



Leaving Certificate Examination, 2015

Design & Communication Graphics
Higher Level

Sections B and C (180 marks)

Wednesday, 17 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.

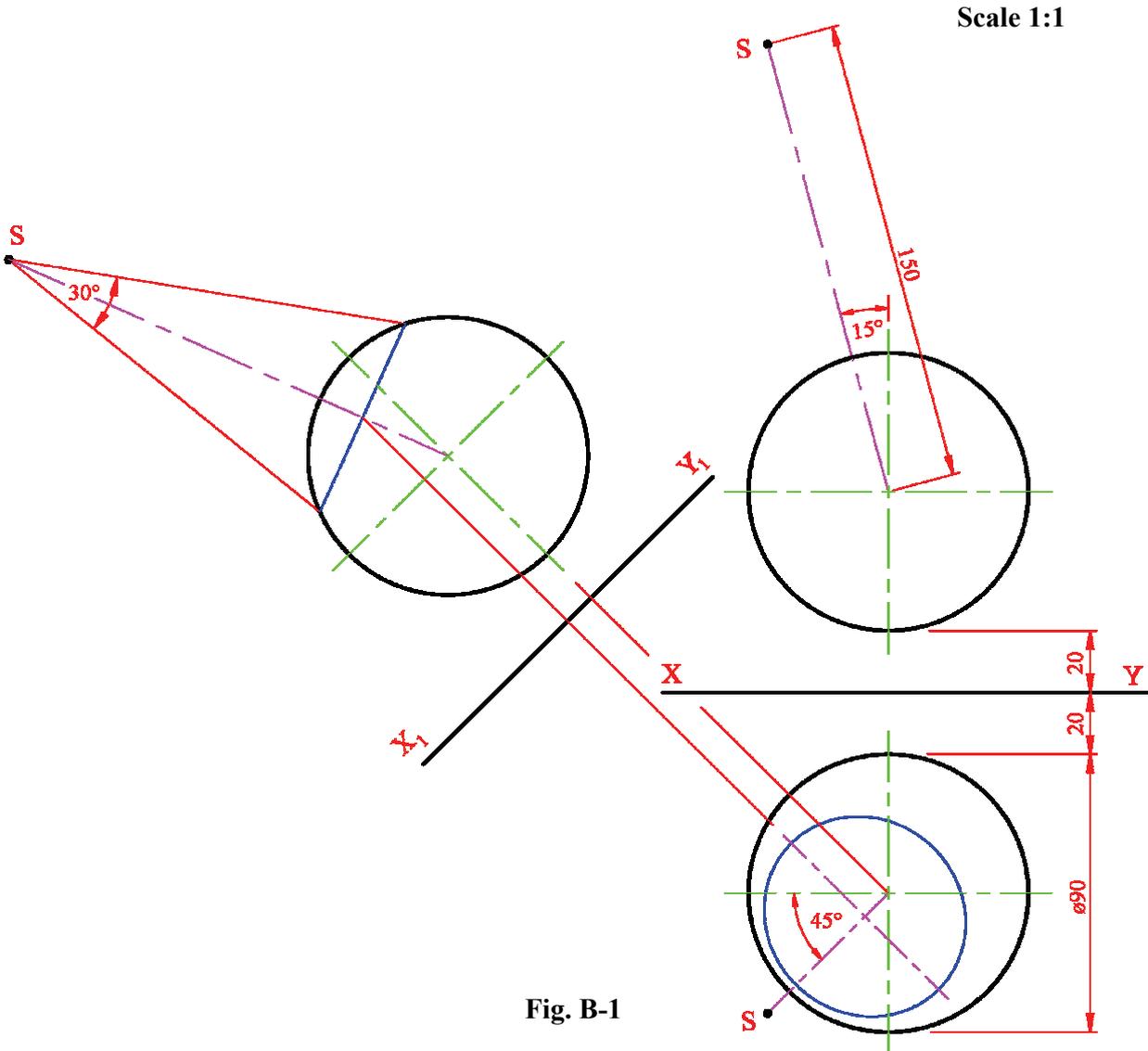
B-1. Thousands of satellites, such as the one shown in the image on the right, are in orbit above the earth. They are used for a variety of purposes including communications and weather research.



