledge and ability to construct an ellipse and also to construct the first and second moment of area. Candidates were required to construct an ellipse having a major axis of 120 mm and a minor axis of 120 mm. This caused for a couple candidates who changed the minor diameter to 60 mm. It is significant that only five of about 43 responses were correct. The other candidates, who attempted this question, simply drew the semi-circle with their compasses. Candidates were able to construct the derived curves. A few proceeded to calculate the centroid and second moment of area I_{xx}.

Question 4

This question tested candidates' ability to produce the development of a transition piece. It was attempted by less than 50 per cent of the candidates, many of whom did not complete the question. It could be said that some candidates did not recognize the object to be a transition piece of a square base to a circular top and as such treated it as a basic cone. This meant that candidates did not resolve to obtain the true length; therefore, this made the lengths incorrect for the development.

Question 5

This question tested candidates' ability to draw an isometric projection of a wedge bracket and construct an auxiliary view of the wedge bracket. Fifty-eight per cent of the candidates who sat the examination responded to this question.

Part (a) of the question was done satisfactorily by candidates. Most candidates knew how to outline the bracket but failed to construct and outline the curves accordingly. Of the two curves, the one situated on the back slant surface posed most of the difficulty to the candidates.

Part (b) of the question posed a great deal of difficulty. Only about 40 per cent of the candidates who attempted this question responded to this part. However, the majority of these candidates did fairly well in constructing the auxiliary view of the wedge bracket. The construction of the curves was well done by most of these candidates, who pretty much knew how to transfer distances from the given view to the auxiliary view.

Question 6

Candidates' ability to produce an auxiliary view of a block as viewed from a specified direction, given two views, was tested. Overall, candidates' response to this question was not favourable in that not many candidates responded to this question. The few candidates who attempted the question presented responses that were weak. Candidates were able to do up to stage 3 or 4 of the profile in marking, comfortably. Some struggled to gain marks after stage 4 but did poorly. Practicing this topic using simple shapes would help candidates.

Question 7

This question tested candidates' knowledge of joining methods, fasteners and power transmission. The question was attempted by approximately 25 per cent of the candidates, with only a few giving satisfactory responses. No candidate completed the question. Very few of the responses showed candidates being able to design more than two methods of joining the two plates. In some instances the sketches were poor. Similarly in Part (b), many of the responses showed candidates only able to identify and sketch no more than two of the four methods of locking a nut. Very few of the candidates that responded to this question were able to complete Part (c). No candidate was able to correctly sketch the gear pump to show the internal components.

Question 8

This question tested candidates' ability to produce orthographic views of an isometric drawing of a component, inserting title block and using ISO convention. It was widely done and most candidates completed it. The main area for concern was: most candidates did not make a separate drawing of the bearing. Many candidates did not place the quality of dimensions required and many more tended to place most of the dimension in the front view and none in their end view. Little attention was placed on radii and diameters.

Question 9

This question tested candidates' ability to correctly draw an assembled front elevation and plan of a wheel puller assembly, given the working drawing. It was not generally well done, with just about one third of the candidates attempting the question. In some instances candidates only drew one of the two required views. Most responses showed no dimensions as was required. Very few of the candidates that responded to this question were able to draw the correct assembly and in some of these responses, candidates were not able to draw the head of the bolt correctly.

REPORT ON INTERNAL ASSESSMENT

Approximately 70 per cent of the Unit One Internal Assessment was completed with a high level of accuracy. Candidates displayed good understanding of what the Internal Assessment required 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 method 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 ORIGINAL 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 completed five drawings and marks were allotted for six assignments. One of the drawings is 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 drawings 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 Gemd 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 of concurrent forces and coplanar forces. It also tested their ability to find graphically the resultant of a system of concurrent, coplanar forces. Approximately 97 per cent of the candidates attempted this question with 61 per cent of them receiving a score of 80 per cent or more. Only 21 per cent of the candidates received a score of below 50 per cent. This question was reasonably well done with the main deficiency being in the area of the application of BOW's notation and the labeling of the vector diagram. Candidates displayed good understanding of the definitions of concurrent and coplanar forces, with only 18 per cent of them getting it incorrect. One candidate completed this question by graphically resolving the forces into vertical and horizontal components, summing them up using vector addition and hence obtaining the resultant.

Question 2

This question tested candidates' knowledge of the definition of spur gear teeth terminology and their ability to sketch and label a gear wheel. Seventeen per cent of the candidates who attempted this question scored over 80 per cent and 51 per cent of the candidates scored below 50 per cent. Generally, candidates had knowledge of the gear terminology but lost marks for the labeling of the sketch of the gear.

Candidates should be made to practice more on labeling their diagrams; this would also help them in understanding how to further construct the gear teeth profile.

