G12 ECZ GMD P1 2016 GCE SOLUTIONS

Grade 12 ECZ Geometrical and Mechanical Drawing Paper 1, 2016 GCE (7040/1)

Construction methods + computed values -- this is a practical drafting exam, see note

am: the true answer is a full-size drawing on A2 paper. This PDF gives the exact construction method and any cleanly computable numeric ans

by Zambian Online Education Company (eskulu.com | zedpastpapers.com)

EXAMINATIONS COUNCIL OF ZAMBIA

Examination for General Certificate of Education Ordinary Level

Geometrical and Mechanical Drawing

Paper 1 **7040/1**

Tuesday **2 AUGUST 2016**

Additional materials:
A2 Drawing paper (1 sheet)
Standard drawing equipment

Time: 2 hours 40 minutes **Marks: 100**

Instructions to Candidates

Print your **name, centre number** and **candidate** number in the Title Block at the bottom right-hand corner of your drawing paper.

There are **eight** questions in this paper. Answer **five** questions.

Answer not more than **three** questions from any one section.

Unless otherwise stated, strictly geometrical methods must be used. Solutions should be drawn full size and no dimensions are required. All construction lines must be shown clearly. Lines which are parallel, perpendicular or inclined at angles of 30°, 45° or 60° to other lines may be drawn without showing construction lines.

All the drawings in this question paper are **NOT DRAWN TO SCALE**.

USE ONLY ONE SHEET OF A2 DRAWING PAPER.

You may use **both** sides of the drawing paper for your answers.

Information for Candidates

The number of marks is given in brackets [ ] at the end of each question or part question.

All dimensions are in millimetres unless otherwise stated.

Cell phones are not allowed in the examination room.

SECTION A

PLANE GEOMETRY

Answer **two** or **three** questions from this section

QUESTION 1

(a) Construct a regular pentagon given its perimeter 145mm.

(b) Transpose the pentagon in (a) to a square of equal area.

(c) Measure and state the side of the square.

[Total 20 marks]

QUESTION 2

Figure 1 shows a drawing of a locking lever in which curve **ABC** is semi-elliptical. Draw full size the locking lever showing all the geometrical constructions.

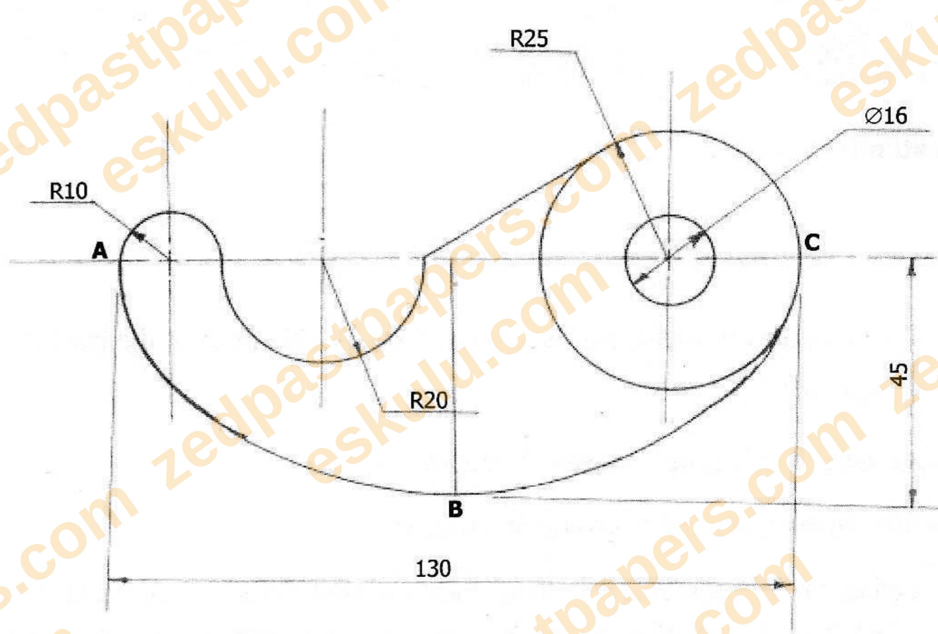

Figure 1

[Total 20 marks]

QUESTION 3

(a) Construct the locus of a point on the circumference of a thin disc of diameter 75mm rolling without slipping off along a horizontal path for one revolution.

(b) Name the produced locus.

(c) Draw the normal and tangent to the locus at a point 'P' 50mm above the horizontal path on the right hand side.

[Total 20 marks]

SECTION B

SOLID GEOMETRY

Answer not more than **three** questions from this section.