Fig. B-1 below shows the plan, elevation and an auxiliary view of a model of the earth. The position of a satellite **S**, which is used to beam television signals back to earth, is also shown.

The satellite is in a fixed orbit above the earth and has a “*beam angle*” of 30° , aimed directly at the earth, as shown in the auxiliary view. The “*beam angle*” limits the transmission to an area with a circular outline on the surface of the earth, which is shown as an ellipse in plan.

- (a) Draw the given projections, clearly showing how the elliptical transmission area is located in plan.
- (b) Draw the outline of the transmission area in the elevation, including hidden detail.



B-2. The 3D graphic below shows an exterior light. In the cap of the light, a regular hexagonal prism penetrates a square based pyramid.

Fig. B-2 below shows the incomplete isometric projection (using the axonometric axes method) of the two solids which penetrate each other. The plan and incomplete elevation are shown in their required positions. A pictorial view of the intersecting solids is also shown.

- (a) Draw the axonometric axes **X**, **Y** and **Z** and the equilateral triangle **abc**, which has a side of 110mm.
- (b) Draw the plan and the incomplete elevation, orientated as shown.
- (c) Complete the drawing showing all lines of interpenetration in the axonometric projection and in the elevation.

Note: *It is not necessary to include hidden detail.*

Scale 1:1

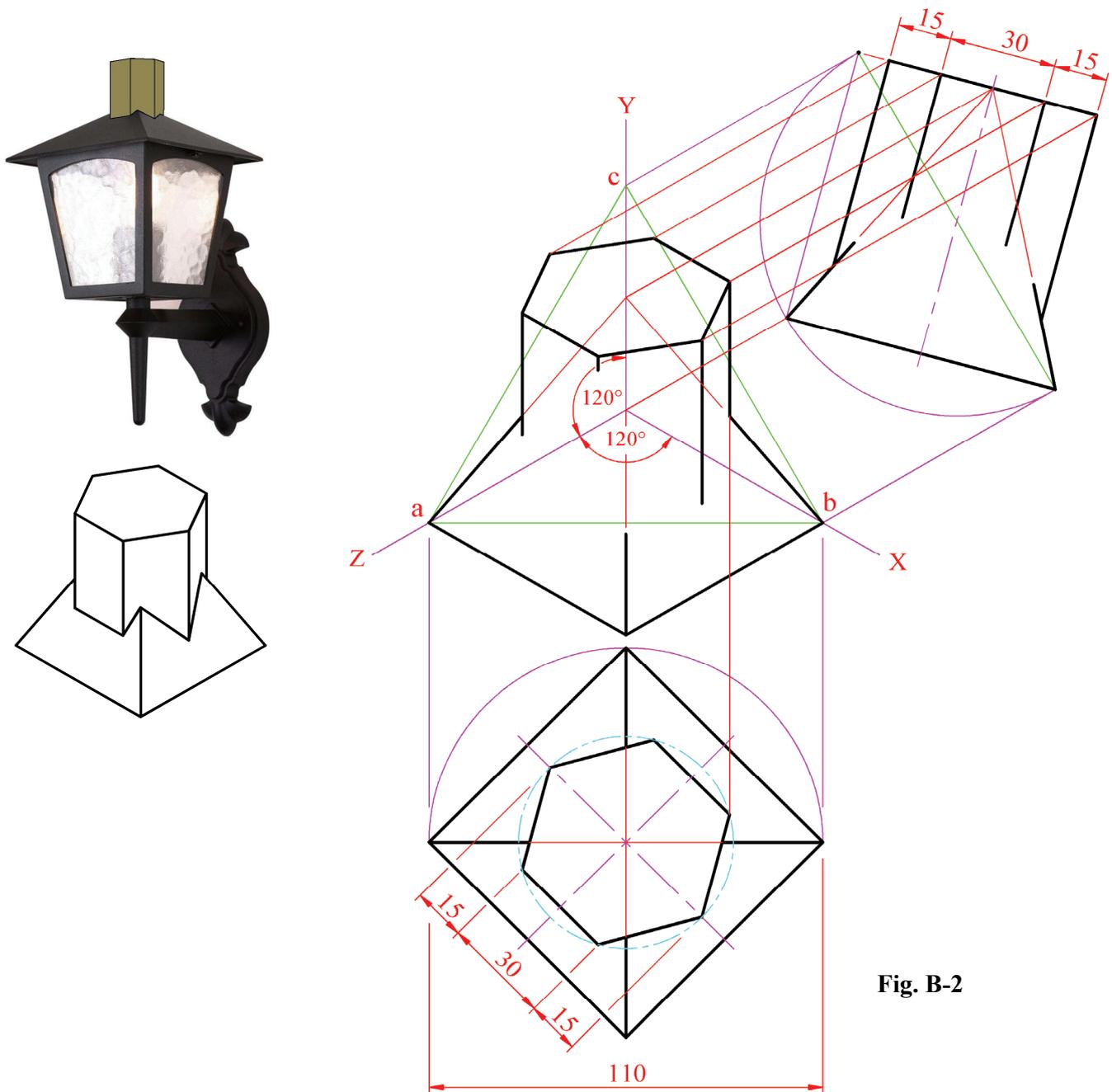


Fig. B-2

B-3 Fig. B-3 shows the outline plan and elevation of a greenhouse, based on the graphic on the right.

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 4.5m from corner **A**
- The picture plane is touching corner **A**
- The horizon line is 3.25m above the ground line
- The door and window are in their closed positions.



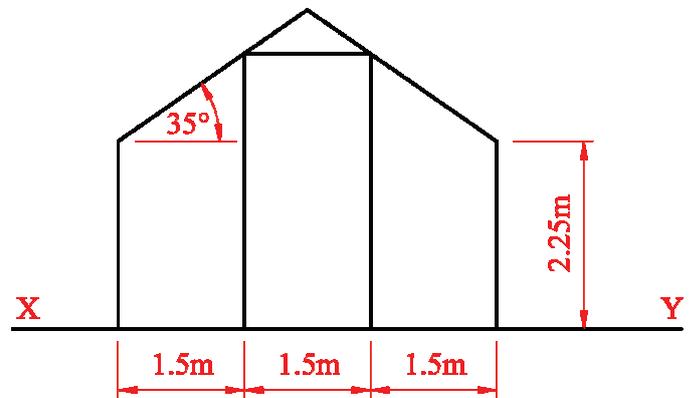
Use auxiliary vanishing points where appropriate.

Note: *It is not necessary to include hidden detail.*

(b) The door is then hinged open, as shown in the pictorial view, until it is parallel to the picture plane.

On your perspective drawing, show the door in this position.

(c) On your perspective drawing, show the roof window when it has been opened through an angle of 70°.



Scale 1:50

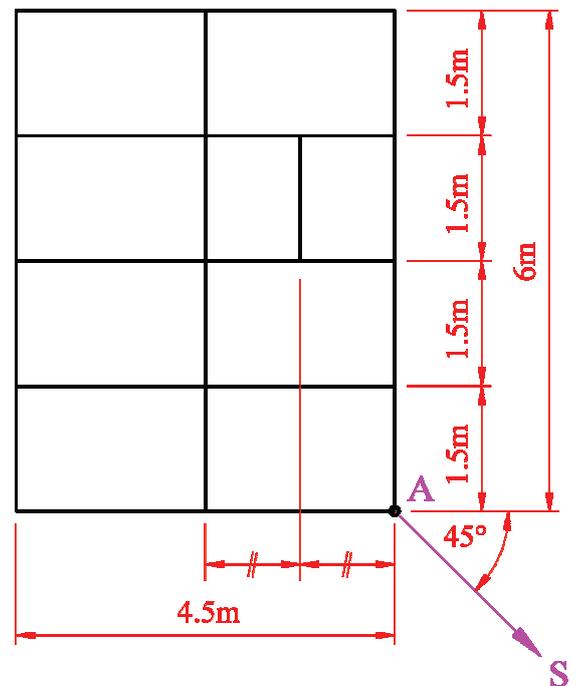
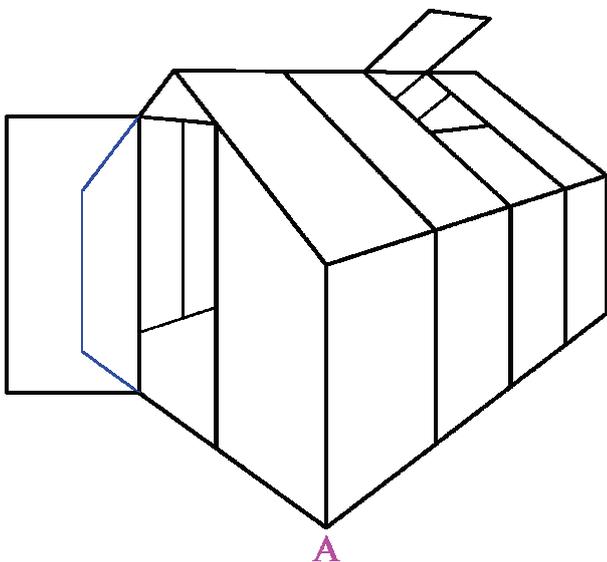


