2021. M81BC

2021L562A2EL

Coimisiún na Scrúduithe Stáit
State Examinations Commission

Leaving Certificate Examination, 2021

Design & Communication Graphics

Higher Level
Sections B and C (120 marks)

Thursday, 24 June
Morning, 9:30 - 12:30

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 A3 sheet overleaf. • All questions in Section A carry **20 marks** each.
SECTION B and SECTION C	• Eight questions are presented. • Answer **any two** on drawing paper. • All questions in Section B and Section C carry **60 marks** each.

General Instructions:

- *Construction lines must be shown on all solutions.*
- *The graphics presented are not necessarily drawn to scale and must not be used for scaling purposes.*
- *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 the eight questions presented in **Section B** and **Section C** on drawing paper.

B-1. The image on the right shows a pedestrian bridge in Newport, Wales. It is based on a parabola.

Fig. B-1 shows the elevation, plan and end view of a model of the bridge. The curve **ABC** is a parabola in elevation with vertex at **B**.

A pictorial view of the bridge is also shown.

(a) Draw the given elevation and end view of the bridge.

(b) Project the given plan.

(c) Determine the true shape of the curve **ABC**.

Scale 1:1

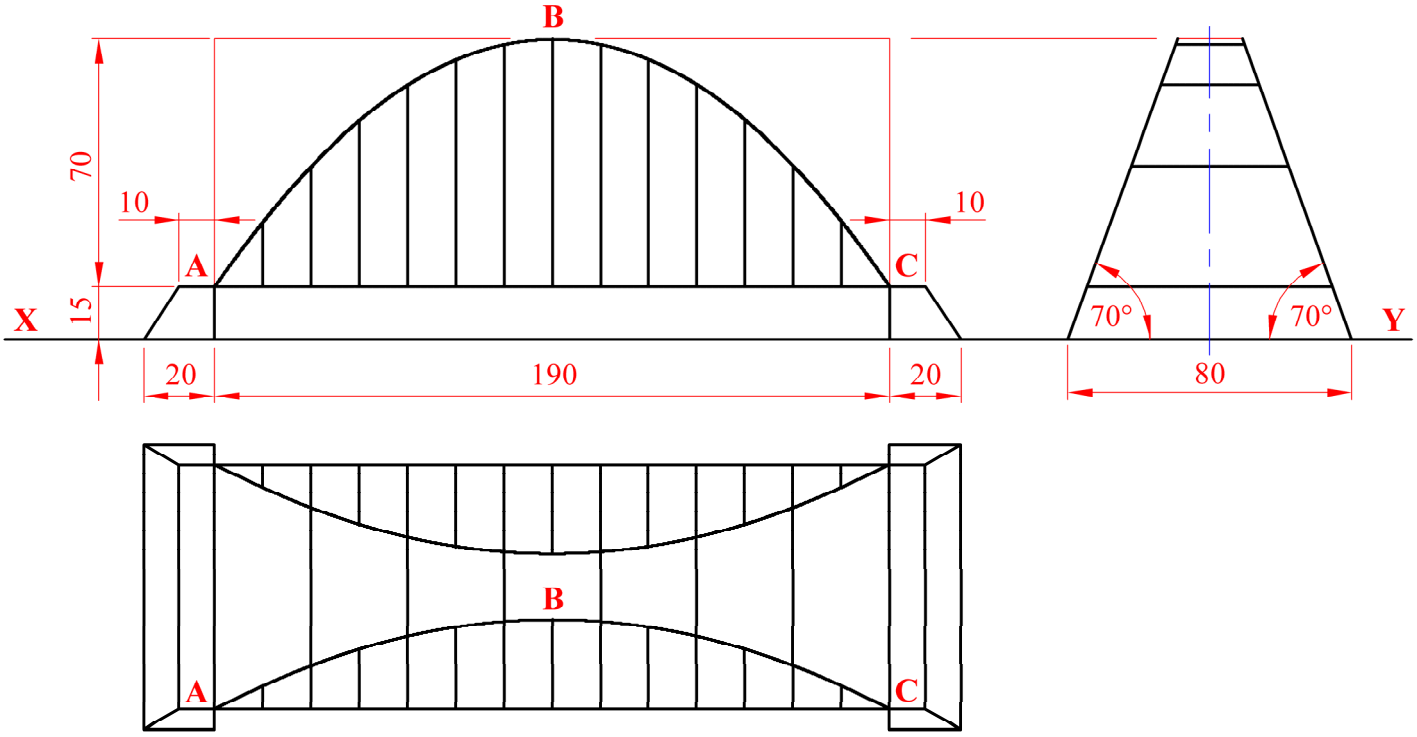
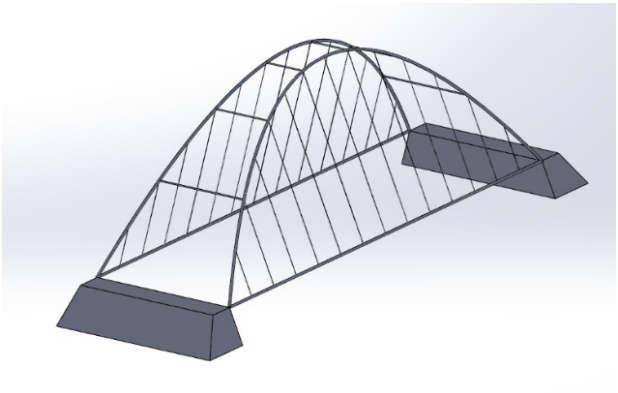


