MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

UNIVERSITY OF MALTA, MSIDA

MATRICULATION EXAMINATION
INTERMEDIATE LEVEL
SEPTEMBER 2017

SUBJECT:	ENGINEERING DRAWING AND GRAPHICAL COMMUNICATION
DATE:	1st September 2017
TIME:	9:00 a.m. to 12:05 p.m.

Directions to Candidates

Write your index number where indicated at the top of all drawing sheets.

Only scientific calculators may be used. Programmable calculators are **not** allowed.

Unless otherwise stated:

a. B.S. or equivalent (ISO) recommendations should be adopted throughout your answers;
b. all dimensions are in millimetres, unless otherwise stated;
c. all answers are to be accurately drawn with instruments;
d. all construction lines must be left in each solution;
e. drawing aids may be used.

Dimensions not given should be estimated.

Careful layout and presentation are important.

Marks will be awarded for accuracy, clarity and appropriateness of constructions.

Colour/shading may be used where appropriate.

Section A: Attempt any **FOUR** questions from five.

Section B: Attempt any **ONE** question from two.

Section C: Attempt any **ONE** question from two.

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SECTION A

Attempt only **FOUR** questions from this section.

Question 1

The mechanism shown in the illustration in Figure 1a, is employed in metal-drawing presses, where the piston moves in linear motion. The input drives two meshing gears which in turn drive the connecting links.

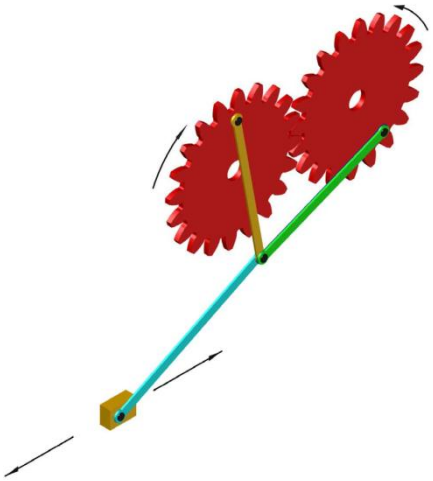


Figure 1a

a) Refer to Figure 1b and copy the two cranks AB and CD and draw the locus of the end points B and D. Link BE is pin-jointed at B and link DE is pin-jointed at D. The ends of both links are pin-jointed together at E. Trace the locus of the point E. (7)

b) Another link EF is pin-jointed to the two links at E while the other end F is connected to a piston sliding along a horizontal line. Draw the displacement of point F. Measure and state the length of the stroke. (4)

c) Show the positions of points F and E when D turns 60° clockwise. (2)

(Total: 13 marks)