Fig. B-3

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 5 metre vertical intervals from an area of hilly countryside, similar to that shown below.



ABC is the centreline of a proposed roadway and **DEFG** is a proposed car park.

The roadway **ABC** has the following specifications:

- the section between **A** and **B** is level at an altitude of 65m;
- the section from **B** to **C** is rising uniformly to a level of 70m at **C**;
- the sides **DE** and **GF** of the car park are level.

Using side slopes of 1 in 1 for the cuttings and 1 in 1.5 for the embankments, complete the earthworks necessary to accommodate both the roadway between **A** and **B** and the car park on the northern and eastern sides.

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

- (b) On the map, vertical boreholes at points **P**, **Q** and **R** reveal the top surface of a stratum of ore at altitudes of 30m, 35m and 45m respectively.

In the space provided at the top of the map, draw the elevation of this triangular portion of the top surface of the stratum and determine its strike and dip.

- (c) A lake is located in the area marked **L** in the South East corner of the map. The surface of the lake is at an altitude of 50m. The line **ST** represents the centreline of an overflow pipe from the lake. The pipe travels from the point **S**, at an altitude of 50m, to a manhole located at the point **T**. The pipe falls uniformly at an angle of 10° .

Determine, and indicate in metres, the depth of the pipe vertically below the ground at point **T**.

Scale 1:1000

Structural Forms

C-2. The graphic on the right shows a pack of potato crisps. These potato crisps have a distinctive surface shape, which is based on a hyperbolic paraboloid.



The projections of one of the crisps are shown in Fig. C-2 below.

The perimeter is an ellipse in plan. The surface of the crisp is formed by extending the hyperbolic paraboloid surface **ABCD**.

- (a) Draw the given plan, using the same number of elements in each direction on the surface of the crisp as shown.
- (b) Project the given elevation from the plan.
- (c) Show the curvature of the surface when intersected by a vertical cutting plane passing through points **B** and **D**.
- (d) Draw the plan and elevation of the shortest distance between the two skew lines **AB** and **CD**.

Scale 2:1 (enlarged scale)