Fig. B-1



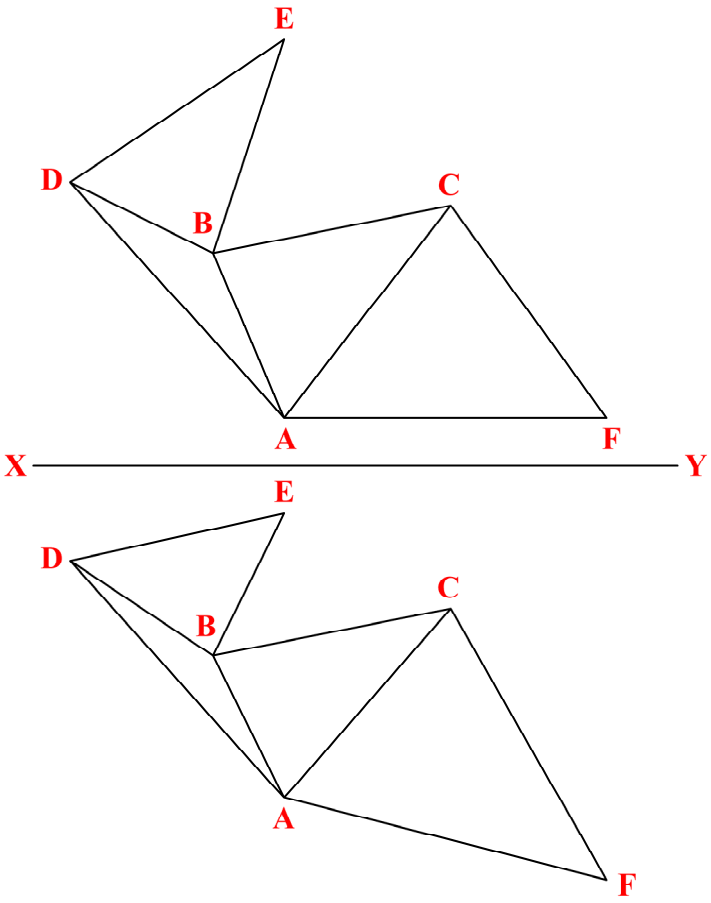
B-2 The image on the right shows a car showroom in Qatar. The building includes a series of intersecting planar triangular surfaces.

Fig. B-2 shows the plan and elevation of four intersecting triangular planes.

The horizontal and vertical coordinates for points **A**, **B**, **C**, **D**, and **E** are given.

Partial coordinates for point **F** are also given.

Scale 1:1



A:	145	---	10	---	70
B:	130	---	45	---	40
C:	180	---	55	---	30
D:	100	---	60	---	20
E:	145	---	90	---	10
F:	?	---	10	---	?

Fig. B-2

(a) Draw the given elevation and plan of the intersecting planes **ABC**, **ABD,** and **BDE**.

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

(c) A line is drawn from the point **E**. This line is parallel to the line **AC** and intersects the horizontal plane at a point **P**.

Draw the projections of the line **EP** and determine its inclination to the horizontal plane.

(d) The true lengths of the edges **AF** and **CF** of the plane **ACF** are 70mm and 80mm, respectively. Complete the projections of the triangle **ACF**.