Question 3

This question tested candidates' knowledge of skew lines and their ability to apply it in finding the true length of a line. Eighty per cent of the candidates responded to this question. Of those candidates just about 25 per cent received maximum marks, 75 per cent received 6 out of 10 marks or higher. This question was satisfactorily done. In responding to the question few candidates attempted to complete the front elevation first, and incorrectly mark off the true length "ab" of this view. In all the responses, candidates were able to correctly construct the X-X planes. The majority of responses showed candidates correctly projecting the partial plan and front elevation. In those responses which showed the front elevation incorrectly drawn, candidates failed to ensure that the perpendicular distance from the X-X planes to the top of the triangle (a) on the front elevation and auxiliary view were the same.

Question 4

This question was designed to test candidates understanding of engineering materials. Approximately 90 per cent of candidates attempted this question.

Part (a) required candidates to differentiate between ferrous and non-ferrous metals. Few of the candidates were able to correctly differentiate between the two metals in terms of iron content in the metals. Most other candidates attempted to describe the structures of ferrous and non-ferrous metals in differentiating between the two.

Part (b) required candidates to describe engineering materials and give examples of use. In most of the responses, candidates were able to give, at least, a partial description and give one use of each.

In (b) (ii) and (iii) candidates were expected to select only one of the three steels and one of the two plastics, however some candidates described all three steels and the two plastics. The question was very clear with the OR capitalized. Some candidates gave one example of the plastic rather than one use of the plastic.

Question 5

This question tested candidates' knowledge of plain bearings and anti-friction bearings. It also tested candidates' ability to select a suitable roller bearing for a particular loading condition and produce a labeled sketch of the bearing indicating the loads.

Seven per cent of the candidates scored above 80 per cent, while 70 per cent, of the candidates scored below 50 per cent. Candidates' attempt at this question was weak. Most candidates failed to identify the bearing as a tapered roller bearing and produced a labeled sketch with arrows indicating the radial and thrust loads. Most candidates failed to give clear definitions of a plain bearing and an anti-friction bearing. It is recommended that candidates be shown samples of real bearings as a teaching aid and compare it with the diagrams being used to teach.

Question 6

This question tested candidates' knowledge of a stuffing box and gland assembly as well as their knowledge of different types of seals and their sketching ability. Fifty-six per cent of the candidates attempted this question with only 30 per cent of them scoring over 50 per cent. This question highlighted deficiencies in sketching, identifying gaskets and "U" seals. Candidates demonstrated limited knowledge of the appropriate screws to be utilized on the stuffing box on the rotating shaft.

Question 7

This question tested candidates' knowledge of belt, chain and gear drives. It also tested their ability to produce a sketch showing the application of an idler pulley in tensioning a belt drive. Of the candidates who responded to this question, 12 per cent scored 80 per cent and above while 61 per cent scored 50 per cent and below. 17 per cent of the candidates did not respond. This was due to candidates failing to produce the correct sketch and proper labeling. Also they showed weakness in giving clear description of the different drives. Candidates need to be given more practice at describing the drives as well as given more exercises on application of the different drives.

Question 8

This question tested candidates' knowledge of the manufacturing processes and their ability to apply a process to manufacture a particular component. Candidates demonstrated relatively good understanding of this question. Approximately 36 per cent of the candidates scored 80 per cent or more, while only 29 per cent scored 50 per cent or less. Out of a total of 41 candidates, 3 candidates did not attempt this question. There was a high level of knowledge displayed in the naming of the processes (97 per cent) however, there were deficiencies in giving three reasons for the process they chose. This would indicate that they are having problems with the application of the manufacturing processes.

Question 9

This question tested candidates' knowledge and understanding of the stages in the design process and their ability to apply them in a particular situation. It was well attempted with about 75 per cent of the candidates responding to it. Most of the candidates showed that they were able to explain "analysis", however only a few were able to explain "optimization" in terms of "….repeating the process to seek the best final product".

Part (b) was satisfactorily done, with the majority of the responses revealing that candidates were able to suggest three ways of analyzing or optimizing the metallic T-square.

PAPER 02

Question 1

This question tested candidates' knowledge and ability to determine graphically the reaction and resultant of a loaded beam and to draw the shear force and bending moment diagram. This was a popular question and was well attempted with a high degree of accuracy. Approximately 64 per cent of the candidates who attempted this question received a score of 80 per cent and above. Only 14 per cent of the candidates received a score below 50 per cent. Of the 41 candidates, only 2 candidates did not attempt the question. Candidates displayed good knowledge of the link polygon, shear force diagram and identifying the resultant. There were minor deficiencies in labeling the link polygon.

Question 2

This question tested candidates' ability to use auxiliary projection to determine the point where a line pierces a plane and also to construct the true shape of a figure. Fifty-one per cent of the candidates attempted this question with 76 per cent scoring below 50 per cent, and 14 per cent scoring above 80 per cent. The question had a two part response and candidates showed weakness in locating the point "P" where the line pierced the plane. Candidates were able to do some amount of auxiliary projections but failed to correctly produce the true lengths for constructing the true shape of the triangle. A more indepth revision and practice on this topic would increase the performance of the candidates.

Question 3

This question tested candidates' knowledge of calculating the parameters of an involute spur gear and their ability to construct the gear tooth profile. Approximately 50 per cent of the candidates attempted it, with just over 10 per cent obtaining full marks. Eight candidates received between 1 – 10 marks, five received between 11 – 17 marks, and 9 obtained 18 – 25 marks.