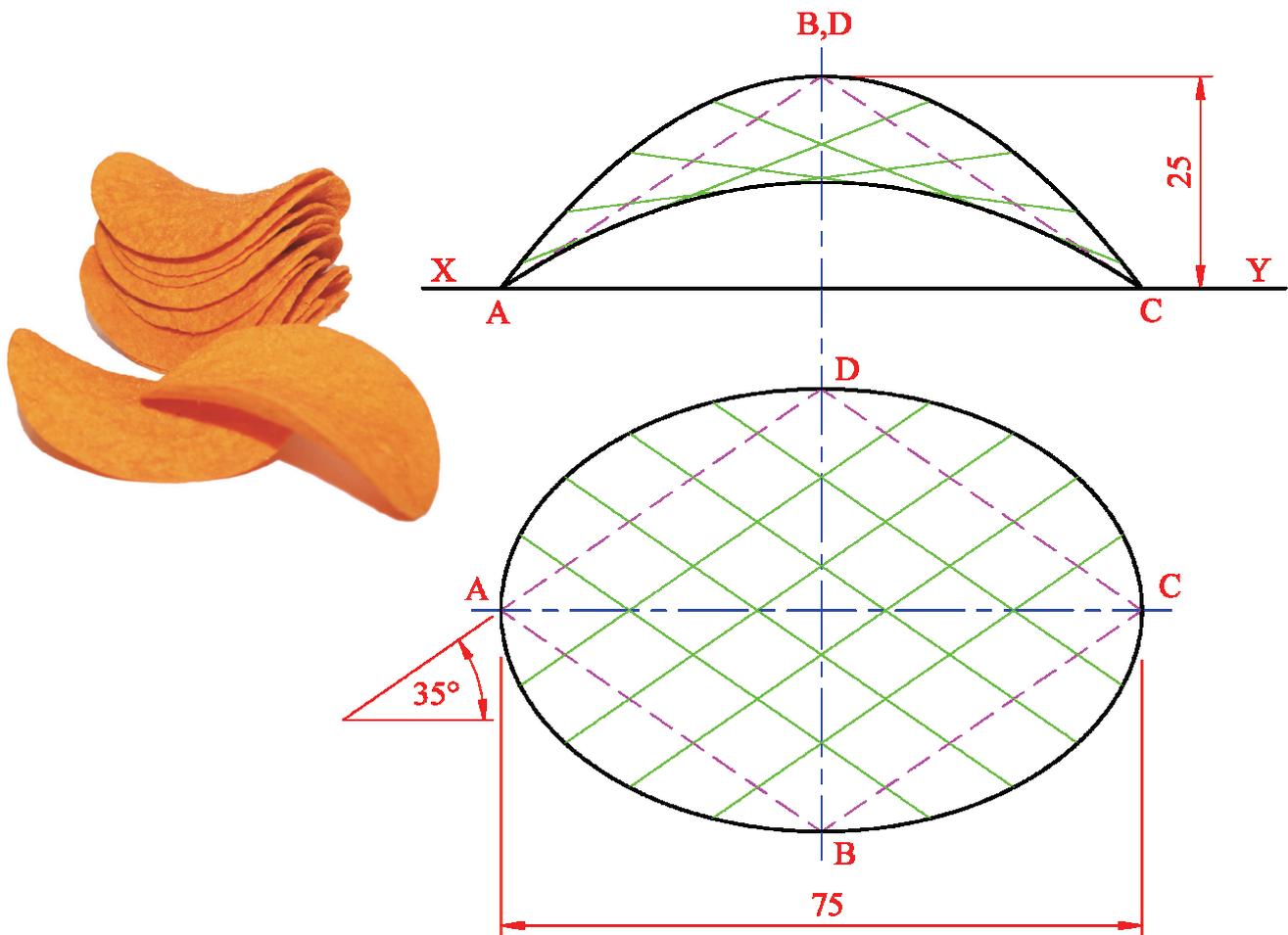


Fig. C-2

Surface Geometry

C-3. The graphic on the right shows a modern Irish building structure.

Fig. C-3 below shows the plan and elevation (excluding hidden detail) of the structure. The outline of the building is square in plan.



- (a) Draw the given plan and elevation of the structure.
- (b) Determine the dihedral angle between the surfaces **A** and **B**.
- (c) Draw the true shape of surface **C** and hence determine the radius of the largest circle that can be contained within the surface.
- (d) (i) Determine the pitch of surface **A**.
- (ii) A lightning conductor is to be fitted to the building. The conductor cable is to run from the apex of the building, along the outer edges of surface **A**, through point **P** and down to the ground at **Q**.

Determine and indicate, in metres, the minimum length of cable required.