QUESTION 4

Figure 2 shows the front and end elevation of a crank bearing. Do not copy the given views, but draw full size the block in isometric projection with point 'P' as the lowest point. Hidden details should not be shown.

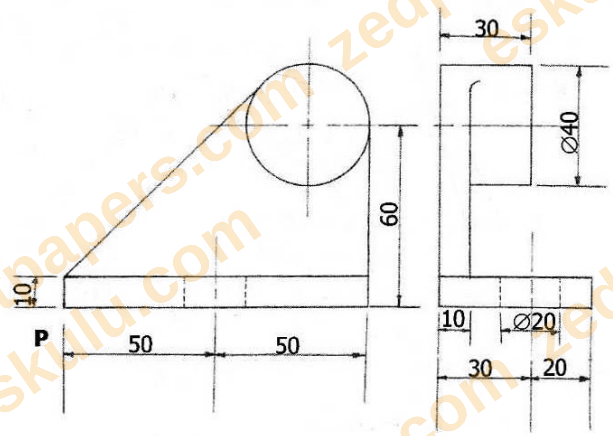

Figure 2

[Total 20 marks]

QUESTION 5

Figure 3 shows two views of a bearing bracket drawn in First Angle Projection.

(a) Draw the given views.

(b) Project an auxiliary elevation looking in the direction of arrow X.

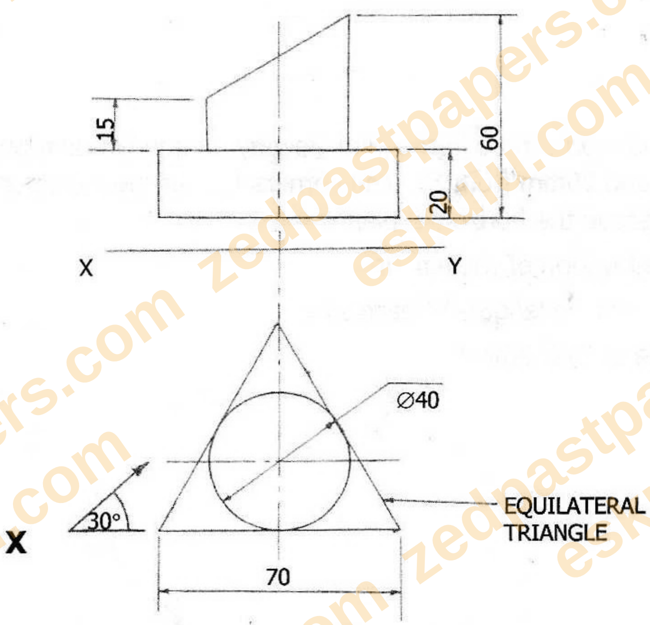

Figure 3

[Total 20 marks]

QUESTION 6

Figure 4 shows a truncated regular pentagonal pyramid in First Angle Projection.

(a) Draw the given views and complete the plan as viewed from arrow A.

(b) Draw the End Elevation viewed from arrow E.

(c) Draw the true shape of the cut surface.

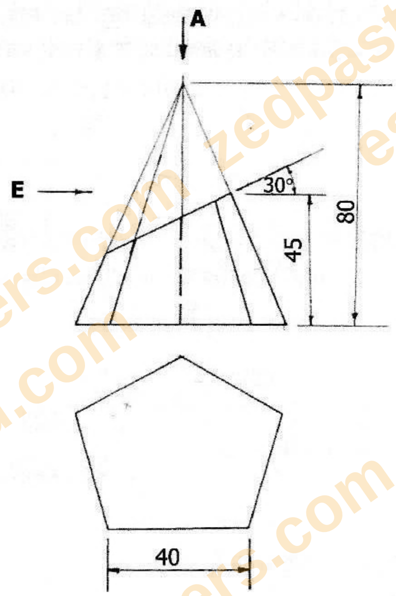

Figure 4

[Total 20 marks]

QUESTION 7

A triangular lamina ABC is represented in the plan view by an equilateral triangle of side 40mm, with side AB parallel to, and 25mm from XY. The corners ABC of the elevation are 30mm, 70mm and 10mm respectively above the horizontal plane.

(a) Draw the plan and elevation of the lamina.

(b) Measure and state the true lengths of each side.

(c) Draw the true shape of the Lamina.

[Total 20 marks]

QUESTION 8

Figure 5 shows an incomplete plan and elevation of an octagonal hollow prism intersected by a square duct. Both are made from material of negligible thickness.

(a) Draw the given views.

(b) Complete the plan and elevation by showing the necessary lines of intersection.

