



Leaving Certificate Examination, 2016

Design & Communication Graphics
Higher Level

Sections B and C (180 marks)

Wednesday, 22 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.*

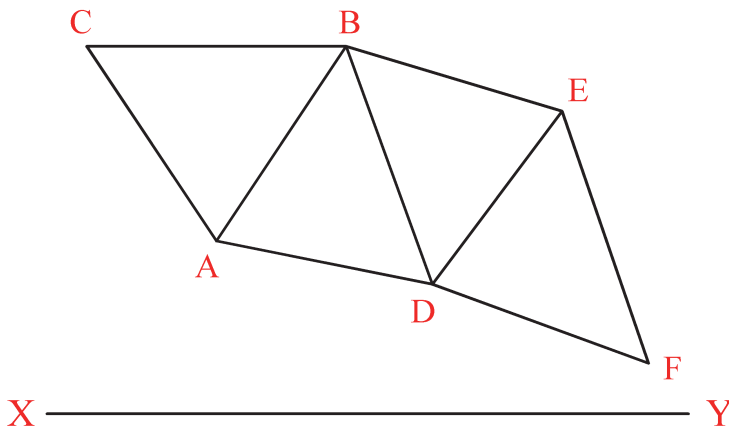
SECTION B - Core

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

B-1. The image on the right shows a restaurant which consists of a series of intersecting triangular glass surfaces.

Fig. B-1 shows the plan and elevation of four such intersecting planes.

Data related to the horizontal and vertical coordinates for points A, B, C, D, E and F, defining the four planes, are also given.



A:	130	---	40	---	80
B:	160	---	85	---	35
C:	100	---	85	---	35
D:	180	---	30	---	75
E:	210	---	70	---	25
F:	230	---	?	---	55

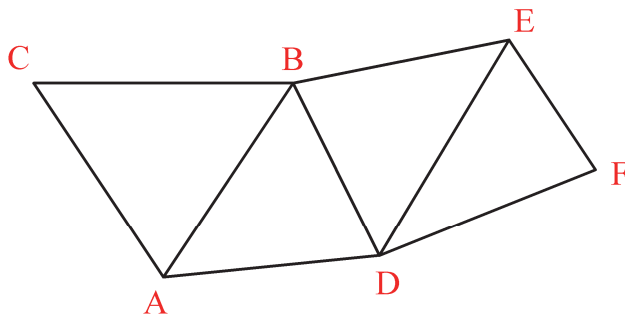


Fig. B-1

- (a) Draw the given plan of the four triangular planes and complete the elevation of the intersecting planes **ABC**, **ABD** and **DEB**.
- (b) Determine the dihedral angle between the planes **ABC** and **ABD**.
- (c) Draw the elevation and plan of a horizontal line on the surface **DEB** and then determine the true inclination of surface **DEB** to the horizontal plane.
- (d) The dihedral angle between the planes **DEB** and **DEF** is 170° . Complete the projections of the surface **DEF**.

Scale 1:1

B-2. The image on the right shows a hotel located beside the river Shannon in Limerick. Two views of an architectural model of a similar structure are shown in the 3D graphics below. The outline projections of the structure are given in Fig. B-2.



The plan is based on an ellipse, reflecting the city's rugby tradition. The top of the structure is parabolic, as indicated by the curve **ABC** in the elevation. **B** is the vertex of the parabola. One side of the structure has been shaped to produce a flat vertical surface as shown.

- (a) Draw the given plan and elevation of the structure.
- (b) Project an end view in the direction of arrow E.
- (c) An architectural feature, in the form of a steel band, is to be constructed around the outside of the structure as shown in the 3D graphics.

VT and HT are the traces of an inclined cutting plane used to define the position and shape of the steel band. Determine the true shape of the intersection between the structure and this inclined cutting plane.

Note: It is not necessary to show the steel band in either the plan or the elevation. Only the true shape is required.