Most of the candidates were able to correctly apply the formula for computing the gear parameters, and draw the necessary pitch, root and outside circles. Additionally, those responses showed candidates were able to correctly mark off the pressure angle. However, in few of the responses candidates were not able to construct the involute and failed to accurately construct the gear profile.

Question 4

This question tested knowledge of the sand casting process and the ability of candidates to sketch and describe the step by step procedures in casting a hollow cylindrical component. Seventy per cent of the candidates displayed a fair amount of knowledge in describing the sand casting process. However, in part "B" of the question, candidates lacked the ability to sketch the process in the correct order. Approximately 55 per cent – 60 per cent of the candidates displaced poor sketching ability and produced sketches with bad proportions. In addition, 70 per cent – 80 per cent of the candidates showed lack of ability to use the correct terminologies for the various stages in the sand casting process. It is recommended that candidates be made aware of the difference between a solid and a hollow cylindrical component.

Question 5

This question tested candidates' knowledge of different lubricants and lubrication methods and their ability to use sketches to illustrate how the external reservoir lubricating system can be used to lubricate gears. Approximately 72 per cent of the candidates attempted this question. Of those who did so 80 per cent displayed very good knowledge in explaining, with the aid of sketches, the difference between bath, splash and pressurized lubrication methods. Approximately 60 per cent displayed a fair amount of sketching skills in representing the external reservoir and how it is used to lubricate gears. Eighty per cent showed good knowledge and understanding of two main functions of lubricants in bearings. Overall candidates demonstrated good knowledge of lubricants; however most candidates (approx. 90 per cent) had problems in selecting suitable materials for use as a solid lubricant

Question 6

This question tested candidates' knowledge of limits and fits as it applies to shaft and bush. It also tested candidates' ability to calculate the maximum and minimum clearance or interference of a particular fit. Their knowledge of materials and the purpose and use of a bush were also tested. Approximately 50 per cent of the candidates who sat the exam attempted this question.

Part (a) of the question was well done with the majority of candidates identifying the bushing and shaft correctly.

Part (b) was fairly well done, however, some candidates did not know how to calculate the maximum and minimum clearance and interference.

n Part (d) posed a bit of a problem as the majority of candidates who responded had difficulty dimensioning the drawing appropriately.

Part (e), (f) and (g) were also poorly done.

Fourteen per cent of the candidates scored between 0 – 8 marks, 67 per cent scored between 9 – 17 marks and 19 per cent scored between 18 – 25 marks.

Question 7

This question tested candidates' knowledge of the ergonomic and aesthetic factors in a design. It also tested candidates' ability in applying their knowledge of engineering materials and manufacturing processes to the design of a specific component and also factors that would affect the cost of the component.

This was a very popular question. Seventy-nine per cent of the candidates who sat the exam responded to the question. Part (a) of the question was well done. The majority of the candidates scored maximum marks. Parts (b) and (c) were also well done. Part (d) of the question posed a bit of a problem. Fifty per cent of the candidates responded to this part and scored poorly. Twelve per cent of the candidates who responded scored between 0 – 8 marks, 63 per cent scored between 9 – 17 marks while 25 per cent scored between 18 – 25 marks. While speaking to a few teachers they commented on the fact that they did not have a text with the ergonomic control loop and so they did not know what it was and was not able to teach the candidates about it.

Question 8

This question tested candidates' knowledge of the design process, manufacturing processes and engineering materials and their ability to apply these in the design of a stool for a drawing table. Part (a) of the question was fairly well done; however, most of these candidates did not synthesize the three sketches and only did one final design. Part (b), (c) and (d) of the question was well done. The majority of the candidates knew the design stages, the advantages and the alternative materials that could be used 9 per cent of the candidates who responded to this question scored between 0 – 8 marks, 58 per cent scored between 9 – 17 marks while 33 per cent scored between 18 -25 marks.

Question 9

This question tested candidates' knowledge of different types of couplings and their ability to sketch and describe them. This was not a popular question with 29 per cent of the candidates responding to it. However, the question was fairly well done. The majority of candidates who responded to it could sketch and describe the couplings. However, approximately 50 per cent of these candidates had difficulty sketching the Hooke's coupling. Their drawing skills were below standard. Thirty-three per cent of those who responded to this question scored between 0 – 8 marks. Thirty-three per cent scored between 9 – 17 marks and 33 per cent scored between 18 – 25 marks.

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) alternative preliminary design sketches
- Justification
- A Technical report comprising of a work schedule
- Limits and constraints
- Proper organisation of the contents of the portfolio
- Final drawings with proper dimensions

There was a general lack of consideration for Health and Safety in the designs 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 of commands, electronic copies of CAD work nor 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 aspect of the design portfolio, producing poor design sketches, poor Project Reports and poor or no Technical Report.

Technical Report writing must be revisited. Even though marks were awarded for the work programme provided by the candidate, 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 in compatibility 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.
- Revise the Gemd 1 – 3 and the Gmed 2 – 3 forms to indicate the marks allocated for each criterion.