B-3 The image on the right shows a table-tennis table.

Fig. B-3 shows an incomplete trimetric projection, using the axonometric axes method, of a similar table-tennis table. The elevation and end view are shown in their required positions.

A pictorial view of the table is also shown.

(a) Draw the axonometric axes **X**, **Y** and **Z** and the scalene triangle **abc**.

(b) Draw the elevation and end view, orientated as shown, and complete the trimetric projection.

(c) Determine the true length of the diagonal along the top surface of the table.

Scale 1:1

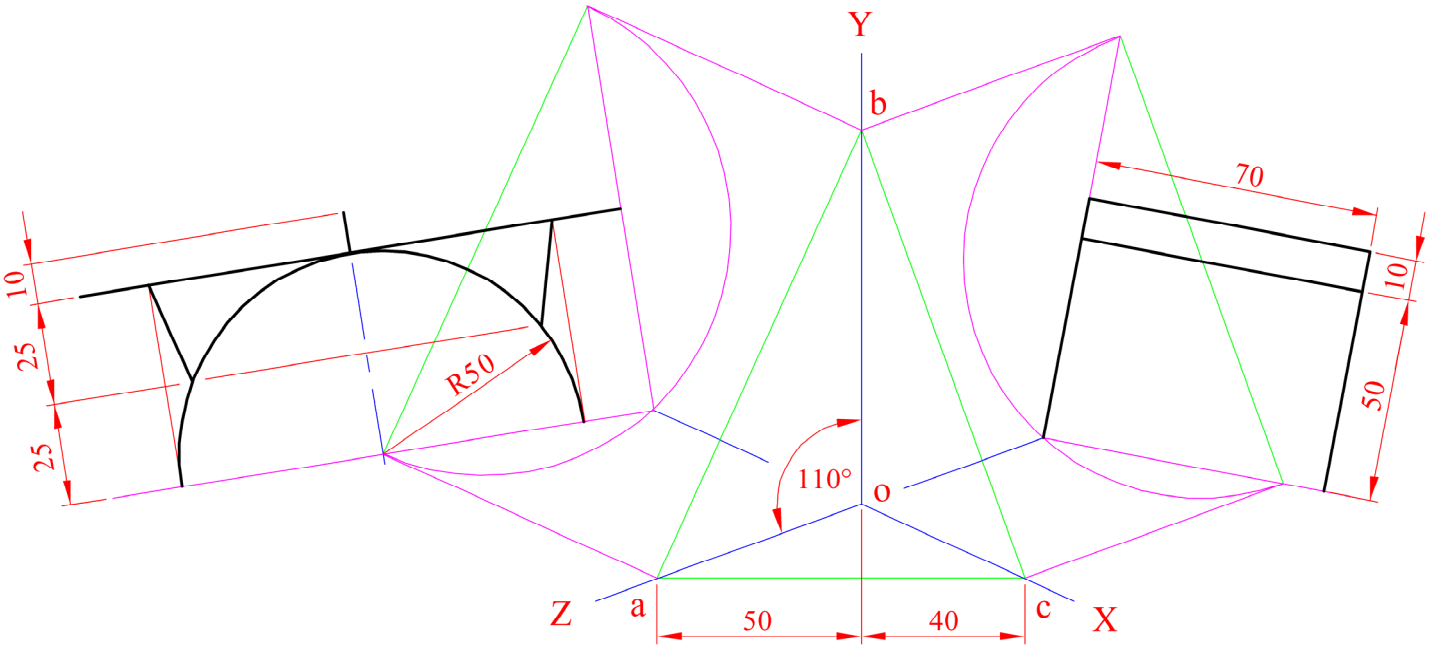
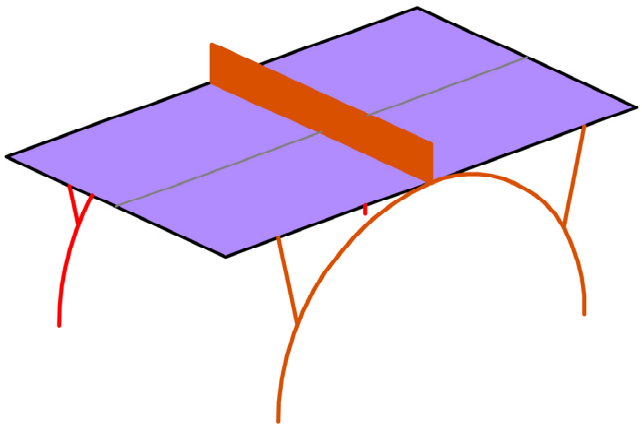


Fig. B-3



SECTION C - Applied Graphics

Answer **any two** questions from the eight questions presented in **Section B** and **Section C** 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 on the bank of a river used for kayaking.

