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 CARIBBEAN SECONDARY EDUCATION CERTIFICATE® EXAMINATION

MAY/JUNE 2014

TECHNICAL DRAWING

TECHNICAL PROFICIENCY EXAMINATION

GENERAL COMMENTS

There was an increase in the number of entries from 9 162 in 2013 to 9 622 in 2014. An analysis of the data indicated an increase from the previous overall distribution of Grades I, II and III from 74.39 per cent in 2013 to 78.61 per cent in 2014.

Improvements in candidates' performance in Papers 01, 02, 031 and 04 contributed to the overall increase in performance. Paper 032 showed a slight decrease in performance.

While candidate responses displayed greater content knowledge and application, their practical ability skills require significant improvement, especially in Paper 031. Consequently, the marks allocated to the practical aspects such as presentation, line work and labelling, contributed to a reduction of their overall performance.

DETAILED COMMENTS

Paper 01 – Multiple Choice

This paper consisted of 60 multiple-choice questions, testing the profile dimensions of Knowledge (Profile 1), Application (Profile 2), and Practical Ability (Profile 3). The mean score of 35.54 was very consistent with candidates' performance on the paper over the previous 2 years.

DETAILED COMMENTS

Paper 02 – Plane and Solid Geometry

Section I – Plane Geometry

Question 1

This question was designed to test candidates' ability to construct:

a) a rectangle ABCD, that has a diagonal of 150 mm and the length of one side = 70 mm.

b) an ellipse within the rectangle with the major axis equal to the length and minor axis equal to the width of the given figure.

Generally, candidates who attempted this question (part a) demonstrated knowledge of a rectangle and therefore were able to construct the rectangle from the given data, and also construct an ellipse (part b) inside the rectangle.

However, some candidates demonstrated lack of knowledge of the diagonal by making the side 150mm, and also to construct an ellipse inside the rectangle. (Any suitable method of ellipse was accepted).

Question 2

Candidates were presented with an irregular polygon ABCDE with BC=40 mm, AE=60 mm, CD=75 mm and ED=45 mm.

Candidates were required to construct:

a) the given irregular polygon

b) a similar figure with its base AB increased from 50 mm to 70 mm.

Generally, candidates who attempted this question demonstrated good knowledge of constructing the given figure and therefore, were able to construct it. However, some candidates demonstrated lack of knowledge of the principles of similar figures when sides are LINEAR increased.

Question 3

Candidates were presented with a diagram showing a template of a metal cutter and were required to:

a) Draw the given template showing clearly how the following are obtained:

(i) The centres for arcs A and B
(ii) The straight line from point 'P'

b) Identify EACH point of tangency with a 'DOT'.

Generally, candidates who attempted this question demonstrated a good grasp in reproducing the given circles, the hexagon and the straight line.

However, some candidates demonstrated lack of knowledge of the construction for obtaining the centres for the required two arcs (A and B) and identifying the points of tangency.

Question 4

In this question, candidates were presented with a figure showing a crank mechanism in which OA revolves clockwise about O. The end, B, of the rod AB is constrained to move horizontally along XY.

This question was designed to test candidates' ability to:

a) Copy the given mechanism
b) Plot the locus of P for one revolution of OA.

Generally, candidates who attempted this question demonstrated a good grasp in copying the given mechanism. However, some candidates demonstrated a lack of knowledge and understanding of the movement of the mechanism along the given XY line and were unable to plot the locus of P.

Question 5

Candidates were presented with the end elevation and an incomplete front elevation of a cylinder intersecting a triangular prism.

This question was designed to test candidates' ability to construct:

a) the given end elevation
b) the front elevation showing the curves of interpenetration. Show hidden details.

Generally, candidates who attempted the question demonstrated good knowledge and understanding of constructing the given end elevation and drawing the front elevation.

However, some candidates demonstrated limited knowledge of the interpenetration of a cylinder and a prism and therefore were unable to complete the front elevation with the curve of interpenetration.

Question 6

Candidates were presented with a figure showing the elevation of two square sheet metal pipes A and B intersecting each other at 45°. This question was designed to test candidates' ability to:

a) Copy the given view.
b) Construct the development of pipe A' using the seam as shown on the given view.

Generally, candidates who attempted this question demonstrated some knowledge of drawing the given view and were able to complete the development. However, some candidates demonstrated lack of knowledge and understanding of drawing the two pipes and constructing the development of a square prism (pipe A) with the given seam.