Scale 1:100

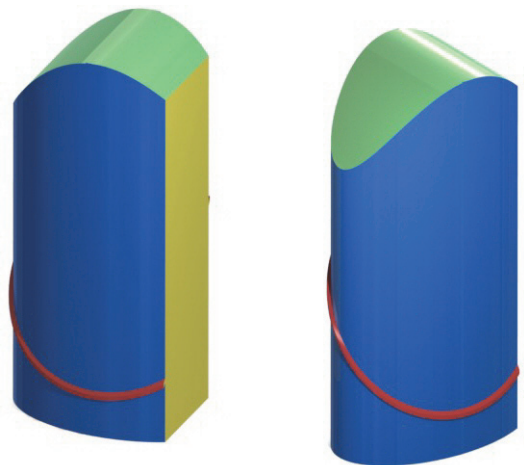
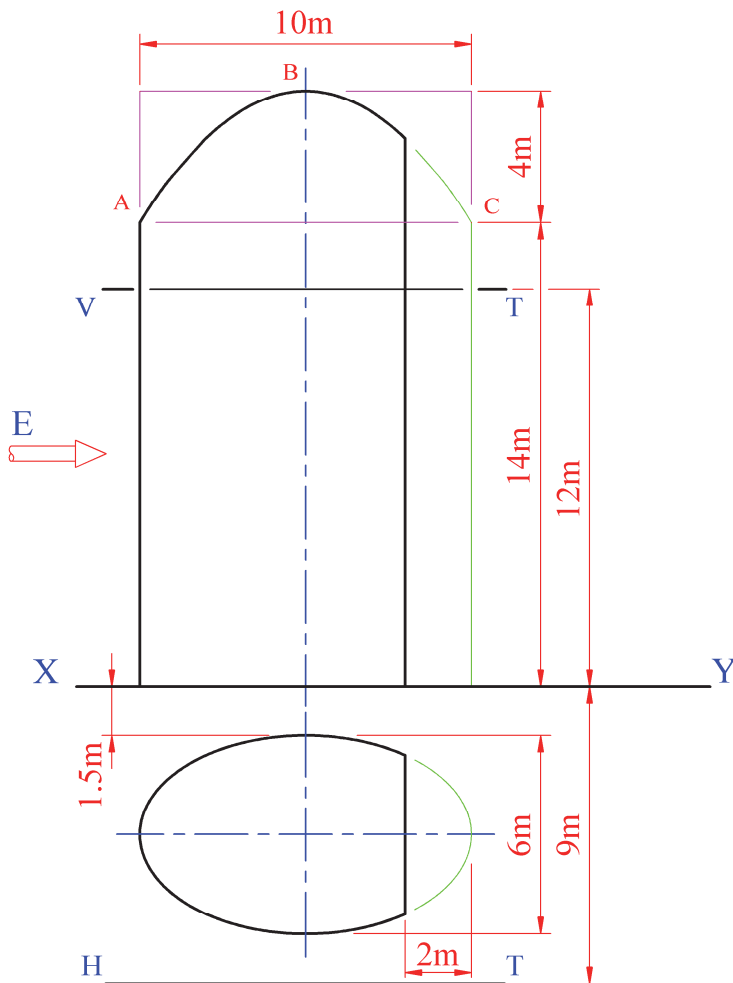


Fig. B-2

B-3 The image on the right, shows a sculpture located in Caherciveen, Co. Kerry, which celebrates the seafaring adventures of Brendan the Navigator.