ABCD is the edge of the river and **O** is the centre of the circular curve **AB** which forms part of the river edge.

The river has the following specifications:

- the portion of the river edge between **A** and **C** is level at an altitude of 95m
- the portion from **C** to **D** is falling uniformly to a level of 90m at **D**.

Using side slopes of 1 in 2 for the cuttings and 1 in 1.5 for the embankments, complete the earthworks necessary to accommodate the river on the northern side.

***Note**: The earthworks on the southern side have already been completed.*

(b) On a separate diagram on the map, the elevation and plan of three boreholes drawn from points **P**, **Q** and **R** are shown. They reveal the top surface of a stratum of ore at distances of 13m, 15m and 10m from **P**, **Q** and **R**, respectively.

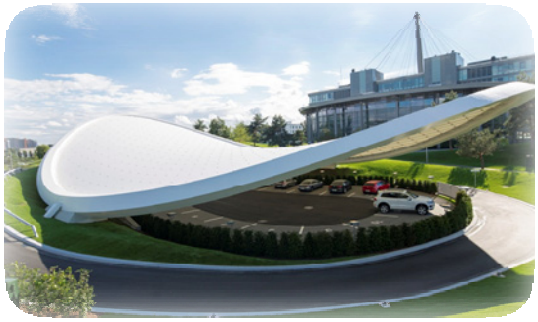
(i) Draw the elevation and plan of the top surface of the stratum.

(ii) Determine the strike and dip of the stratum.

(iii) The length of the borehole from **P** as it passes through the stratum is 15m. Determine the thickness of the stratum.

Scale 1:1000

C-2. The image on the right shows the roof of a mini-circuit for testing cars at the Volkswagen factory in Germany. The shape of the roof is based on a hyperbolic paraboloid.



The projections of the roof are shown in Fig. C-2 below. The perimeter is an ellipse in plan. The lengths of the major and minor axes are 42m and 22m respectively.

The surface of the roof is formed by extending the hyperbolic paraboloid surface **ABCD**.

(a) Draw the given plan including the elements as shown.

(b) Project the given elevation from the plan. Show clearly how to locate the point **P**.

(c) Show the curvature of the surface when intersected by a vertical cutting plane passing through points **B** and **D**.