(c) Draw the surface development of the square duct, the seam line along S – S.

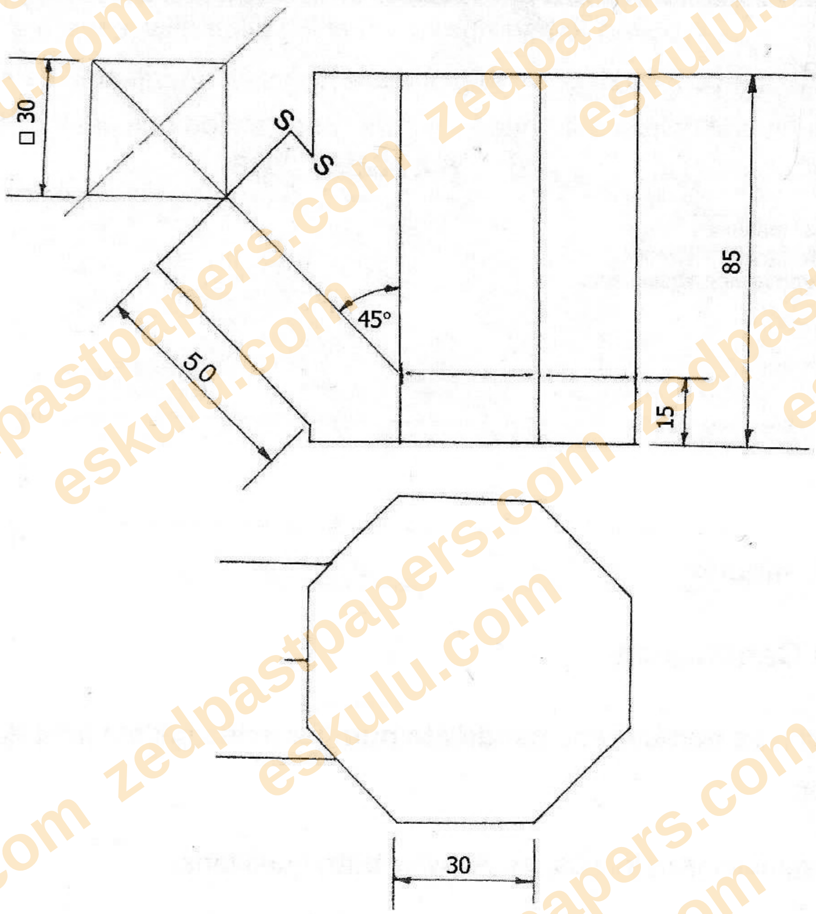

Figure 5

[Total 20 marks

Question 1. SECTION A, Q1 [20]. (a) Construct a regular pentagon given its perimeter 145mm. (b) Transpose the pentagon to a square of equal area. (c) State the side of the square.

(a) Construction method: pentagon side = perimeter / 5 = 145/5 = 29mm exactly. Construct one side AB=29mm, then use the standard regular-pentagon construction (bisect AB, erect a perpendicular, use compass arcs based on the golden-ratio relationship, or simply set out 5 equal 29mm sides at the pentagon's interior angle of 108 degrees at each vertex) to complete the pentagon.

(b) 'Transposing' (squaring) a polygon by GEOMETRICAL method: divide the pentagon into triangles from its centre, convert each (or the whole shape via a running total, using the mean-proportional/semicircle method) into an equal-area rectangle, then that rectangle into a square using Euclid's mean-proportional construction (as in the equivalent 2016-internal Q1(b)).

Answer: (c) Computed exactly: regular-pentagon area formula = (5 x side^2)/(4 x tan36 deg) = (5 x 29^2)/(4 x tan36) = 1446.92 mm-squared, so the equal-area square's side = sqrt(1446.92) = 38.04mm (approximately 38mm).

Question 2. SECTION A, Q2 [20]. Figure 1 shows a locking lever: curve ABC is semi-elliptical, blended with R10, R20, R25 arcs and a Ø16 hole (130mm base, 45mm height references). Draw full size showing all geometrical constructions.

Construction method: construct the semi-ellipse ABC using the auxiliary-circle (or trammel) method, sized to the 130mm overall base and 45mm height references given. Blend the R10 arc (the small hook/notch near A) tangentially into the ellipse curve, the R20 arc (the central scalloped notch) tangentially between the two adjacent curves, and the R25 arc (the large rounded boss near C) tangentially into the ellipse and the Ø16 central hole's surrounding boss -- in every case, the arc's centre lies on the perpendicular to each curve/line it touches, at a distance equal to its own radius.