Scale 1:200

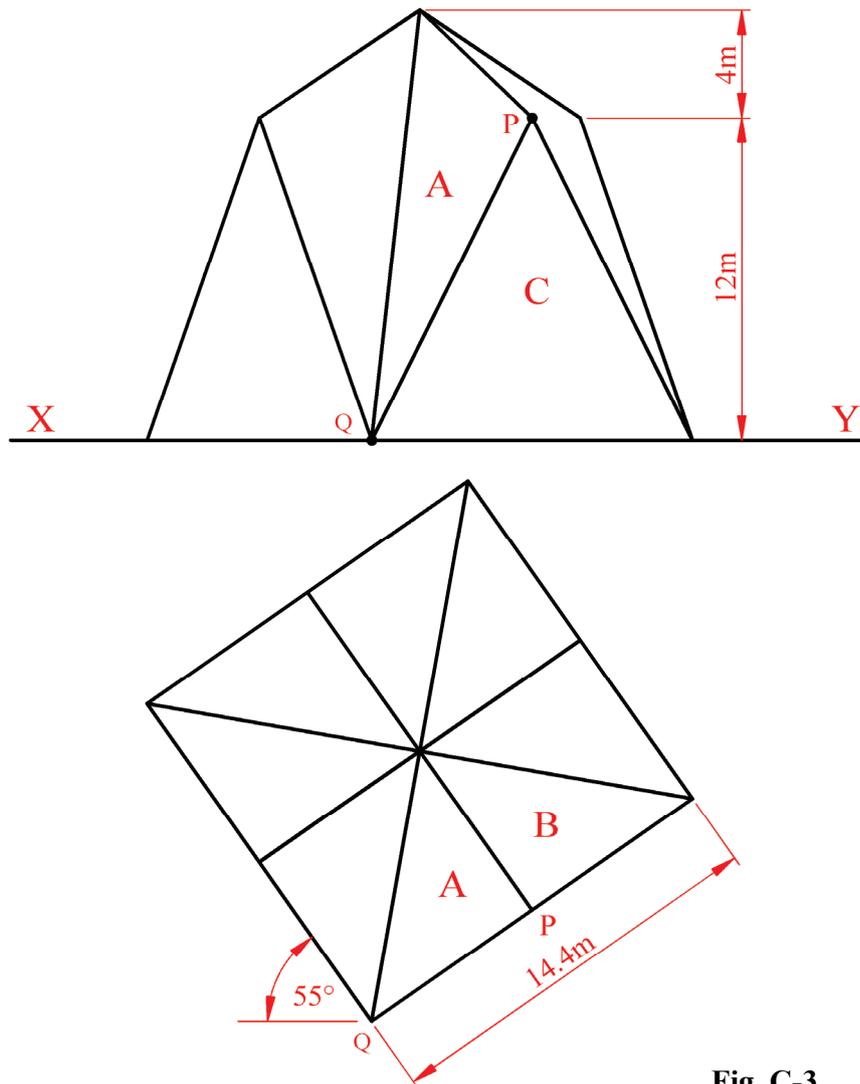


Fig. C-3

Dynamic Mechanisms

C-4. (a) The image on the right shows a machine from the popular TV game show “Tipping Point”.

The machine is similar to those found in amusement centres. The forward and backward movement of the top shelf causes counters to fall from the bottom shelf. In order to achieve this shelf movement, a link mechanism, which will produce linear motion, is used.

Such a link mechanism is shown in Fig. C-4(a) below.

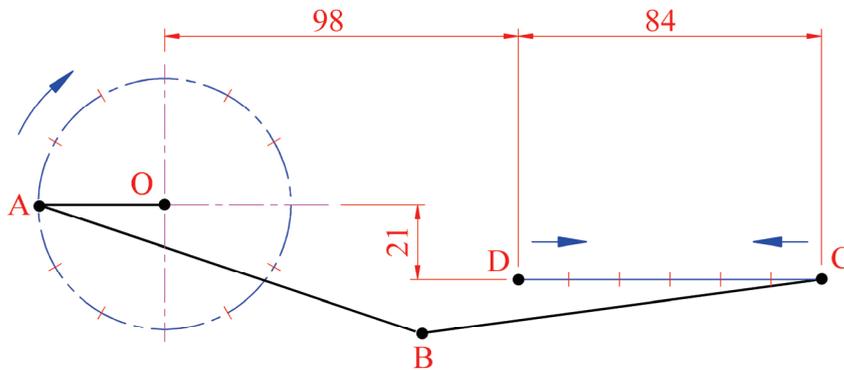
In the mechanism, crank **OA** rotates at a constant speed in a clockwise direction about point **O**. Joints **A** and **B** are pin-joints.