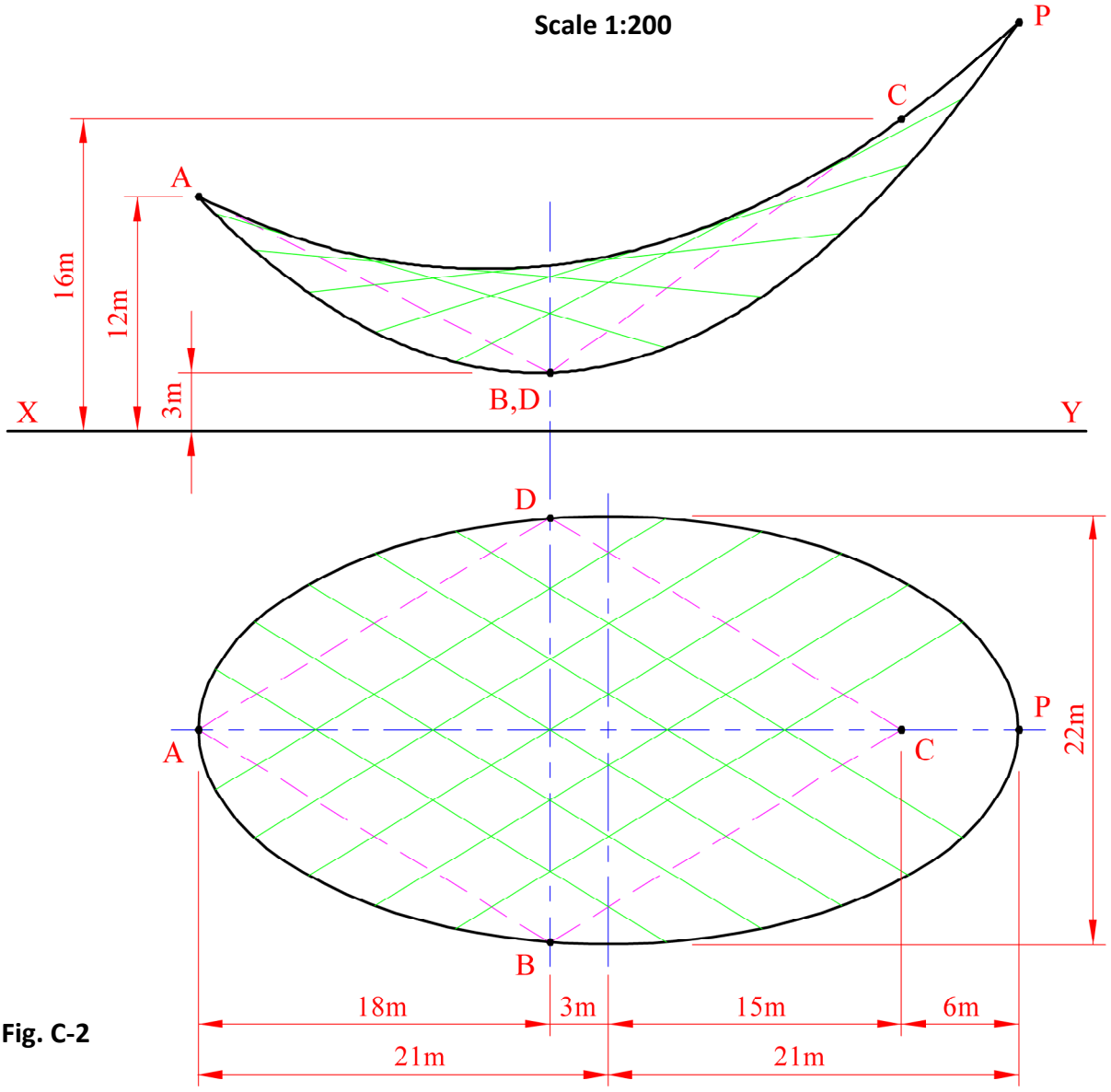


Fig. C-2

Surface Geometry

C-3. The image on the right shows a series of windscreens on an aeroplane.

Fig. C-3 shows the plan and elevation of a set of similar windscreens on a model aeroplane.

A pictorial view is also given.

(a) Draw the plan and elevation of the surfaces **A**, **B**, **C,** and **D**.

(b) Determine the dihedral angle between the surfaces **A** and **B**.

(c) Draw a one-piece surface development of the surfaces **C** and **D**.

(d) The elevation and plan of a windscreen wiper blade **PQ** are shown.

The line **PQ** is inclined at 45° to the horizontal plane. Draw the projections of the line **PQ**.