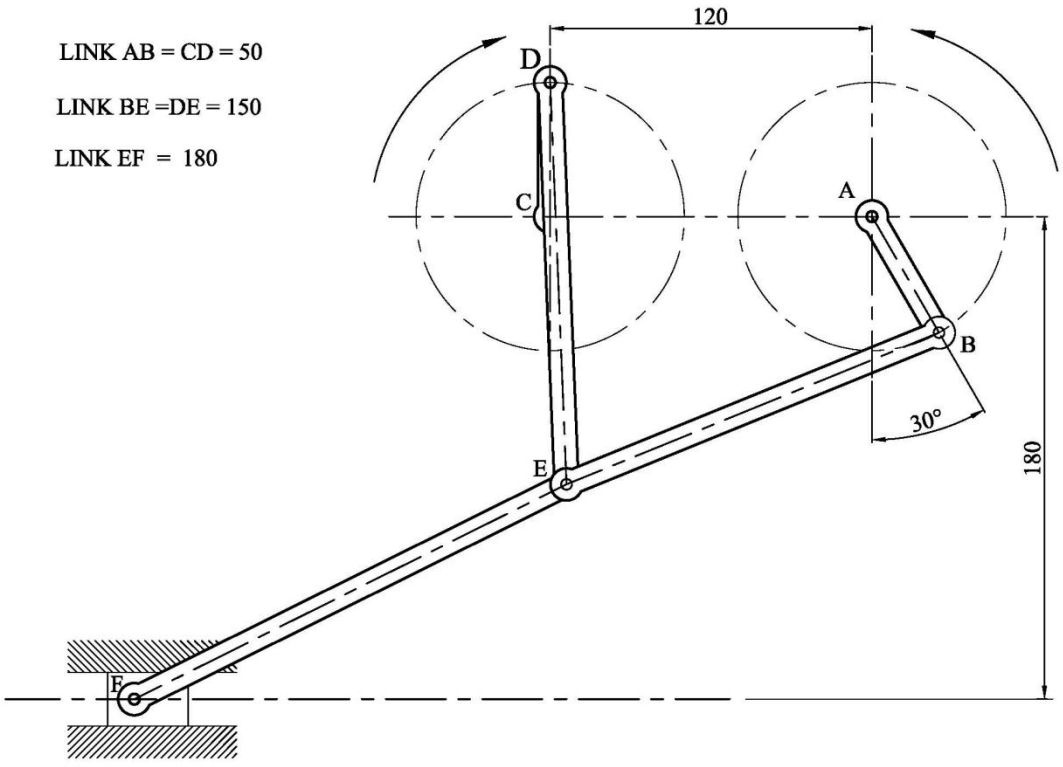


Figure 1b

Question 2

A pin-jointed frame has loads located as shown in Figure 2a.

a) Copy, full size, the space diagram shown in Figure 2b and letter the forces using Bow's notation. (2)

b) Draw a force/vector and polar diagram. Use a scale of 10 mm representing 1 N. (4)

c) i. Construct the funicular polygon to determine graphically the magnitude and direction of the equilibrant; (5)

ii. Show the resultant on the space diagram. (2)

(Total: 13 marks)

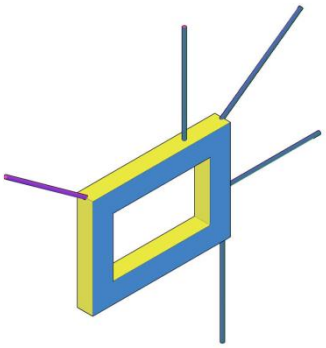


Figure 2a

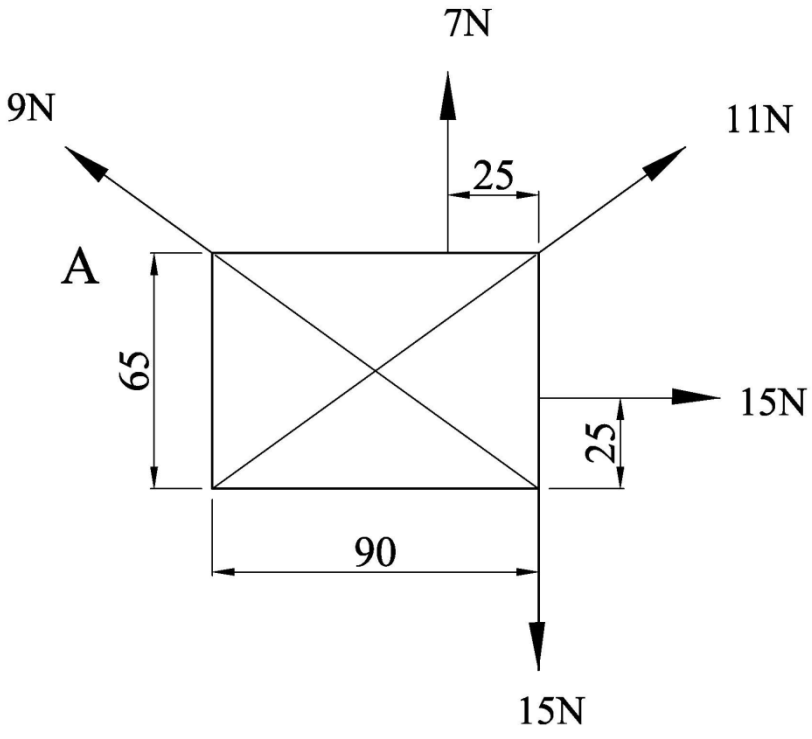


Figure 2b

Question 3

Two similar right cones are resting on the 100 mm diameter base, tangential to each other and their centres are parallel to the vertical plane. Two spheres are to be placed on the horizontal plane, one in front and one behind the cones, touching the two cones as illustrated Figure 3a.