Question 7

Candidates were presented with the plan and elevation in orthographic projection of a truncated hexagonal prism to draw:

a) the given views
b) an auxiliary elevation on X^1Y^1.

Generally, candidates who attempted this question demonstrated good knowledge of drawing the given views. However, some candidates demonstrated limited knowledge of projecting the auxiliary elevation on the given X^1Y^1 line.

Question 8

In this question, candidates were presented with a figure showing two orthographic views of a location bracket. Candidates were NOT required to copy these views.

This question was designed to test candidates' ability to draw an isometric view of the bracket with 'X' as its lowest point.

Generally, candidates who attempted the question demonstrated good knowledge of the principles of isometric for drawing the Bracket with 'X' as its lowest point. However, some candidates interpret the views as being in 3rd angle projection and therefore use the bottom view as the elevation. The construction of isometric circles seemed to have been a challenge to some candidates.

NOTES TO TEACHERS

In respect to Paper 02, teachers should focus on the specific objectives of the syllabus, to ensure that their students are well prepared for the Geometry in Technical Drawing.

Paper 031 – Building Drawing

Section I – Working Drawing

Question 1

Candidates were presented with the outline of a floor plan for a concrete-block constructed office. They were also presented with a site plan drawing with an outline of the building and sewage disposal components.

Part (a) candidates were required to draw at a scale of 1:50, a working drawing floor plan of the building. The working drawing was to include the following:

i. internal and external wall thicknesses
ii. all doors and windows
iii. reception counter
iv. kitchen appliances, cupboards, and cabinets for a staff room.
v. bathroom fixtures (toilet and hand basin)
vi. names of rooms and,
vii. 10 important dimensions

In Part (b) candidates were required to draw the site plan to a scale of 1:100. The completed drawing was to show the following:

i. proposed building profile
ii. setbacks
iii. driveway, walkway and parking spaces
iv. sewage disposal including connections for septic tank and soakaway
v. dimensions of the property line and,
vi. a north arrow

Both parts were to use standard drawing practices and conventions for producing working drawing floor plans and site plans. A suitable title and scale were to be printed at the base of each drawing. Specifications for all relevant components were provided and candidates were allowed to use their discretion for dimensions not given.

This question was attempted by the majority of the candidates and it is the view of the examiners that this may be due to the heavy focus in the classroom on floor plans during preparation for the examination.

Many of the candidates who attempted part (a) of the question demonstrated the appropriate knowledge of floor plans and successfully applied this knowledge to the production of the drawing. This proficiency was shown in the drawing of a floor plan to 1:50, drawing internal and external walls, labeling rooms, attempts at dimensioning, indication of windows and doors. Weaker candidates did not follow specifications for wall thickness, doors or windows and also had difficulties representing the internal and external walls in the drawing resulting in inconsistent sizes, single lines or drawings not to scale.

While candidates drew the lines required to assemble the drawing, basic aspects of a conventional floor plan were not satisfactorily drawn as several candidates seemed to have difficulty with the following:

- using thick lines and thin lines to differentiate between cut objects (walls) and objects in elevation (window sills, cupboards etc.)

- drawing bathroom and kitchen fixtures to scale – *In most cases these were drawn undersized and incorrectly placed, thereby making them impractical*.

- representing of windows – *In some case, windows were larger than specifications or wall thickness. Windows used the wrong symbol or simply failed to show the difference between window and wall*.

In part (b) of the question, stronger candidates responded as asked and added missing information and applied conventions for site plan drawings. Weaker candidates reproduced the given diagram exactly and to scale without any additions. It was therefore, in this case, difficult to determine knowledge of the drawing type. Candidates on the whole had difficulty with the following:

- using different line types to communicate in the drawing (dash lines, thick lines, thin lines, hatching etc.)

- drawing the requested waste water and sewage disposal diagram for the site. It should be noted that this is a part of the syllabus (II.II.2)
- laying out driveways adequately with the right size for curves and driving areas.

General aspects of weakness in question 1 were the quality of drawings (line work and line type not properly done), labelling (text was unreadable, not straight, varied sizes), dimensioning techniques (dimensions did not connect to lines properly, orientation, accuracy, inconsistency in arrows/ticks) and the omission of the printed title and scale used as required by the question.

In producing the drawings for this question, most candidates did not adhere to the principles of good working drawing practice (as outlined in the weaknesses above). This is cause for serious concern. **Teachers are reminded that this is the "working drawing" section of the examination. As such,**

standard practices and conventions for completing working drawings are to be rigorously followed. Emphasis should be placed on line thickness; drawing correct symbols on the appropriate drawings; dimensioning where it concerns extension and dimension lines and the placing and size of the dimension.

