Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2018

Design & Communication Graphics

Higher Level
Sections B and C (180 marks)

Wednesday, 20 June
Afternoon, 2:00 - 5:00

This examination is divided into three sections:

SECTION A	(Core - Short Questions)
SECTION B	(Core - Long Questions)
SECTION C	(Applied Graphics - Long Questions)

SECTION A

- Four questions are presented.
- Answer **any three** on the accompanying A3 examination paper.
- All questions in Section A carry **20 marks** each.

SECTION B

- Three questions are presented.
- Answer **any two** on drawing paper.
- All questions in Section B carry **45 marks** each.

SECTION C

- Five questions are presented.
- Answer **any two** (i.e. the options you have studied) on drawing paper.
- All questions in Section C carry **45 marks** each.

General Instructions:

- *Construction lines must be shown on all solutions.*
- *Write the question number distinctly on the answer paper in Sections B and C.*
- *Work on one side of the drawing paper only.*
- *All dimensions are given in metres or millimetres.*
- *Write your Examination number in the box provided on section A and on all other sheets used.*

SECTION B - Core

Answer **any two** questions from this section on drawing paper.

B-1. The image on the right shows the new *Poolbeg Incinerator* in Dublin.

Fig. B-1 shows the plan and elevation of a similar structure.

A pictorial view of the structure is also shown.

(a) Draw the given plan and make a perspective drawing of the structure, given the following:

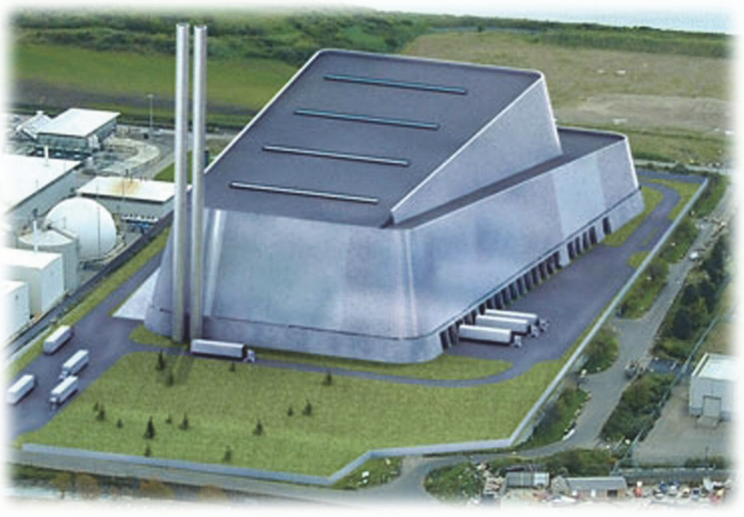
- The spectator point, **S**, is 20m from the corner **A** as shown
- The picture plane passes through the corner **A**
- The horizon line is 10m above the ground line
- The sloping lines on surface **B** are inclined at an angle of 20° to the horizontal plane.

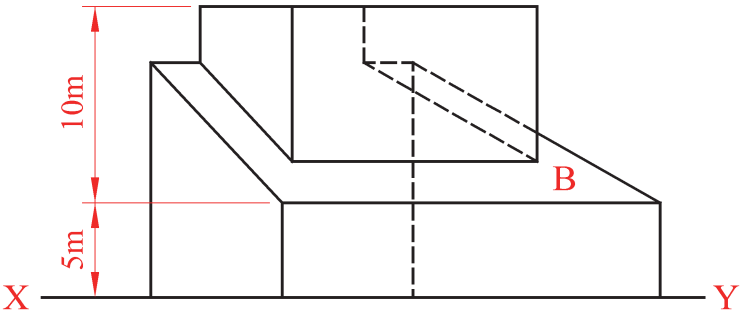
*Use auxiliary vanishing points to determine the sloping lines on surface **B** in the perspective drawing.*