Scale 1:1

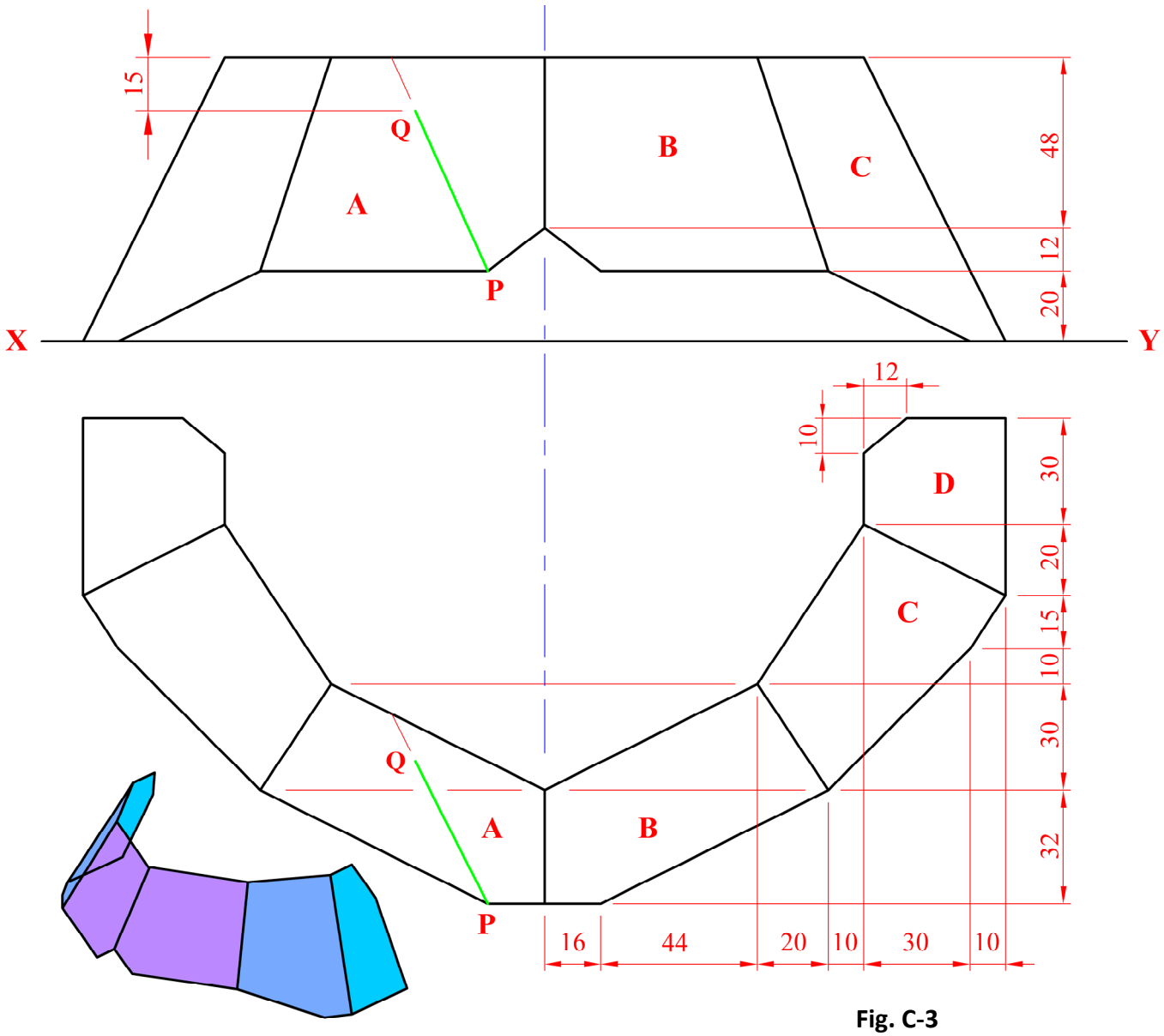


Fig. C-3

C-4. **(a)** The image shows a skip lorry. Details of the rear of the lorry are given in Fig. C-4(a) below.

The line **AB** represents the hydraulic arm which is used to load and unload the skip. Whilst unloading, the line **AB** rotates 150°, in an anticlockwise direction about **A**, at a constant speed. At the same time, **AB** extends to $\mathbf{AB_1}$ at a constant speed. The path traced by point **B** during this movement is portion of an Archimedean spiral.

(i) Draw the given outline of the lorry and plot the portion of the Archimedean spiral between **B** and $\mathbf{B_1}$. The spiral has an initial radius of 90mm at **AB** and a radius of 122mm at $\mathbf{AB_1}$.

(ii) Plot the locus of point **C**, on the skip, for the combined movement until the base of the skip rests on the ground $\mathbf{LL_1}$.
The base of the skip remains horizontal throughout this movement.