Question 2

In this question candidates were presented with a floor plan outline for a two bedroom house. An outline of the roof was shown on the diagram.

In Part (a), candidates were required to draw a roof framing plan to a scale of 1:50. Candidates were to use a single line to represent the framing members. The roof framing plan was to include the following members:

i. ridge
ii. hip rafters
iii. jack rafters
iv. valley rafters
v. common rafters
vi. fascia board

Candidates were further asked to label all roof members and show the building outline.

In Part (b) candidates were asked to draw to a scale of 1:50, two elevations of the building indicated on the outline by arrows “view 1" and “view 2”. The elevation drawings were to include the following:

i. all door and window positions
ii. columns and,
iii. roof design

A suitable title and scale were to be printed at the base of each drawing. Specifications for all construction elements were provided. Candidates were also given discretionary judgment for dimensions not given. As with question 1, standard drawing practices and conventions for drawing roof framing plans and elevations were to be followed.

Most of the candidates that attempted this question did well in their attempt. Knowledge was demonstrated in the drawing of the building outline and roof edge. The drawing of an initial framing plan by candidates also indicated some limited knowledge of a framing plan.

Examiners however, discovered that candidates were unsure of some roofing details as most were unable to properly identify and label roof members correctly.

In the second part of the question, candidates demonstrated adequate knowledge of elevations in the placing of doors and windows. Some candidates seemed to experience difficulty in interpreting and developing the required elevations for the building from the roof framing plan.

The following are characteristics of weak submissions:

- door and windows did not line up at beam level.
- fascia board omitted from drawing
- ground line not drawn.
- patio with columns were left out of drawing.
- panel door and louver windows were drawn incorrectly or not at all.
- candidates were unable to accurately measure the given distance from wall plate to top of ridge board.

Other aspects of weakness were as in question 1, that is, the quality of drawing, labeling, dimensioning techniques and the omission of the printed title and scale used as required by the question. Teachers are

reminded that standard practices and conventions for completing working drawings are to be rigorously followed.

Sketch and Design or 3D Solid Model Design Drawing

Question 3

Candidates were required to make neat well-proportioned three dimensional/pictorial sketches to show the difference between a reinforced concrete stair and a timber stair, labelling the differences clearly.

This question was the least popular in section 2. The majority of the candidates managed to draw pictorial images of stairs/steps. However proportion was not consistent or well executed. Candidates in the majority demonstrated limited knowledge of the major differences between the two types of stairs beyond the fact that one was made of concrete and the other was made of wood. As such, candidates drew the same form and simply added the material symbol for concrete or timber.

Attention must be given to ALL aspects of the syllabus. Sketching in proportion *(II.I.4 in the syllabus)* appears to be an area of weakness.

Question 4

Candidates were presented with the outline of a wall section for a house. They were required to make a neat well-proportioned section sketch of the foundation and floor detail indicated in the given image. The question further required the identification, through labeling and material representation, of the following elements:

i. R.C. strip footing
ii. 100mm R.C. slab
iii. 200mm hardcore
iv. 300mm ceramic tiles
v. foundation wall

Candidates proportionally drew the required elements for the question. In most cases the proper convention (e.g. line weight, material symbols) for section detail was not shown. Regrettably, a large number of candidates did not correctly identify the drawn elements. This indicated limited knowledge of the elements that comprised a floor and foundation detail. It should be noted that preparing sketches for concrete foundations of buildings is included in the syllabus (II.III.2)

Notes to Teachers

Attention must be given to ALL aspects of the syllabus.

There was a general weakness in drawing construction details especially foundation and stair details. Emphasis should be placed on teaching details including the correct positioning and naming of construction members.

Sketching appears to be an area of weakness and students should be given more freehand drawing exercises to hone this required skill.
Students must be reminded to state the title and scale at the base of each drawing.

Generally throughout the paper, it should be noted that Technical Drawing (according to the syllabus) is a language of communication and as such the strict adherence to convention and basic principles are as important as diction and grammar in other languages. Students should be taught the value of conforming to established drawing standards in order for their drawings to be clear and unambiguous.

Paper 032 – Mechanical Engineering Drawing

Section I – Assembly Drawing

Question 1

Candidates were presented with an enclosed sheet with orthographic details of the parts which made up a "**Movable Arm Assembly"**.