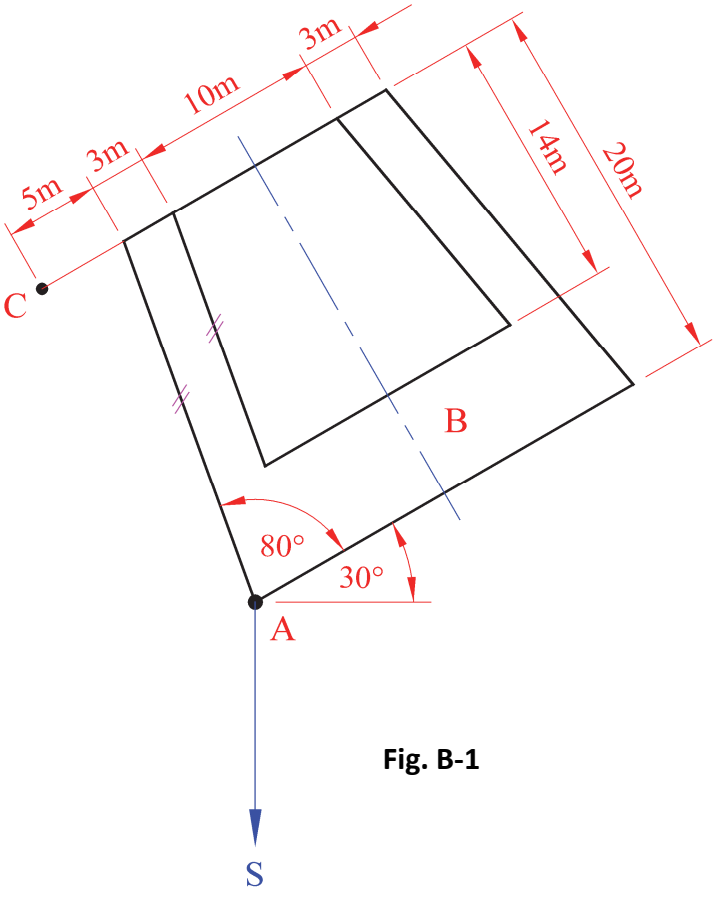
(b) A vertical chimney is located at position **C**. It has a height of 20m. Draw the chimney in the perspective view.

(c) Determine the *angle of elevation* when viewing the top of the chimney from point **S**.

Scale 1:200







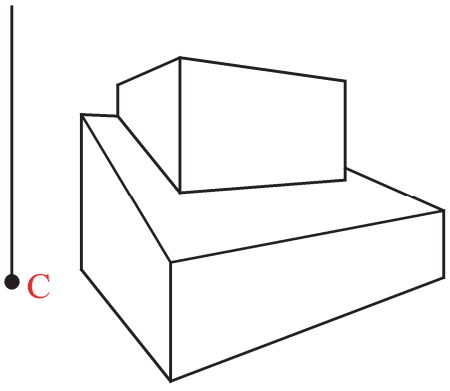


Fig. B-1

B-2. The image shows a cardboard carry-box for a child's novelty toy. A complete surface development of a similar box (without 'glueing tabs') is given in Fig. B-2 below. When the box is assembled, point **C** coincides with point $\mathbf{C_1}$ and point **A** coincides with point $\mathbf{A_1}$. **AB** is a straight line.