End **C** slides from **C** to **D** and back to **C** at a constant speed during one revolution of the crank.

Plot the locus of point **B** for one full revolution of the crank **OA**.



Scale 1:1



OA = 35mm
AB = 112 mm
BC = 112 mm

Fig. C-4(a)

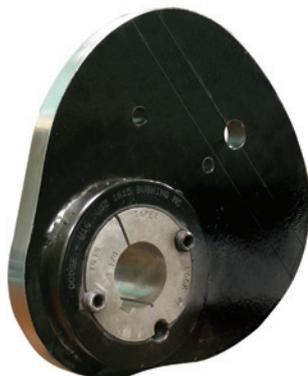
(b) The 3D graphic below shows a radial plate cam.

Fig C-4(b) below shows the details of a similar cam. The nearest approach of the in-line knife edge follower to the cam centre is 42mm. The cam rotates in a clockwise direction and has a $\varnothing 20\text{mm}$ camshaft.

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

- 0° to 180° Rise 54mm with uniform acceleration and retardation
- 180° to 240° Dwell
- 240° to 360° Return to initial position as shown in the diagram.

(In the displacement diagram, use a distance of 12mm to represent each 30° interval.)



Scale 1:1

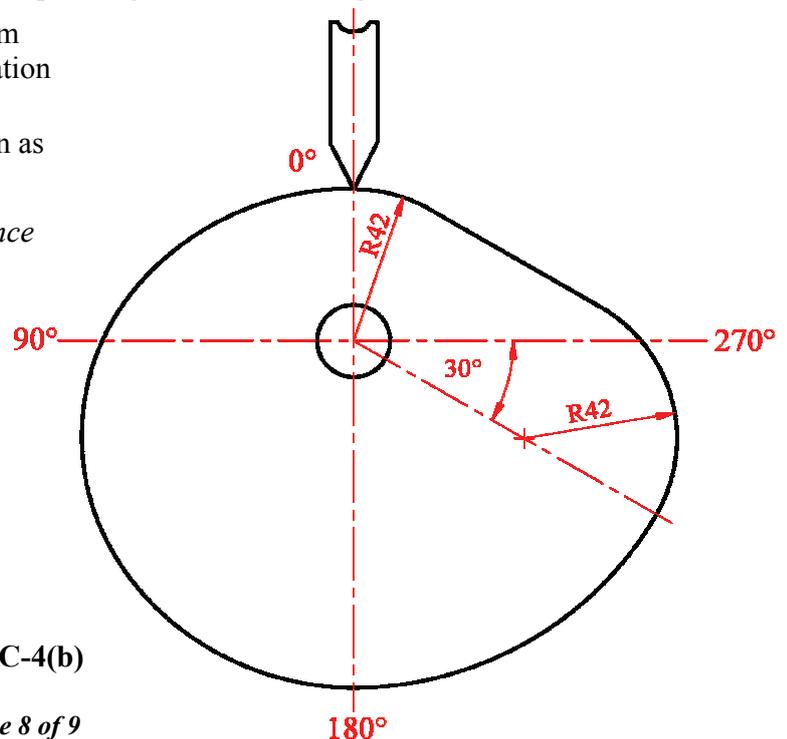


Fig. C-4(b)

Assemblies

C-5. (a) Details of a *Bench Mounted Nutcracker* are shown in Fig. C-5. The parts list is given below and a 3D Graphic of the individual parts is also shown. Draw a full size sectional elevation on A-A, showing the parts fully assembled, with the handle in the vertical position and the moving jaw at its highest position. (Unless otherwise stated all fillets are 6mm and any omitted dimensions may be estimated.)

Note: Four return springs, which are required for the device to work, are shown in the 3D graphic, but it is **not necessary** to include these in your drawing.

(b) Determine, and indicate on your drawing, the shortest vertical distance between parts 1 and 2 when the handle rotates through 45° in a clockwise direction.