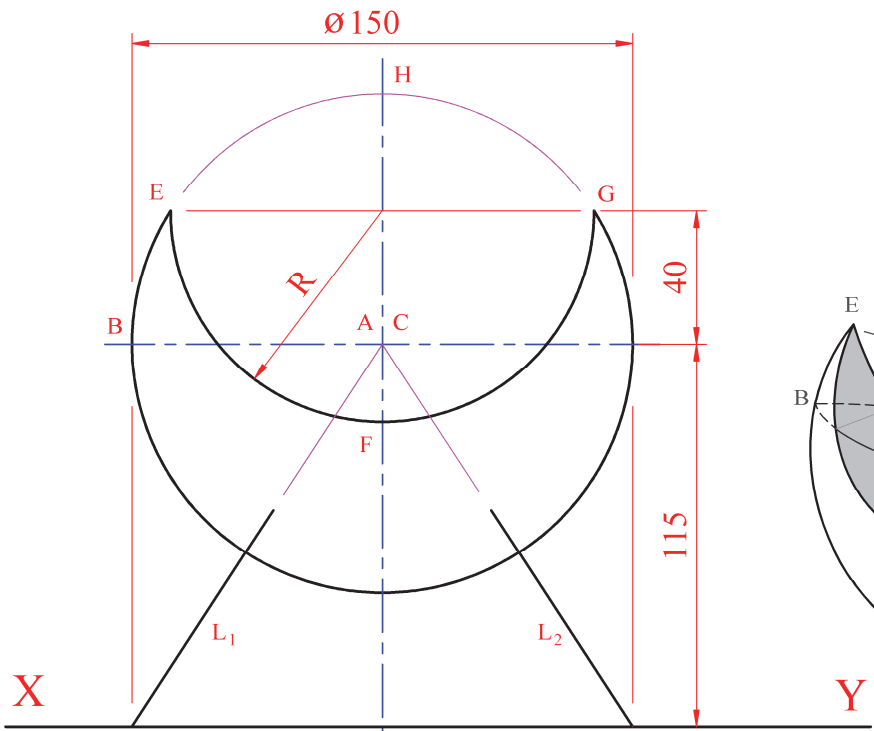


The plan and elevation of a model of part of the sculpture are shown in Fig. B-3(a) on the left below.

In the plan, curves **BCD** and **BAD** are arcs of radius 90mm as shown.

The model is generated by initially revolving the profile **ABC** about the axis **AC** through 360°. The structure is then completed by removing the top portion, **EFGH**, as shown in the elevation. This is also shown in the 3D view in Fig B-3(b) on the right below.

- (a) Draw the given elevation.
- (b) Draw the arcs **BCD** and **BAD** in the plan.
- (c) Using vertical sections, or any other method, draw the inner curve in the plan as shown.
- (d) The sculpture is supported on eight legs as shown in the image above. **L₁** and **L₂** represent two of the legs. Draw the plan and elevation of the two legs showing the constructions necessary to locate the penetration points.



Scale 1:1

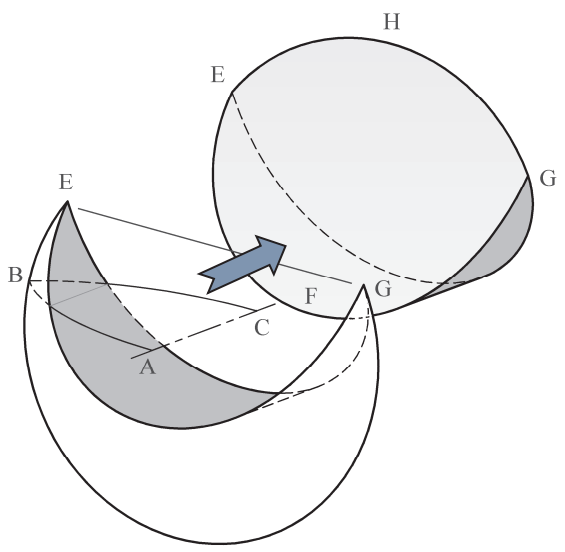


Fig. B-3(b)

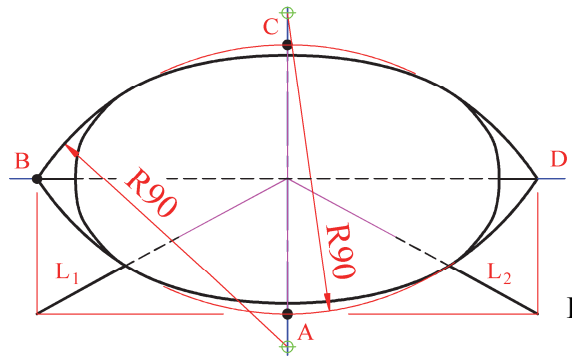


Fig. B-3(a)

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 the plan of a garden with a swimming pool, similar to that in the image on the right.