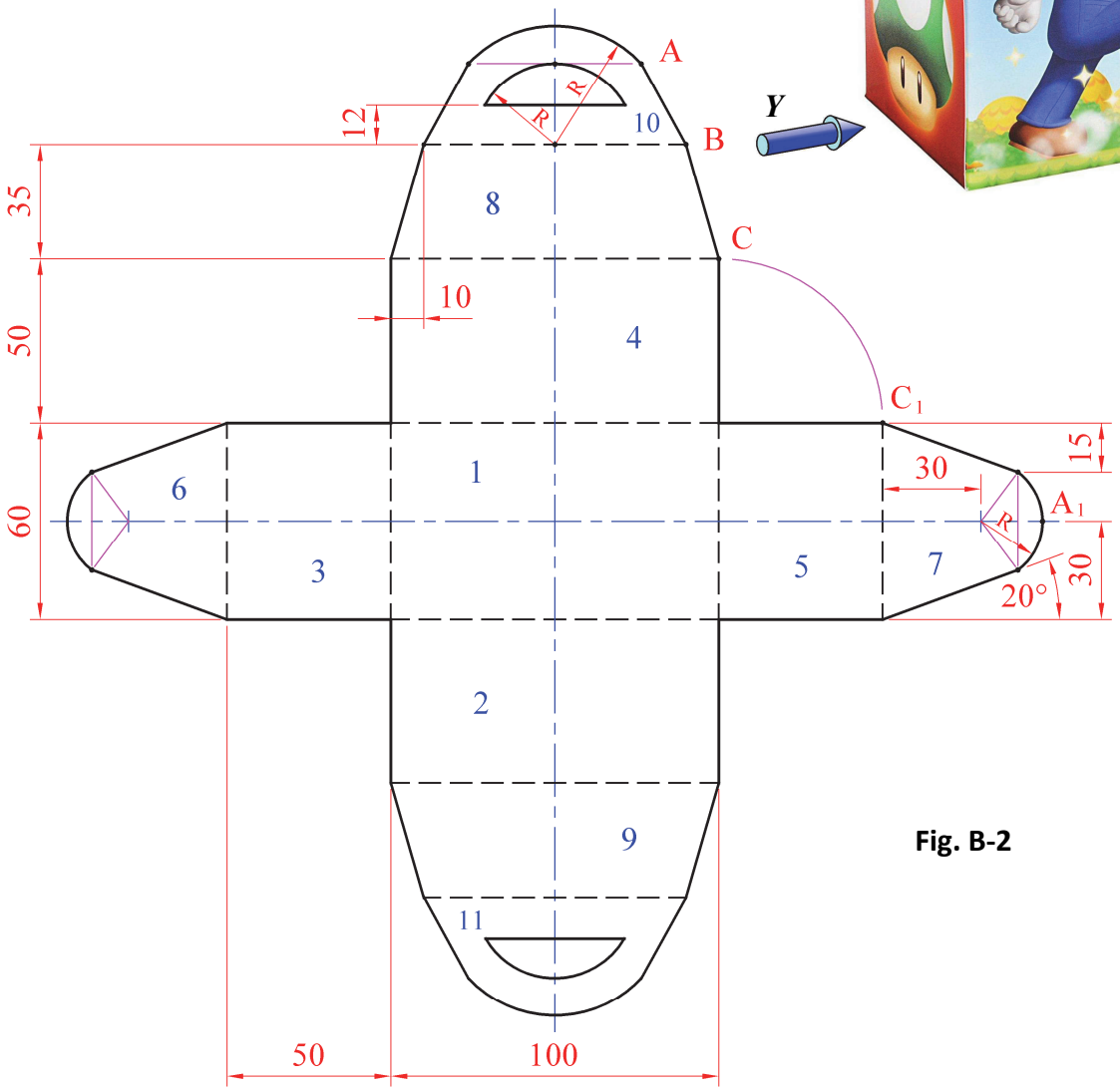


Fig. B-2

(a) Draw the given development of the surfaces labelled 1, 2, 3, 4 and 5.

Note: *Position this view carefully to ensure that the entire answer fits on one drawing sheet.*

(b) On a separate diagram draw the orthographic projections, as follows, of those five surfaces, when the box has been **assembled**:

- An elevation in the direction of arrow **X**.
- An end view in the direction of arrow **Y**.
- A plan projected from the elevation.

(c) Draw surfaces 6, 7, 8 and 9 in your development and also in the elevation, end view and plan.

(d) Draw the remaining vertical 'handle' surfaces (10 and 11) in the elevation, end view and plan and hence complete your surface development.

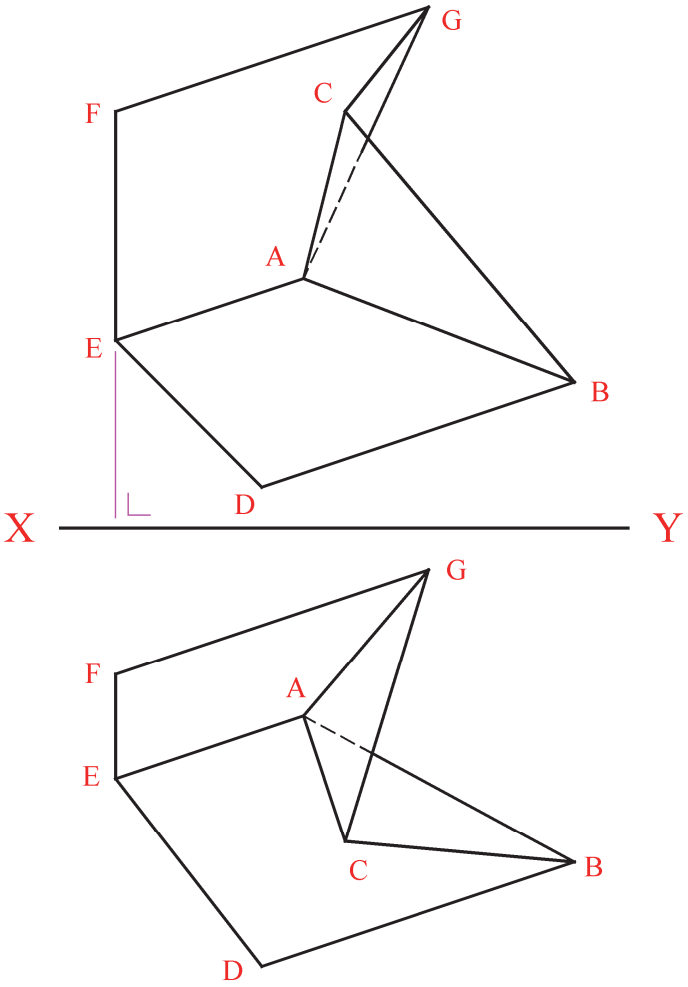
Note: *Both surfaces (10 and 11) meet to form the vertical carry-handle.*