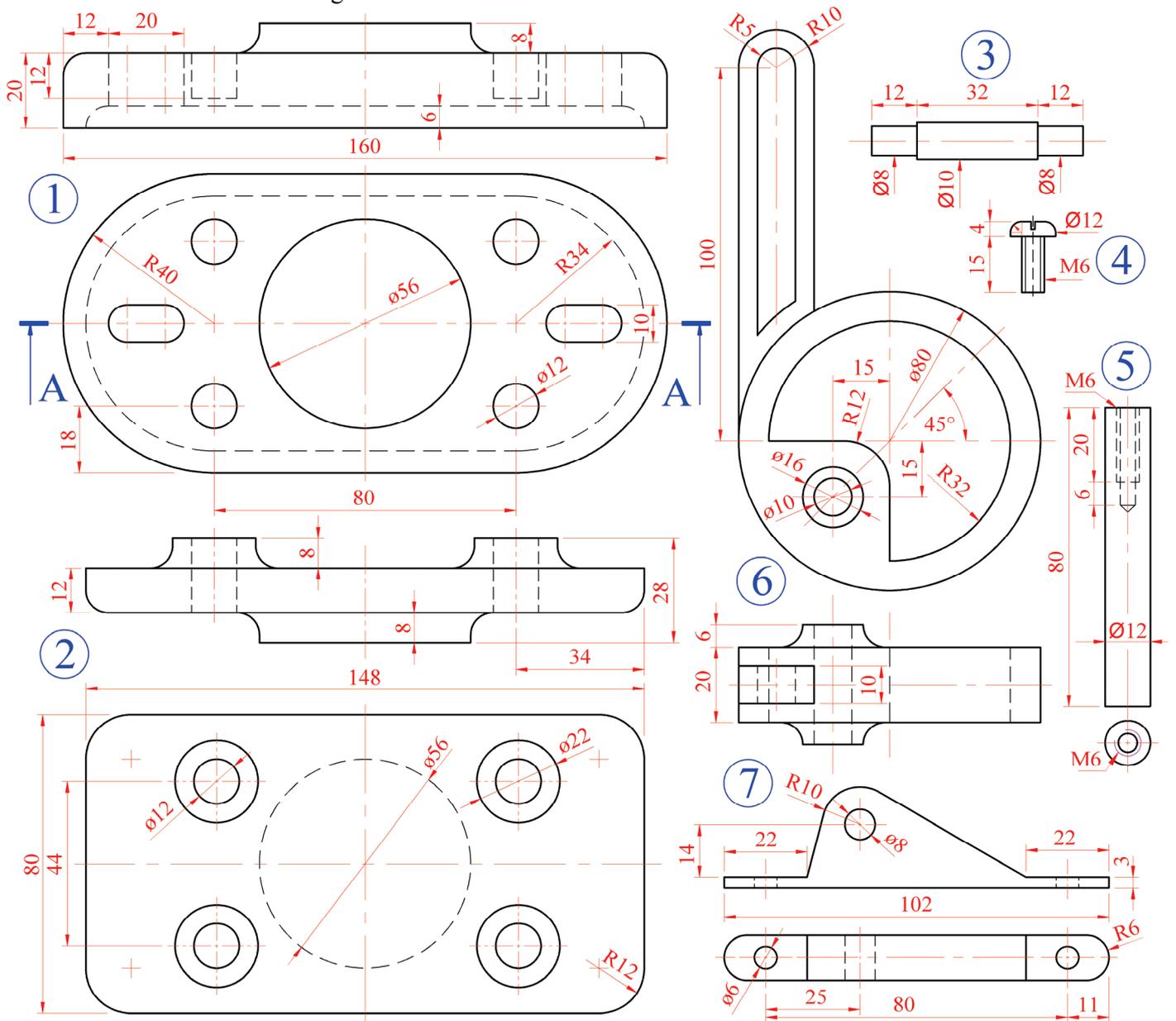


Fig. C-5

Part	Name	Qty.
1	Base	1
2	Moving Jaw	1
3	Spindle	1
4	Pan Head Screw	4
5	Vertical Slide Rod (Press fit to base)	4
6	Off-centre Circular Cam Handle	1
7	Spindle Mount	2

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