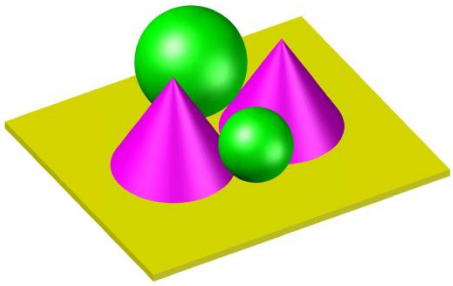


Figure 3a

Draw, full size:

a) the two right cones shown in Figure 3b; (2)

b) a 90 mm diameter sphere resting on the horizontal plane in mutual contact with the two cones situated behind the cones; (4)

c) a 60 mm diameter sphere resting on the horizontal plane in mutual contact with the two cones situated in front of the cones, visible in the front view; (4)

d) Show all construction, hidden detail and points of contact. (3)

(Total: 13 marks)

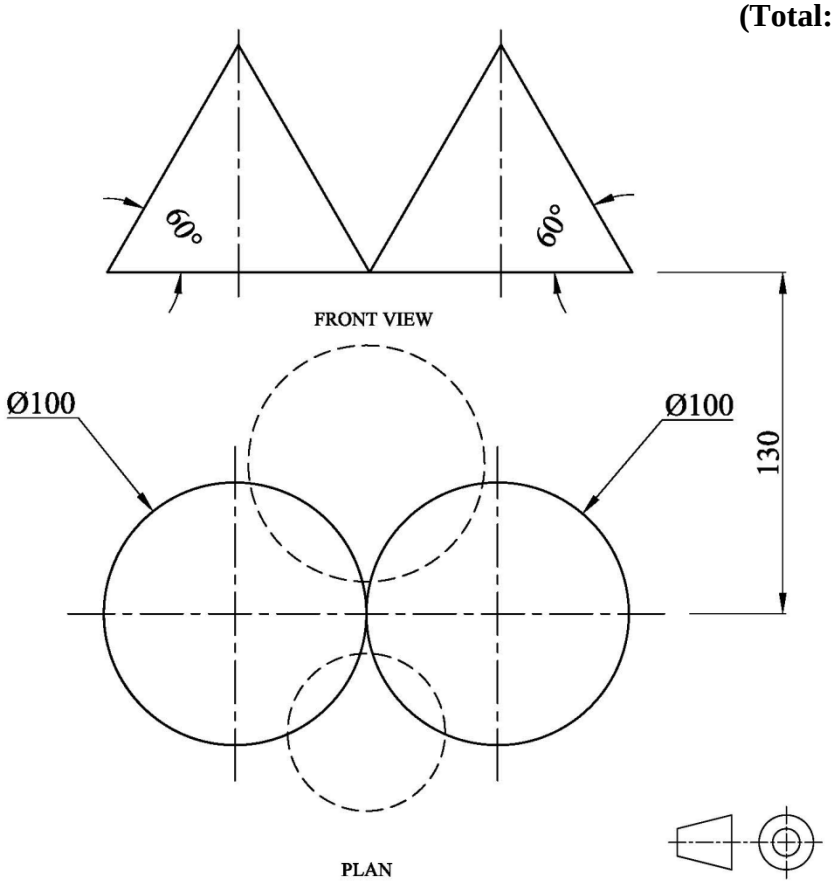


Figure 3b

Question 4

A transition piece is illustrated in Figure 4a. The transition piece, is a combination of half a frustum of a right cone and half of a right square pyramid.