Scale 1:1

B-3. The image on the right shows a piece of roadside sculpture, in the form of a steel hedgehog, which is located on the M11 in Co. Wexford.
It comprises a series of planar surfaces, each carefully angled to allow for the run-off of rainwater.

Fig. B-3 shows the plan and elevation of four such intersecting surfaces.

The horizontal and vertical coordinates for points **A**, **B**, **C, D**, **E** and **G**, defining the four planes, are also given.



A:	145	---	60	---	45
B:	210	---	35	---	80
C:	155	---	100	---	75
D:	135	---	10	---	105
E:	100	---	45	---	60
G:	175	---	125	---	10

Fig. B-3

(a) Draw the given elevation and plan of the intersecting planes **ABC** and **ABDE**.

(b) Determine the dihedral angle between the planes **ABC** and **ABDE**.

(c) Draw the elevation and plan of point **G** and determine the distance between points **G** and **B**. The opposite edges **AE** and **GF** of the surface **AEFG** are parallel. Complete the elevation and plan of the surfaces **AEFG** and **ACG**.

(d) Determine the projections of a horizontal line drawn from **C** which will touch the plane **AEFG** at a point which is 55mm from **C**. Hence determine and indicate, in degrees, the true angle between this horizontal line and the vertical plane.

Scale 1:1

SECTION C - Applied Graphics

Answer **any two** questions (i.e. the options you have studied) from this section on drawing paper.

Geologic Geometry

C-1. **(a)** The accompanying map, located on the back page of Section A, shows ground contours at five metre vertical intervals.
AD is the centreline of a proposed motorway.
The motorway is widened between **B** and **C** to form a toll plaza as shown.

The motorway has the following specifications:

- the portion from **A** to **B** is level at an altitude of 65m
- the portion from **B** to **C** is level at an altitude of 65m and is widened as shown
- the portion from **C** to **D** is rising uniformly at a rate of 1 in 15.

Using side slopes of 1 in 1.5 for the cuttings and 1 in 2 for the embankments, complete the earthworks necessary to accommodate the motorway between **A** and **D** on the northern side.

(*You may ignore the southern side.*)

(b) On the map, **P**, **Q** and **R** are three points on the surface of the earth. Vertical boreholes at these three points reveal a triangle on the top surface of a stratum of ore at altitudes of 45m, 60m and 35m respectively.

(i) In the space provided at the top of the map, draw the elevation of the triangular portion of the top surface of the stratum.

(ii) Draw the plan of the triangle and determine the strike and dip of the stratum.

(iii) Determine, and indicate in metres, the length of the shortest skew borehole from **R** to the top surface of the stratum.

(c) Determine, in plan, the line of intersection between the top surface of the stratum and the surface of the widened portion of the toll plaza.

Scale 1:1000

C-2. The graphic shows a footbridge near Liverpool which is based on a hyperbolic paraboloid. The projections of the bridge are given in Fig. C-2 below.

The elements of the hyperbolic paraboloid surface **ABCD** are extended outwards to form the curved outline loop of the supporting steel structure.

(a) Draw the given plan and elevation of the hyperbolic paraboloid **ABCD**, using the number of elements shown and include the projections of the walkway.

(b) Curve **ABC** is a parabola in elevation with vertex at **B**. Draw the elevation of this parabola.

(c) Project, from the elevation, the given plan of the curved outline loop and project an end view. Draw the walkway in the end view.

(d) The line **CE** is a normal to the parabola at point **C** in elevation. Determine the focal point and the directrix of this parabola in elevation.