Draw the Ø16 hole concentric with the R25 boss's own centre. Show every construction line, arc centre, and point of tangency clearly, as required.

Answer: Answer: construction method as above (semi-ellipse ABC via the auxiliary-circle/trammel method; R10, R20, R25 arc centres each located on the perpendicular to their tangent curves/lines at a distance equal to their own radius; Ø16 hole concentric with the R25 boss).

Question 3. SECTION A, Q3 [20]. (a) Construct the locus of a point on the circumference of a thin disc (diameter 75mm) rolling without slipping along a horizontal path, for one revolution. (b) Name the locus. (c) Draw the normal and tangent to the locus at point P, 50mm above the path on the right-hand side.

(a) Construction method: this is the standard CYCLOID construction. Draw a base line equal to the disc's circumference (pi x 75 = 235.6mm). Divide the rolling circle into 12 equal 30-degree divisions, and divide the base line into 12 equal parts too. Project each circle-division point horizontally to the centre-line locus, then draw the rolling circle at each successive base-line position and mark where the corresponding division point lands -- join all 12 marked points with a smooth curve (French curve) to trace the cycloid.

Answer: (b) Name of the locus: a CYCLOID (the curve traced by a point on the circumference of a circle rolling without slipping along a straight line).

(c) At point P (50mm above the path -- note this is ABOVE the disc's own radius of 37.5mm, since 75/2=37.5mm, so P is on the upper part of the cycloid arch, past the highest point of a simple circle but still on the cycloid's curve since the cycloid's maximum height equals the full diameter, 75mm): the NORMAL to a cycloid at any point passes through the corresponding point of contact between the rolling circle (at that instant) and the base line directly below the circle's current centre; the TANGENT is perpendicular to this normal, drawn through P itself.

Answer: (c) Construction: locate the rolling-circle position on the base line corresponding to height 50mm on the right-hand side of the arch (found by interpolating between the plotted division points from part (a)), draw the normal from P down to that circle's point of contact with the base line, then draw the tangent through P perpendicular to this normal.

Question 4. SECTION B, Q4 [20]. Figure 2 shows the front and end elevation of a crank bearing (Ø40 boss, 60mm main height, 50+50mm base, 10/30/20mm divisions, Ø20 bore). Draw full size in isometric, point P the lowest point, no hidden details.

Construction method: draw the three isometric axes at 120 degrees from origin P (the given lowest point). Set out the overall base length (50+50=100mm) and heights (60mm main body, plus the smaller 30/20mm end-block divisions) along the isometric axes using TRUE lengths only. Build up the wedge/ramp-shaped main body first, then the raised end block (with its Ø40 boss and Ø20 bore, each constructed via the four-centre approximate-ellipse method for circles on an isometric plane). Show only visible edges (no hidden detail, per the instruction).

Answer: Answer: construction method as above (isometric axes at 120 deg from P; true lengths along isometric axes; four-centre method for the Ø40/Ø20 circular features; no hidden lines).

Question 5. SECTION B, Q5 [20]. Figure 3 shows two views of a bearing bracket (equilateral-triangle base 70mm with an inscribed Ø40 circle, wedge-shaped elevation with 15/60/20mm divisions, arrow X at 30 degrees). (a) Draw the given views. (b) Project an auxiliary elevation looking in the direction of arrow X.

(a) Construction method: reproduce the given front elevation (a wedge/ramp block, 15mm step, 60mm total height, 20mm depth) and the given plan (an equilateral triangle of 70mm sides, with an inscribed circle of Ø40 tangent to all 3 sides) directly from the given dimensions, in correct first-angle relative position.

(b) Auxiliary elevation from arrow X (at 30 degrees to the triangle's base, per the figure): draw a new auxiliary reference line parallel to arrow X's direction of sight (i.e. at 30 degrees to the plan's reference line XY). Project each corner of the triangular base, and each point of the wedge-shaped elevation, perpendicular to this new auxiliary datum, transferring true heights (from the ORIGINAL front elevation, using dividers) to correctly locate every point in the new auxiliary elevation. Since arrow X views the triangular base obliquely (at 30 degrees to one side), the base will generally appear as a foreshortened (non-equilateral-looking) triangle in this auxiliary view, and the inscribed circle will generally project as an ellipse, plotted via the ordinate method.

Answer: Answer: construction method as above (auxiliary datum parallel to arrow X's 30-degree direction; heights transferred from the original elevation by dividers; the equilateral triangle and

inscribed Ø40 circle both appear foreshortened/elliptical in this oblique auxiliary view).