The ground contours are at **1 metre** vertical intervals.

On the map, **ABCD** is the edge of the pool and is level at an altitude of 5m.

Using side slopes of 1 in 1 for both the cuttings and the embankments, show the earthworks necessary to accommodate the eastern edge of the pool.

N.B.: Scale **1:100**

Note: The earthworks between **A** and **B** have already been completed for you.



- (b) **DE** is the edge of a sloping pathway.

At **D**, the pathway is at an altitude of 5m and it falls uniformly to an altitude of 4m at **E**.

Using the same side slopes as above, show the earthworks (cuttings) necessary to accommodate the northern edge of the pathway.

- (c) At the southern end, the floor slab of the pool is sloping and is of uniform thickness.

R and **S** are two points on the floor and their altitudes are 4m and 3m respectively.

A vertical borehole at **S** reveals the bottom surface of the pool floor slab at an altitude of 1.5m.

The strike of the floor is north 55° east, as indicated by the line **L**.

Determine the dip and the thickness of the floor slab.

- (d) There are four entrance steps to the pool as shown. The top step is level at an altitude of 4.8m.

In the space provided draw the vertical section (profile) through the steps and the floor slab along the line **PS**. Show the steps to be of equal height.

Note: The top step, **PQ**, has already been drawn for you, and is represented as **P₁Q₁** in the section view.

Structural Forms

C-2. The image on the right shows a low-energy building which is to be built in Abu Dhabi.

Its architectural design includes a series of supporting towers. Each tower is based on half a hyperboloid of revolution, with a truncated cylinder on top, as shown.

Fig. C-2 shows the plan, elevation and end view of one of the towers. A pictorial view is also given.



- Draw the given plan of the tower and project the elevation as shown.
- Project an end view of the tower as shown.
- Determine the positions of the focal point and the directrix for one branch of the hyperbola in the elevation.