Scale 1:500

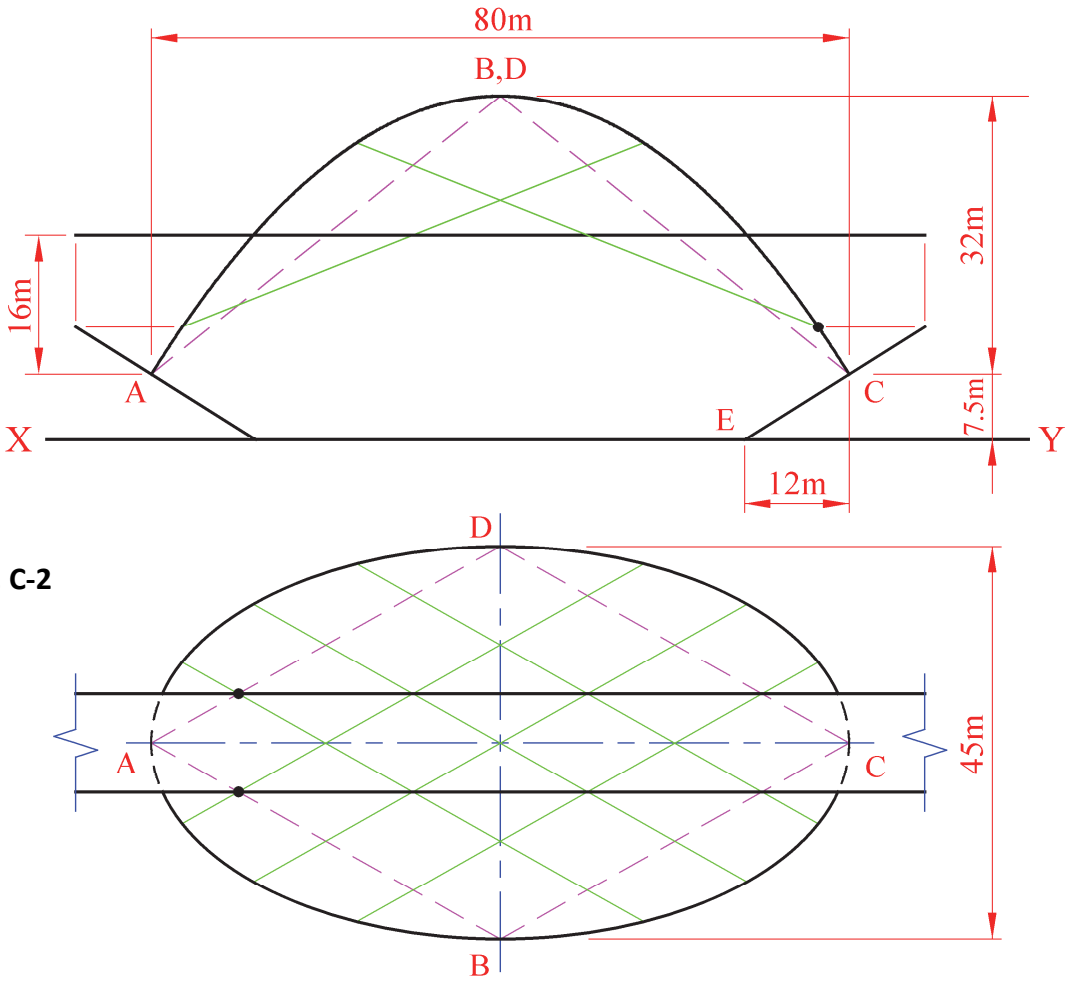


Fig. C-2

Surface Geometry

C-3. A ***terrarium*** is a glass container for soil and plants as shown.

Fig. C-3 shows the plan and elevation of two geometric terrariums.

The terrarium on the left is based on a square-based pyramid and is shaped as shown.

(a) Draw the plan and elevation of this terrarium and determine the dihedral angle between surfaces **A** and **B**.

(b) Develop the surface **C**.

(c) The terrarium on the right is a cube which is tilted and shaped as shown. The outline plan is a regular hexagon of 150mm side. Draw the given plan of this terrarium and project the elevation.

(d) Determine the true inclination of the surface **D** to the horizontal plane. Hence, or otherwise, determine the true shape of surface **D**.