a) Copy, full size, the plan and elevation of the transition piece shown in Figure 4b. (3)

b) Divide carefully, the surface of the transition into triangles. Label the points by drawing zigzag lines between the points and find the true lengths of the generated lines that are used to form the pattern. (4)

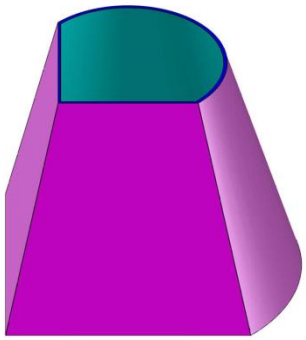


Figure 4a

c) Construct a half surface development of the transition piece by using the triangulation method. (6)

(Total: 13 marks)

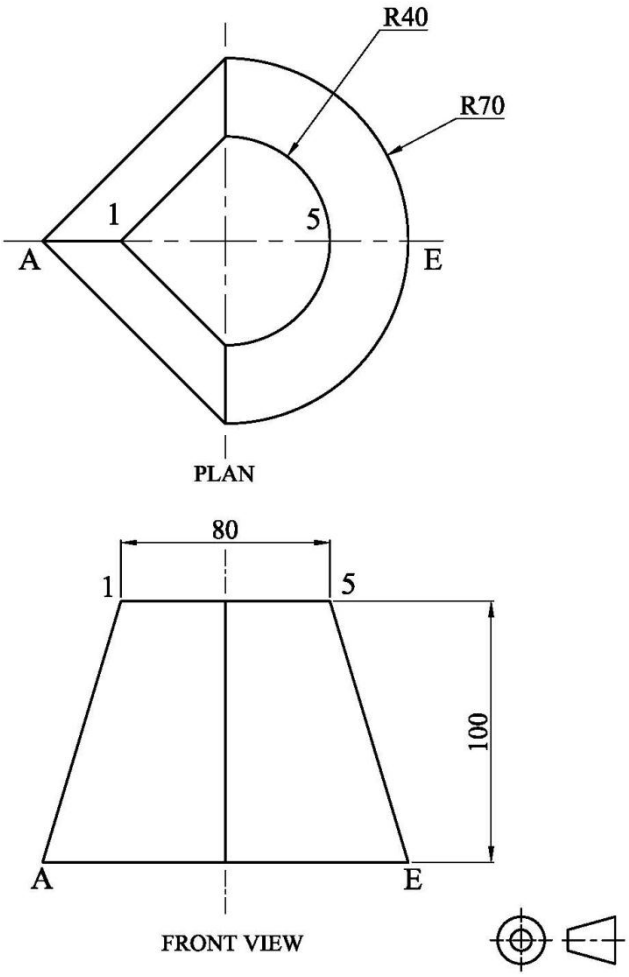


Figure 4b

Question 5

A locking feature in a solid round shaft consists of a drilled conical recess to secure the shaft in assembly by a grub screw. Refer to the illustration in Figure 5a.
The conical recess in the shaft represents an interpenetration of a cone in a cylinder as shown in Figure 5b.

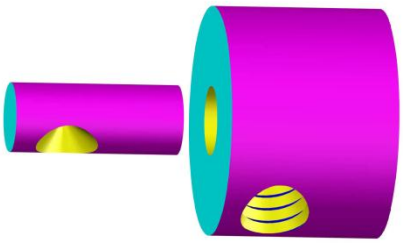


Figure 5a

a) Draw, full size, the elevation of the 100 mm diameter cylinder (solid shaft) together with the right cone (recess) shown in Figure 5b. The base of the cone is 120 mm diameter and the perpendicular height of the cone is 110 mm. The elevation is to be drawn with the centre-line of the conical hole oriented at 60° to the horizontal plane, as shown in Figure 5b. (4)

b) Present an auxiliary view in the direction of the arrow A, showing the cylindrical solid shaft with the pierced conical recess. Generate the outline profile curve of the recess. (4)

c) Complete the shown elevation, the one representing the view in the direction of the arrow B, by showing the conical recess in the cylinder. Use light curves and light lines for the base of the cone. Show the curve of intersection representing the outline profile of the recess in bold. (5)