Scale 1:100

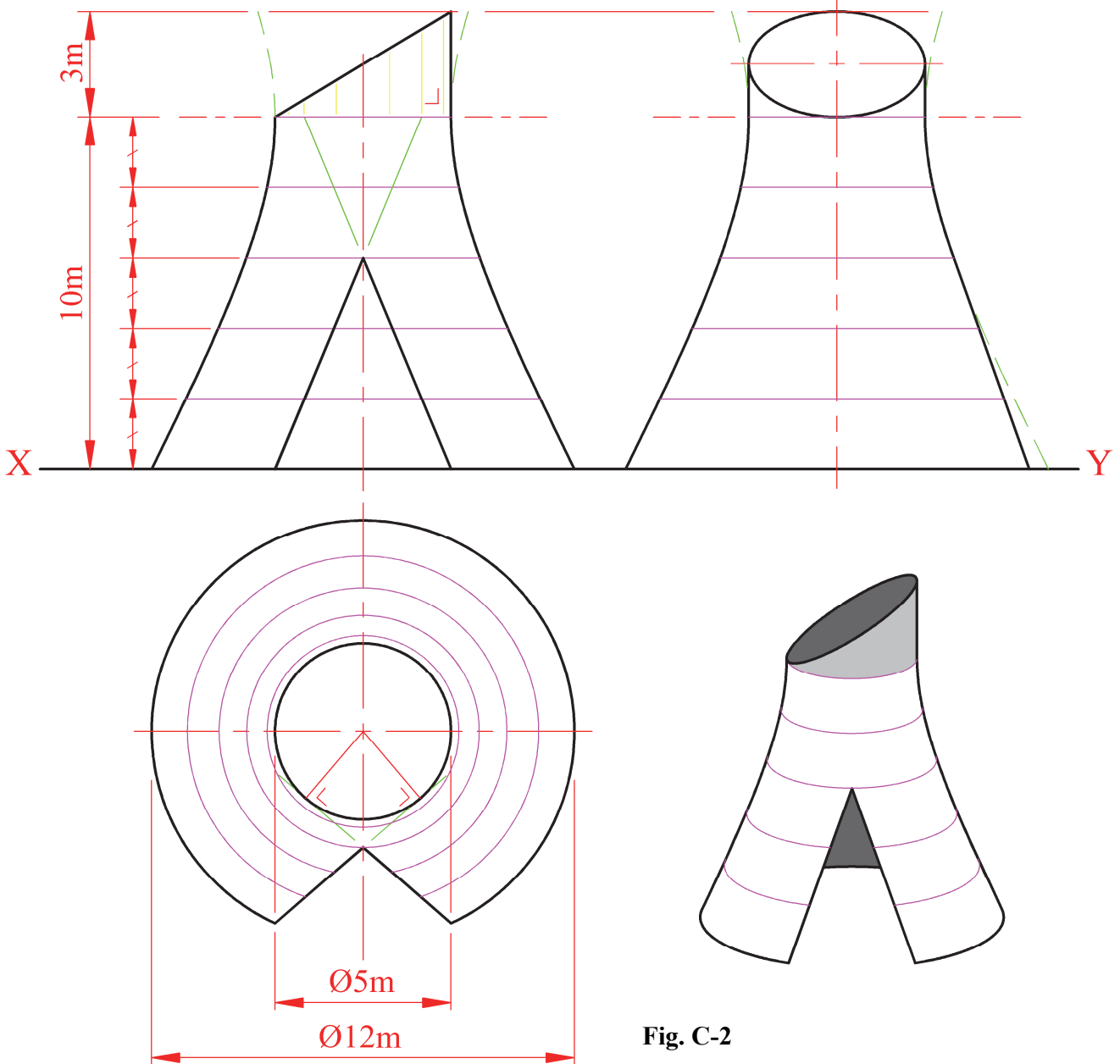


Fig. C-2

Surface Geometry

C-3. The image on the right shows a package for *jelly beans*. The package consists of a cardboard transition piece connecting a square base to a circular top. This transition is achieved using triangulation, as shown.



Fig. C-3(a) shows the plan and elevation of the package and also shows the triangular divisions. A partial surface development of the triangulated transition piece is given in Fig. C-3(b).

- (a) Draw the given plan and elevation to include the straight line elements on the curved surfaces as shown.
- (b) Draw the true shape of surface **ACE** and determine the true length of the straight line element **AF**, showing all necessary constructions.
- (c) Hence, draw the given partial surface development of the transition piece.
- (d) As a design feature, the base is indented to form a pyramid, as indicated by the hidden detail. Determine the dihedral angle between the triangular surfaces **ABC** and **ABD**.