In Part (a), candidates were required to draw full size in either first-angle or third-angle orthographic project the following views of the Movable Arm when fully assembled:

i. A plan showing all hidden details.
ii. A sectional front elevation taken on cutting plane "XX".

In Part (b), candidates were required to show six main dimensions, including a length, a diameter, a radius and a metric screw thread specification.

In Part (c), the candidate was to print the title 'Movable Arm Assembly' and the scale used, as well as show the projection method used, ***by symbol***.

The majority of candidates who did the Mechanical Drawing option attempted this question. Most candidates attempting this question, demonstrated reasonably good knowledge; understanding and practical ability with regards to the positioning and alignment of views in relation to the orthographic projection method used. Students who used CAD software and printed the solution on one page displayed a general knowledge, understanding and practical ability of the alignment and positioning of views based on the orthographic projection method applied. There were a few instances when the candidates using Computer Aided Drawing (CAD) printed the solution on separate pages. As such, the precise understanding of this aspect of the question could not be determined.

In assembling the parts, candidates attempting this question displayed a satisfactory understanding of the instructions to interpret and display knowledge, understanding and practical ability required to assemble the parts to complete the Movable Arm Assembly adequately. However, those candidates also displayed hidden details for the plan which further reflected their understanding of the assembly of parts.

Some of the responses were a simple reproduction of the plan as given in the question as opposed to an assembled view which was required and, an outside elevation of the assembled parts with no hatching.

In doing the sectional front elevation, part (a) (ii) candidates generally displayed a fair knowledge, understanding and practical ability of assembled parts in section. The execution of the actual sectional assembly still presented difficulty in terms of accuracy and conventional representation. However, some candidates demonstrated the understanding of the convention of a web in section.

The conventional representation for the cutting plane, orthographic symbol and printing of title and scale of the drawing were aspects that were well done by a greater majority of the candidates.

Areas of the question that were not well done include:

- Candidates' ability to differentiate between parts with hatching lines as all or most of the assembly was hatched all in one direction or many directions indicating different parts. *Special attention and more practice need to be given with regards to views in section and hatching.*

- Printing of the solutions for candidates doing the examination using CAD software: drawings are not printed to the given scale. In many cases the drawings were printed at a significantly reduced scale or out of scale. Many drawings were scaled so small that marking these scripts became complex. Additionally, some CAD drawings were printed so that the views were separated making it difficult to determine students' knowledge and understanding of orthographic alignment of views.

It is recommended that printing of solutions should be done with the CAD teacher present ***(ONLY printing)*** *or the Technical drawing teacher should set the parameters for printing on whichever drawing sheets would be used to submit solutions PRIOR to the examination.*

- Emphasis needs to be placed on the practice of dimensioning with special reference to the leader lines, the distance of dimension lines from the object, the use of arrow heads for mechanical drawing as well as the features indicated.

Attention is drawn to:

- Interpretation of instructions given in the questions. Students need to be taught how to extract information, interpret such and produce the required product.

Question 2

Candidates were presented with an enclosed sheet with orthographic details of the parts which made up a **"Handle Control Assembly"**.

In Part (a), candidates were required to draw in either first-angle or third-angle orthographic project the following views of the machine vice when fully assembled:

i. A front elevation showing hidden details.
ii. A sectional end elevation taken on the cutting plane "YY".

In Part (b), candidates were required to show six main dimensions, including a length, a diameter, a radius and a metric screw thread specification.

In Part (c), the candidate was to print the title 'Handle Control Assembly' and the scale used as well as show the projection method used, by symbol.

Fewer candidates attempted this question and demonstrated reasonably good knowledge; understanding and practical ability with regards to the positioning and alignment of views in relation to the orthographic projection method used. A greater percentage of candidates attempting this question were able to assemble the handle to the body. However, candidates had difficulty positioning the pivot pin; wing nut and bolt as given in the assembly instructions. The representation of the wing nut itself and the nut were well done.

The sectional assembled elevation seemed to challenge the vast majority of candidates responding to this question. Candidates' had difficulty differentiating between parts with hatching lines as well as conventions in section. Special attention and more practice need to be given with regards to views in section and hatching.

In the instances when the candidates used Computer Aided Drawing (CAD) they demonstrated adequate knowledge, understanding and practical ability of the alignment and positioning of views based on the orthographic projection method applied despite having incomplete solutions. However, some of these candidates had to rescale the drawings for printing purposes so that the views may fit on one page.