(Total: 13 marks)

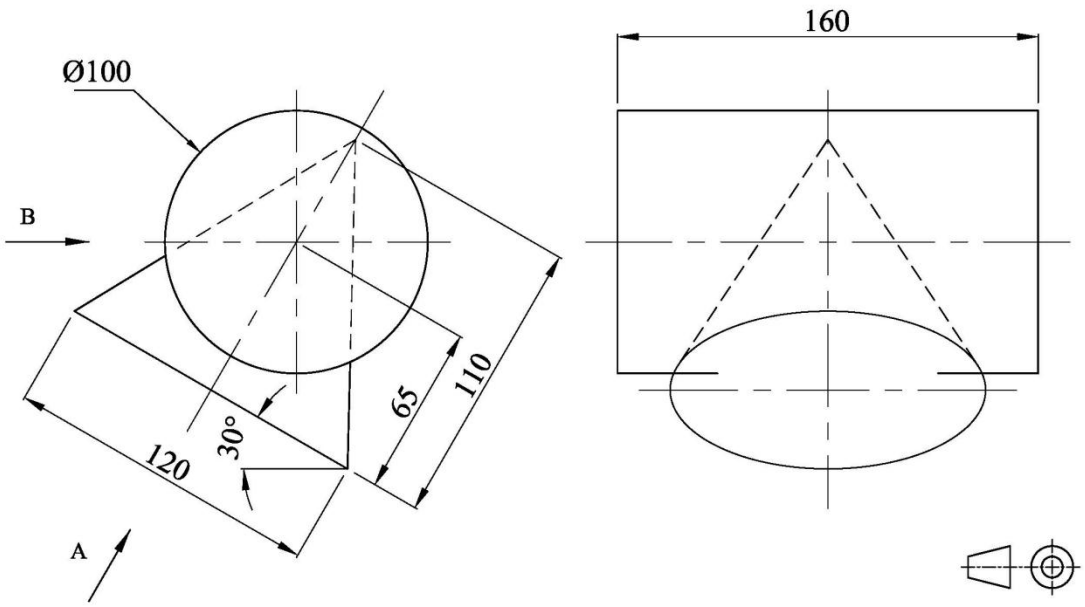


Figure 5b

SECTION B

Attempt only **ONE** question from this section.

Question 6

Figure 6a shows the illustration of a jig, which is a machine shop device used to hold the work and to guide a tool in a fixed location for repeatable machining operations. The assembled jig in Figure 6a is required for the drilling of an 18 mm diameter hole in a quantity of bushes.

Figure 6b on the attached A3 paper shows the orthographic drawing of the parts that together form the jig assembly.

The jig is assembled as follows;

- the machined bolt (Item 2) is inserted with its 50 mm diameter shoulder (flat face A) in the 50 mm diameter x 10 mm deep counter bore recess of the 30 mm diameter horizontal hole of the base (Item 1).
- the machined bolt (Item 2) is secured in position in the 30 mm diameter hole of the base, by an M20 hexagonal nut and a washer (not shown).
- the drill plate (Item 3) is placed on top of the base with the 14 mm diameter holes in the drill plate in line with the M14 tapped holes in the base.
- the drill plate (Item 3) is secured to the base by four M14 cheese-head mounting screws (Item 4).
- the bush (Item 5) is inserted in the 38 mm diameter hole of the drill plate. The 58 mm diameter x 20 mm flange of the bush rests above the drill plate.
- the M12 pan-head screw (Item 6) retains the bush in position. The M12 pan-head screw is installed in the M12 tapped hole on the drill plate. The screw pan head fits in the 15 mm radius x 10 mm deep recess of the bush, preventing the bush from rotating and popping up during the drilling operation.