Scale 1:1

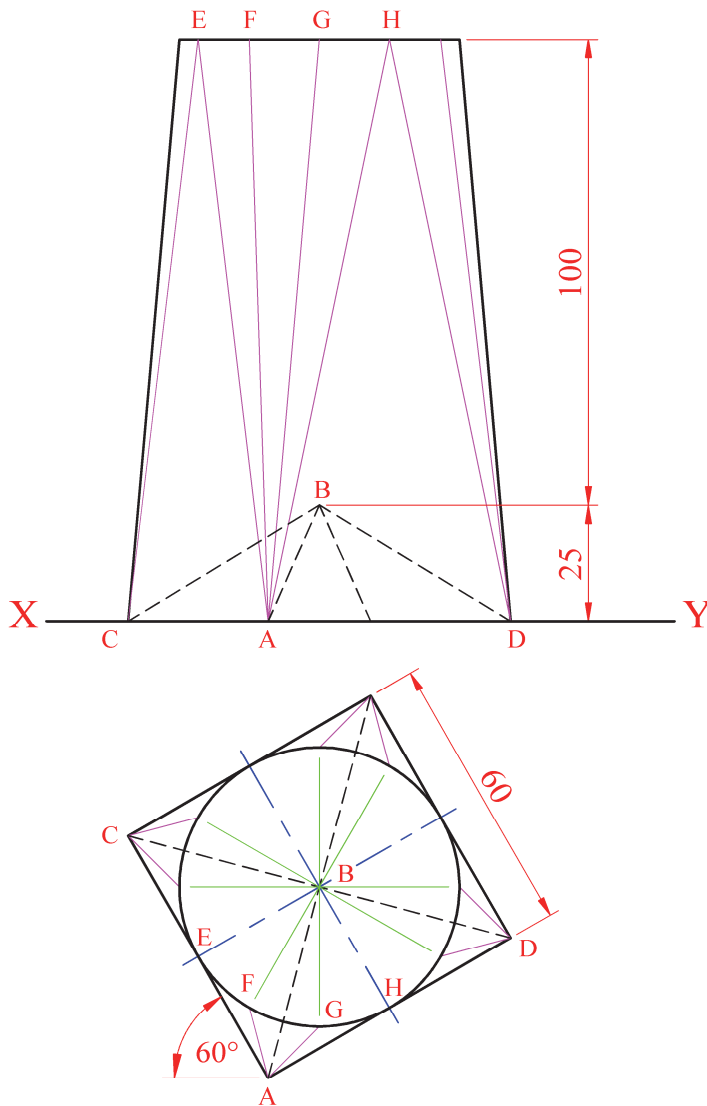


Fig. C-3(a)

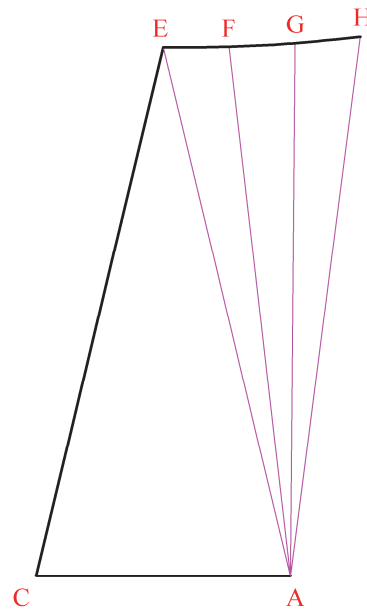


Fig. C-3(b)

Dynamic Mechanisms

- C-4. (a) The image on the right shows a sculpture located on the M4 motorway in Co. Kildare. The design is based on concentric circles and an Archimedean spiral.



A similar design is shown in Fig. C-4(a) below.

- (i) Draw an Archimedean spiral which moves from point **A** to point **B** in one anticlockwise revolution. The spiral has an initial radius of 60mm and a final radius of 96mm as shown.
- (ii) Complete the drawing of the sculpture using the given information.

Scale 1:1

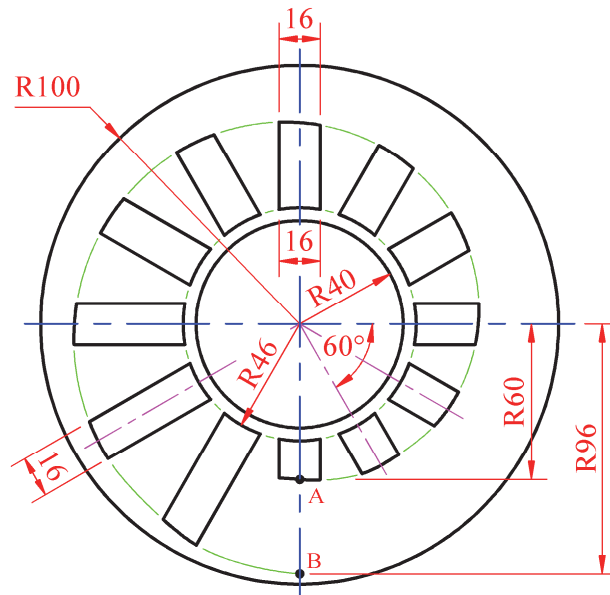


Fig. C-4(a)

- (b) The graphic on the right shows a toy tipper truck. Details of the rear of the truck are given in Fig C-4(b) below. In its initial position the truck body is tipped open as indicated. The truck body then rotates through an angle of 60° , at a constant speed, about point **A** to its horizontal position as shown.