Scale 1:3

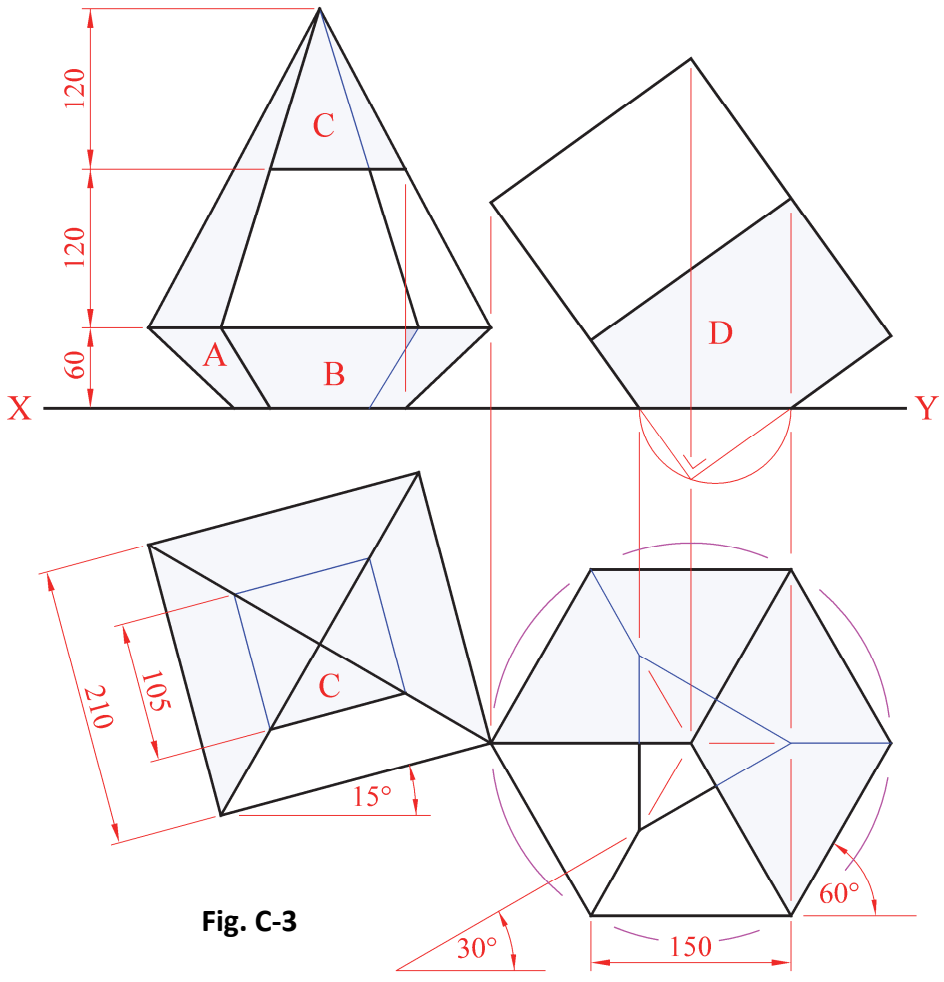


Fig. C-3

Dynamic Mechanisms

C-4. **(a)** The graphic on the right shows a *Fluid Agitator*, as used when donating bodily fluids. Movement is generated by a link mechanism, which causes the tray to rock to-and-fro preventing coagulation of the fluid.

The link mechanism is similar to the one shown in Fig. C-4 (a).

Crank **OA**, which is 48mm long, rotates in an anti-clockwise direction about point **O** as shown. Link **CB** pivots about the fixed point **C**.

AB and **CB** are both 110mm long and are pin-jointed at **A** and **B**.

(i) Plot the locus of point **P**, which is the midpoint of link **AB**, for a full revolution of crank **OA**.

(ii) Determine and indicate, in degrees, the maximum angle of rotation of link **CB**.

Scale 1:1

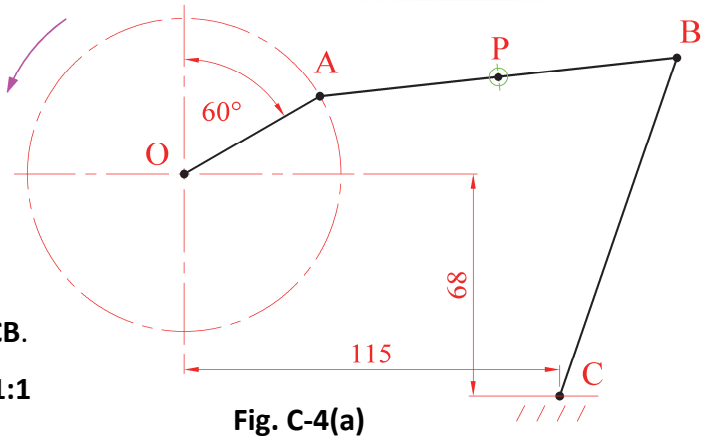
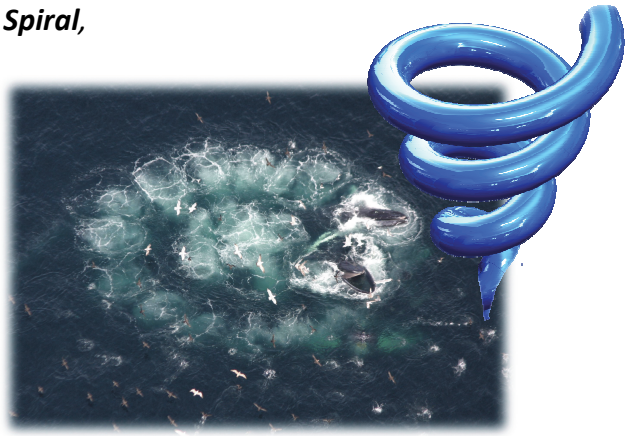