Areas of the question that were not well done include:

- Conventions such as fillet rounds, screw threading, knurling and chamfers which were not well drawn or were left out of the drawing. Special emphasis should be placed on students doing these conventions when practising mechanical drawings in the classroom. Additionally there was a distinct lack of other conventions such as centre and construction lines in most of the responses.

- Dimensioning of radii, diameters and metric nuts/bolts/threading. Emphasis needs to be placed on the practice of dimensioning with special reference to the leader lines, the distance of dimension lines from the object, the use of arrow heads for mechanical drawing as well as the features indicated.

Attention is drawn to:

- Interpretation of instructions given in the questions. Students need to be taught how to extract information, interpret such and produce the required product.

Sketch and Design OR 3D Solid Model Design Drawing

Question 3

This question tested candidates' ability to interpret the given orthographic views of a tool block to produce a well-proportioned oblique sketch. A significant number of the candidates registered for Mechanical option responded to this question.

Generally, candidates who attempted this question demonstrated the ability to interpret the orthographic views to produce a 3D drawing. However, only about half of the candidates produced an oblique sketch of the tool block with the rest producing various solutions in isometric projection.
Areas of weakness included:

- Inability of the candidates to follow the principles of oblique drawing and the position of the true face.

Question 4

This question tested candidates' ability to make neat, well-proportioned orthographic sketches to illustrate three of the following types of sections:

(a) Counterbore
(b) Countersunk
(c) Internal screw threads
(d) Blind tapped hole
(e) Through tapped hole

Fewer candidates responded to this question. Of the candidates' who answered this question, most demonstrated a fair knowledge of the conventions but had difficulty showing the representation in section. However, the few candidates who showed an adequate knowledge of these also presented well-proportioned, orthographic sectional sketches of the conventions.

- Emphasis needs to be placed on drawing these conventional symbols and more specifically in section.

School Based Assessment

The samples selected for this year's 2014 SBA marking exercise once again showed an improvement in the quality of work produced by the students. This therefore indicates that teachers have found the feedback from the moderators to be helpful.

Although the standard of work submitted has improved, the SBA team would still however like to reemphasize a few points:

Selection of SBA Problems

The problems to be solved for the SBA component should be of the type which would prepare the student to answer questions from the actual CSEC examination paper. The knowledge gained from working on the SBA would greatly assist the student when answering Paper 03 of the CSEC examination. There should be a direct correlation between what is done by the student for the SBA and what will be required in the exam.

Students should therefore be guided and instructed on focusing on those areas which will be presented in the exam when working on problems for their SBAs.

Research of Projects

Research should be conducted on items such as springs, plungers and levers. How they are assembled and how they should function would definitely assist the student in producing a drawing clearly showing the method of assembly and how the device (mechanism) should work.

Dimensioning

There are still some areas which need to be worked on. For example some students are still not correctly dimensioning their projects. Drawings should be drawn to a scale with the true (actual) measurement stated. It is very important that the scale used be stated.

Sectional detail of drawings.

In instances where an object has many component parts, as much detail as possible should be shown. Parts should be individually sectioned.

Problems

The solutions presented should answer the problem which was stated. The main focus should be to produce drawings which show the solution to the specific problem.

For example, rain water is settling on a parapet roof and as a result water is dripping through and damaging the ceiling below. The solution should therefore be to find ways in which the water can be drained from the roof. Emphasis should be placed on methods of drainage. The use of guttering and down pipes should be employed in the solution showing how the water is being diverted off the roof.

If the problem also stipulates that a new roof is required, detailed drawings showing the type of roof to be constructed (including roof framing plan and how it is to be secured of the existing structure must be included.

Your solution should not just be basic elevations and pictorial view of the building. As stated above greater detail would be required.

Submission of Problem Statements and Mark Schemes

The problem statement should clearly state what the student is required to produce from information which is given. State specifically what the student is expected to do so that there is no ambiguity when producing what is required (attempting to solve the problem).

As stated before, teachers are expected to make sure that each student's folder contains information on the problem being solved (problem statement, conditions and justifications). Also submit the CXC mark scheme clearly showing how marks were awarded to each student in the categories of knowledge, application and practical ability.

The use of CXC's mark scheme is strongly advised. There can be a deviation from the correct marks which are to be awarded, if this not done.

The Moderation Feedback Sheet on the SBA is used as an indication as to how the teacher has assessed the student's work and how the students have solved the problems for the SBA. *PLEASE TAKE NOTE OF THE COMMENTS WHICH HAVE BEEN MADE BY THE EXAMINERS AND ACT ACCORDINGLY*