The tailgate TT_1 pivots about point **T** and remains in a vertical position at all times.

At the same time, the truck moves forward, with the wheel **W** rolling clockwise for half of one revolution.

Draw the given outline of the truck and plot the locus of point T_1 for the combined movement.

Scale 1:1

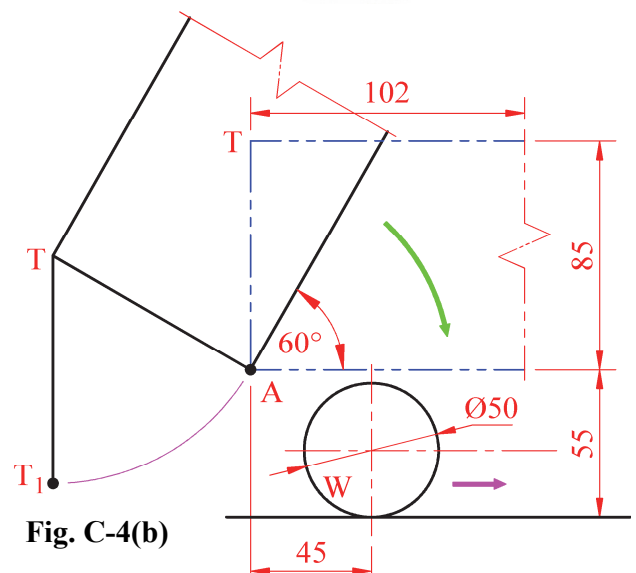


Fig. C-4(b)

Assemblies

C-5. Details of a *Can Crusher* are shown in Fig. C-5. The parts list is given below together with a partially exploded 3D graphic of the can crusher and its constituent parts.

- (a) Draw a full-size sectional elevation on **A-A**, showing the parts fully assembled, with the moving jaw in its highest position and the link plates (part 5) vertical.



(Unless otherwise stated all fillets are 6mm and chamfers 1×1mm.

Unnecessary dimensions have been removed for clarity and any omitted dimensions may be estimated.)

Note: Two *tension springs*, which are required for the device to work, are shown in the 3D graphic, but may be drawn by simplified representational convention.

- (b) Determine, and indicate on your drawing, the maximum angle of rotation of part 5 when the crusher is in use.