Fig. C-4(a)

(b) The image of the ocean on the right shows an aerial view of a group of *Humpback Whales* engaged in a technique called *'Bubble Net Fishing'*.

The whales start underneath the fish and entrap them by blowing a 'net' of bubbles, which move upwards in a ***Conical Archimedean Spiral,*** as shown in the 3D graphic.



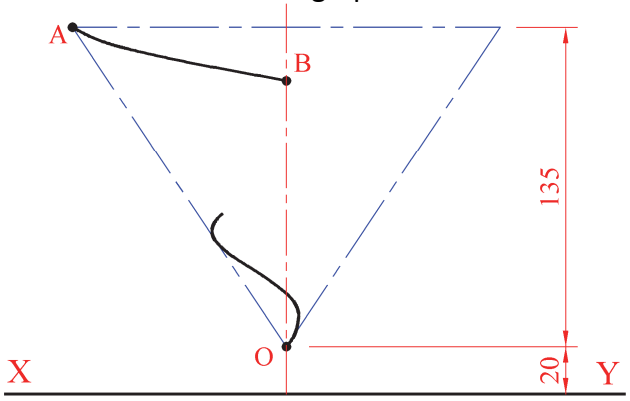


Fig. C-4(b)

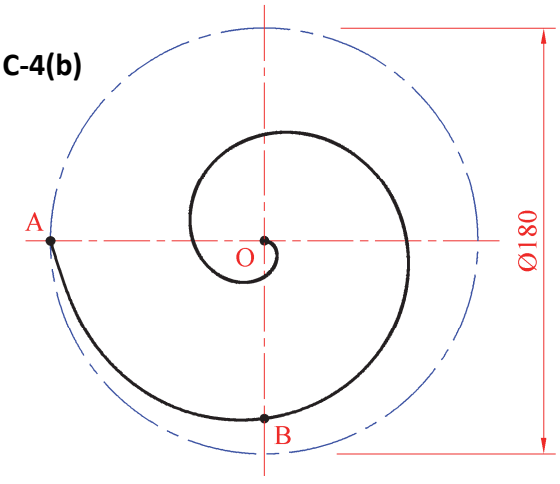


Fig C-4(b) on the left shows the projections of an inverted cone. An Archimedean Spiral moves clockwise from **O** to **A** in 1.5 revolutions, as shown in plan.

(i) Draw the given plan of the spiral.

(ii) Two portions of this Archimedean Spiral (helix) are shown in the elevation. Draw the complete elevation.

(iii) Develop a portion of the surface of the inverted cone to determine the true shape of the curve between points **A** and **B**.