Scale 1:1

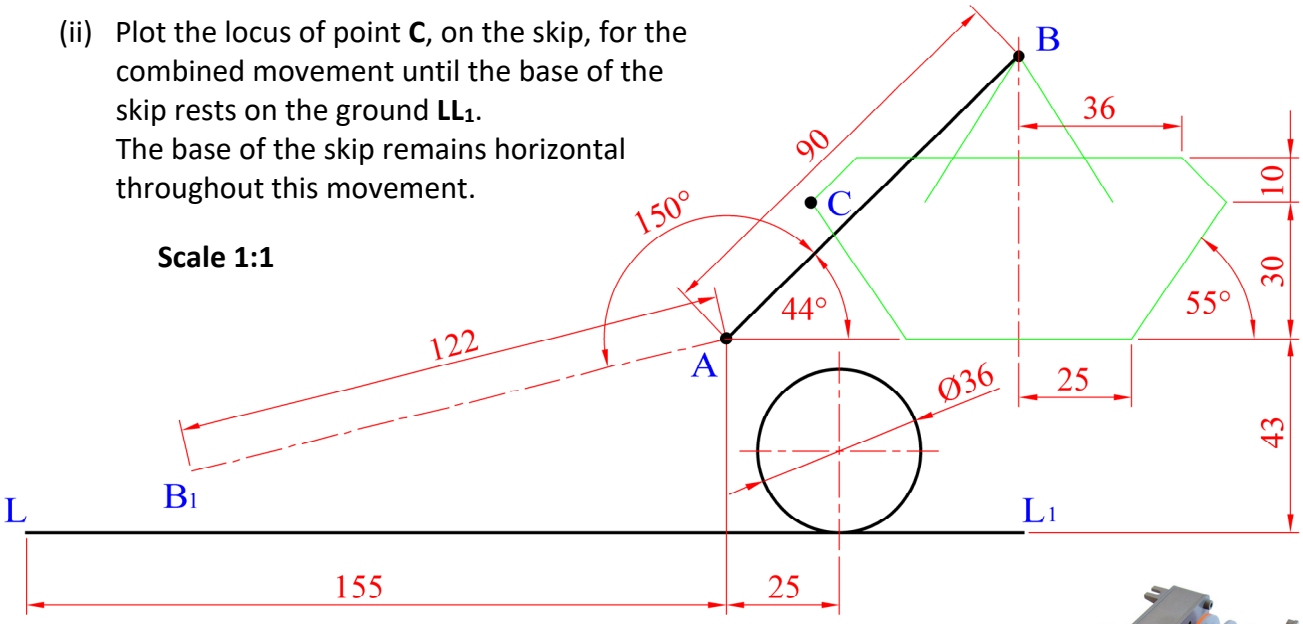
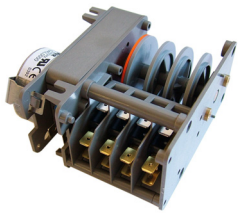


Fig. C-4(a)

(b) The graphic on the right shows a cam timer. This device is used in the automation industry to control repetitive operations.



A series of cams, arranged on a shaft, are driven by a motor.

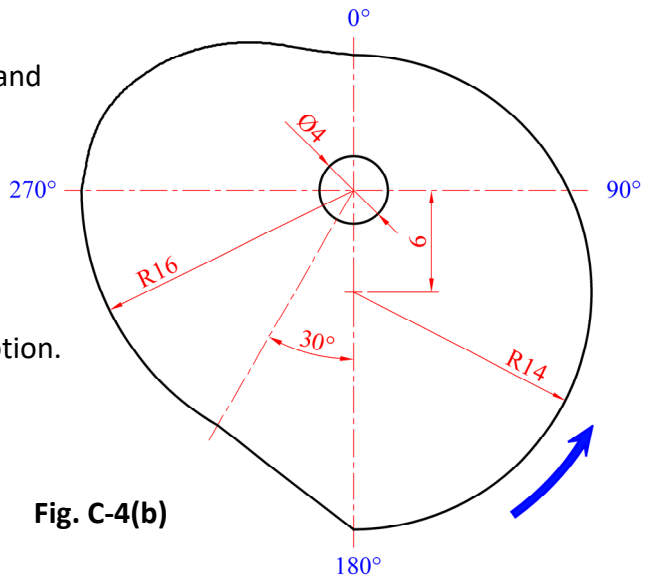
Fig C-4(b) shows the details of one such cam.

The cam rotates in an anti-clockwise direction and has an inline knife-edge follower.

Draw the cam profile and the displacement diagram given the following data:

- 0° to 180° Rise as shown in the diagram
- 180° to 270° Fall as shown in the diagram
- 270° to 360° Fall with simple harmonic motion.

(In the displacement diagram, use a distance of 15mm to represent each 30° interval.)

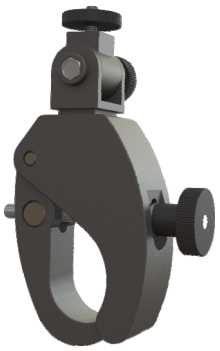


Scale 5:1 **Fig. C-4(b)**

C-5. The image on the right shows a GoPro clamp for the handlebars of a bicycle.
The details of a similar clamp are given in Fig. C-5 below.
The parts list is also given in a table.

Draw a sectional elevation on **A-A**, with the parts fully assembled.
Clearly show all points of contact.

(Unless otherwise stated, chamfers are 1×1mm.
Any omitted dimensions may be estimated.)