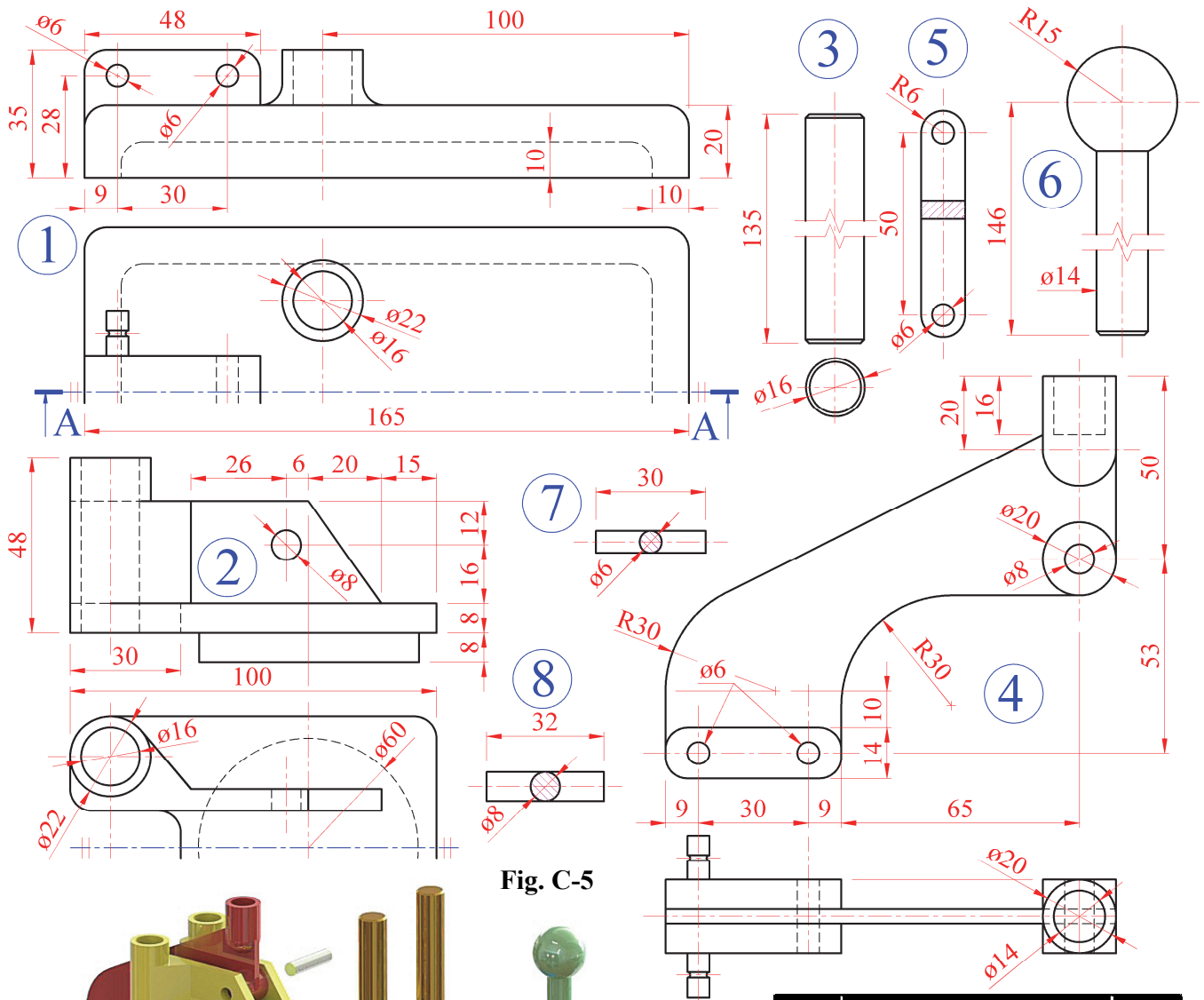
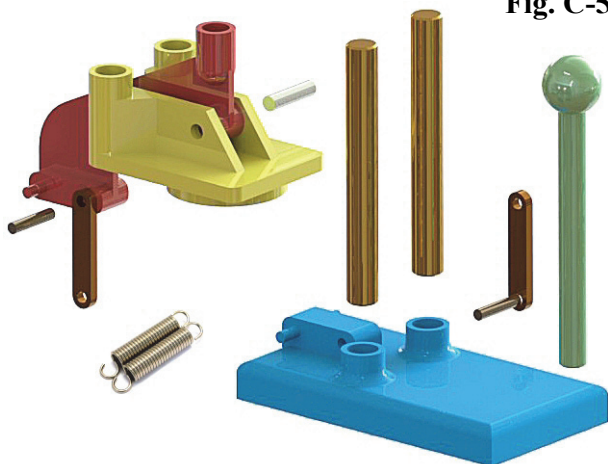


Fig. C-5



Part	Name	Qty.
1	Base	1
2	Moving Jaw	1
3	Vertical Slide Column	2
4	Hinge Plate	1
5	Link Plate	2
6	Handle	1
7	Ø6mm Link Plate Pin	2
8	Ø8mm Moving Jaw Pin	1

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