Scale 1:1

Assemblies

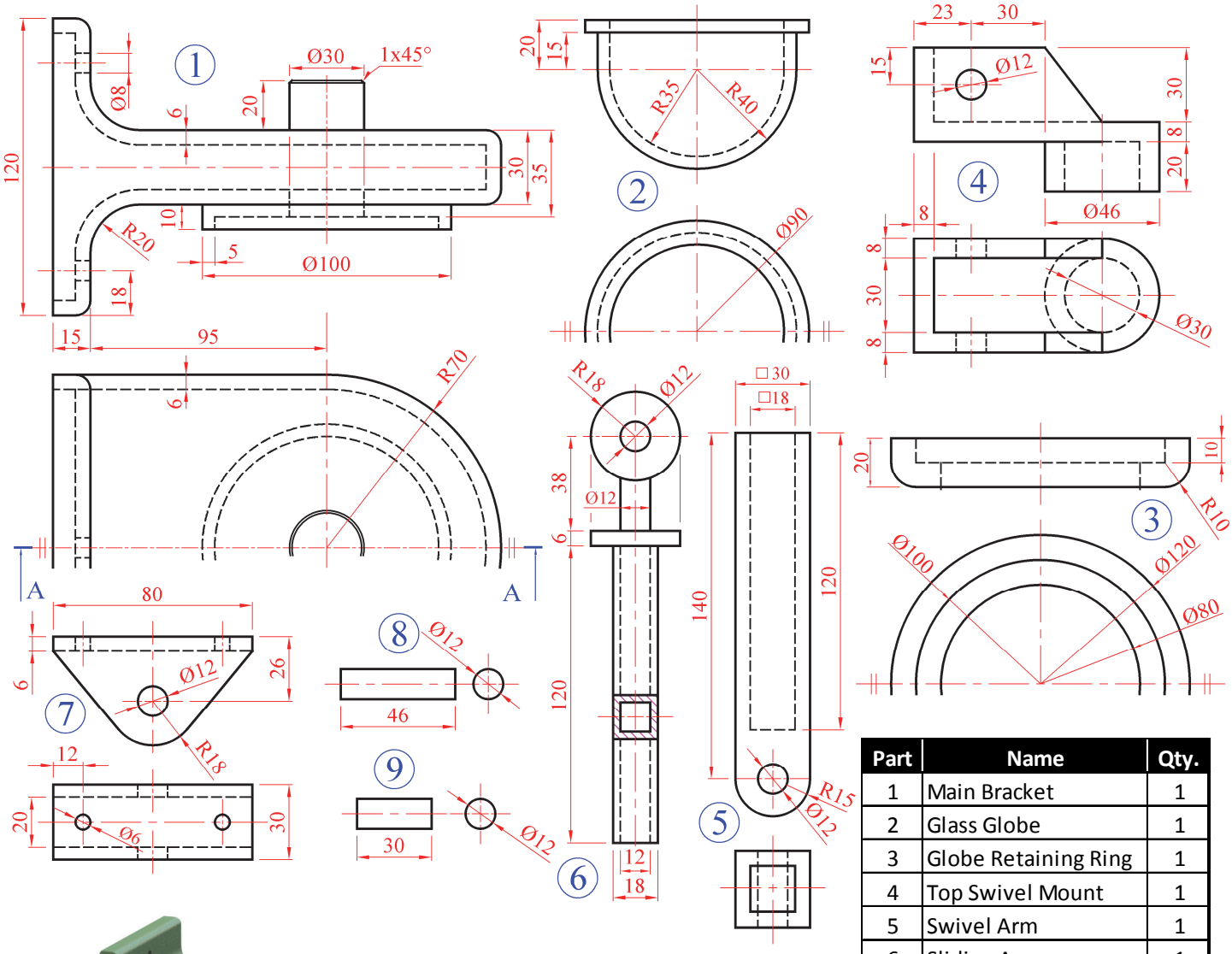
C-5. Details of a ***Security Camera Bracket***, for mounting the two cameras shown, are given in Fig. C-5 below. The parts list for the bracket is also given together with a 3D view of its constituent parts.

(a) Draw a full-size sectional elevation on **A-A**, showing the parts fully assembled, with the *Swivel Arm* raised at 15° to the horizontal plane, the *Sliding Arm* fully inserted and the top of the *Upper Camera Mount* horizontal.

(Unless otherwise stated, fillets are 6mm and chamfers 1×1mm. Some dimensions have been removed for clarity and any omitted dimensions may be estimated.)

Note: *All assembly fits are loose, push or friction fit as required.*

(b) On your drawing insert a dimension to show the vertical distance between the top of part 7 and the bottom of part 2. *(Arrowheads, extension lines, text, etc. should be neatly included and appropriate spacing should be used, in keeping with drawing convention.)*



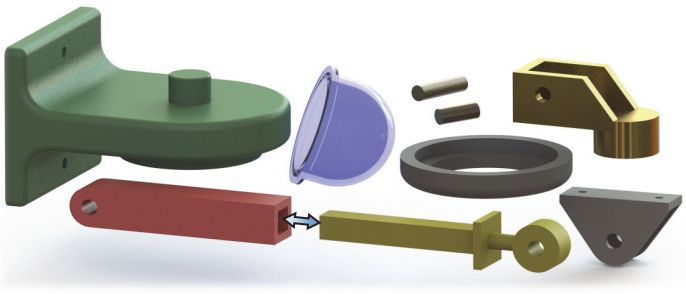


Fig. C-5

Part	Name	Qty.
1	Main Bracket	1
2	Glass Globe	1
3	Globe Retaining Ring	1
4	Top Swivel Mount	1
5	Swivel Arm	1
6	Sliding Arm	1
7	Upper Camera Mount	1
8	Pin Ø12 x 46	1
9	Pin Ø12 x 30	1

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