Question 6. SECTION B, Q6 [20]. Figure 4 shows a truncated regular pentagonal pyramid (base side 40mm, full height 80mm, cut at 45 degrees through a point 45mm up). (a) Draw the given views and complete the plan viewed from arrow A. (b) Draw the end elevation viewed from arrow E. (c) Draw the true shape of the cut surface.

Reference values computed exactly for the FULL (untruncated) pyramid: base side 40mm gives a pentagon circumradius (centre to vertex) = 40/(2 x sin36 deg) = 34.03mm and apothem (centre to mid-side) = 27.53mm; with the full height 80mm, the true length of each slant EDGE (apex to a base vertex) = sqrt(34.03^2 + 80^2) = 86.94mm.

(a) Construction method: draw the given elevation (isoceles-triangle-like silhouette, apex at 80mm, base 40mm-side pentagon) and complete the plan (a regular pentagon of side 40mm, viewed from arrow A, i.e. straight down) by projecting each of the elevation's 5 edges down into the plan using the pentagon's known vertex positions (each at circumradius 34.03mm from the centre, spaced 72 degrees apart).

(b) End elevation from arrow E: project a new view looking along the direction of arrow E (perpendicular to the front elevation's viewing direction), transferring depths from the plan via dividers to each of the 5 base vertices and the apex, to build up the pentagonal pyramid's silhouette as seen from this new side.

(c) True shape of the cut surface: since the cutting plane (45 degrees, through the 45mm-height point) is oblique to the pyramid's axis, it crosses each of the 5 slant edges at a DIFFERENT height/length (because a pentagonal pyramid's edges are not all in the same plane the way a cone's generators radiate symmetrically about an axis of revolution -- each edge must be checked individually). Project the true shape via the standard auxiliary-view method: mark where the 45-degree cutting plane crosses each of the 5 slant edges in the elevation, transfer each of these 5 points to the plan, then set up a new auxiliary reference line parallel to the cutting plane (edge-on in the elevation) and project each of the 5 points perpendicular to it, transferring true depths from the plan by dividers to plot the true (generally irregular pentagonal) shape of the cut.

Answer: Answer: pentagon circumradius = 34.03mm, apothem = 27.53mm, full slant edge length = 86.94mm (all computed exactly); true shape of the cut found via the 5-point auxiliary-projection method described above (generally an irregular pentagon, since the oblique cut meets the 5 edges at different heights).

Question 7. SECTION B, Q7 [20]. A triangular lamina ABC: plan is an equilateral triangle of side 40mm, with side AB parallel to and 25mm from the XY line; corners A, B, C are 30mm, 70mm and 10mm above the horizontal plane (HP) respectively. (a) Draw the plan and elevation. (b) State the true lengths of each side. (c) Draw the true shape of the lamina.

Setting up coordinates from the given data: plan positions (with AB parallel to the x-axis, 25mm from XY) are A=(-20,25), B=(20,25), C=(0, 25+34.64)=(0,59.64) [since the equilateral triangle's height = 40 x sqrt(3)/2 = 34.64mm]; heights above HP are zA=30, zB=70, zC=10.

Method: for each side, true length = sqrt((plan length)^2 + (height difference)^2) -- this is the standard true-length right-triangle construction, applied here three times, once per side, using each side's own plan length (all three are 40mm here, since the plan is equilateral) and each side's own pair of end-point heights.

Answer: (b) Computed exactly: true length AB = sqrt(40^2 + (70-30)^2) = sqrt(3200) = 56.57mm; true length BC = sqrt(40^2 + (10-70)^2) = sqrt(5200) = 72.11mm; true length CA = sqrt(40^2 + (30-10)^2) = sqrt(2000) = 44.72mm.

(c) True shape construction: draw one side at its true length (e.g. AB = 56.57mm) as a base line, then draw an arc of radius BC(true) = 72.11mm centred on B, and an arc of radius CA(true) = 44.72mm centred on A; their intersection gives the true position of C. Joining A, B and this new C gives the TRUE SHAPE of the lamina -- a scalene triangle with sides 56.57mm, 72.11mm and 44.72mm, generally quite different in shape from the 40mm-equilateral plan view, since the lamina is inclined to the HP.

Answer: Answer: true lengths AB=56.57mm, BC=72.11mm, CA=44.72mm (computed exactly by coordinate/Pythagorean method); true shape is the scalene triangle with these three side lengths, constructed by the base-plus-two-arcs method above.

Disclaimer

Created by eskulu Past Papers Tutor

These solutions were created using artificial intelligence and checked against ECZ marking guidelines. If you find an error, report it at eskulu.com/feedback.

eskulu.com | zedpastpapers.com