Scale 1:1

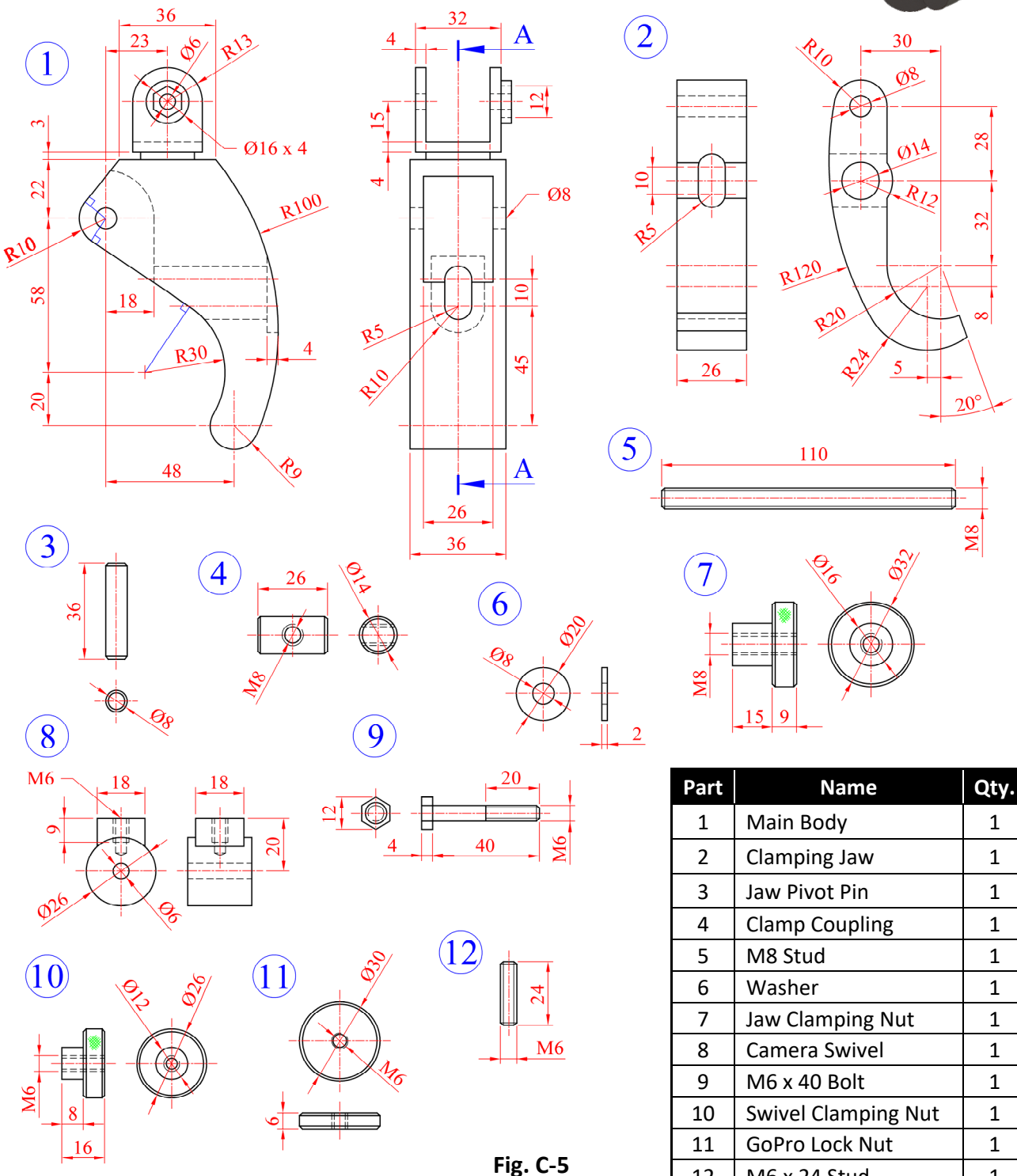


Fig. C-5

Part	Name	Qty.
1	Main Body	1
2	Clamping Jaw	1
3	Jaw Pivot Pin	1
4	Clamp Coupling	1
5	M8 Stud	1
6	Washer	1
7	Jaw Clamping Nut	1
8	Camera Swivel	1
9	M6 x 40 Bolt	1
10	Swivel Clamping Nut	1
11	GoPro Lock Nut	1
12	M6 x 24 Stud	1

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