Draw, full size, a sectional elevation along the horizontal centre line X-X shown for the assembled jig.

Do not show hidden detail.

(Total: 24 marks)

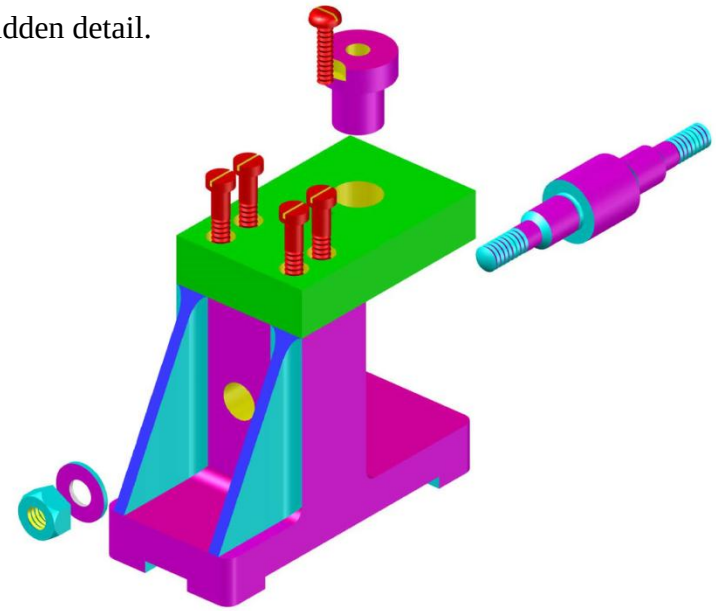


Figure 6a

Question 7

An incomplete illustration of a low-speed pulley unit, consisting of a bracket, bush and wheel is shown in Figure 7a. Detailed drawing of the bracket, bush and wheel are shown in Figure 7b.

a) Draw an isometric view of the:
   i. bracket, with corner A as the lowest point; (6)
   ii. bush, with a quarter of bush removed; (6)
   iii. wheel, with a quarter of the wheel removed. (6)

b) The bush is pressed within the wheel and the assembly is to rest on top of the bracket.

   Sketch a suitable spindle to secure the assembly of the bush and the wheel to the bracket, allowing the wheel to rotate freely.
   The spindle head is to be 72 mm diameter x 15 mm with a tightening feature of your choice.
   An M18 nut and a washer at the other end of the spindle secures the bush and wheel to the bracket. (6)

   Note: The sequence of the assembly and the proposed paper layout are indicated in Figure 7c.

(Total: 24 marks)

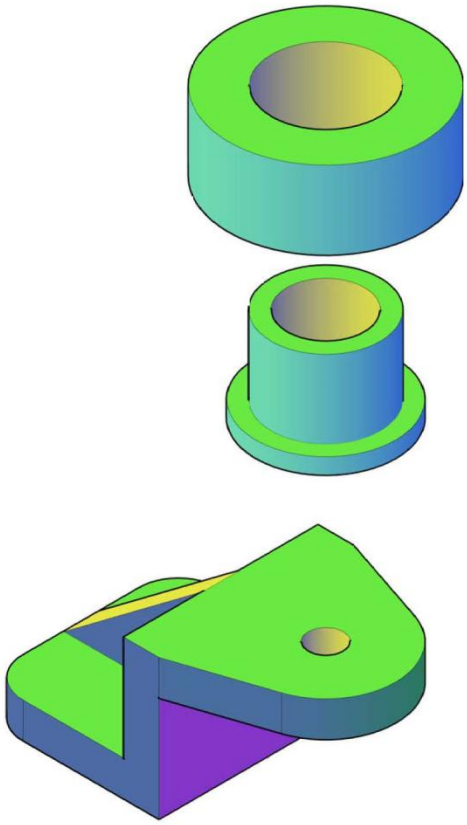


Figure 7a

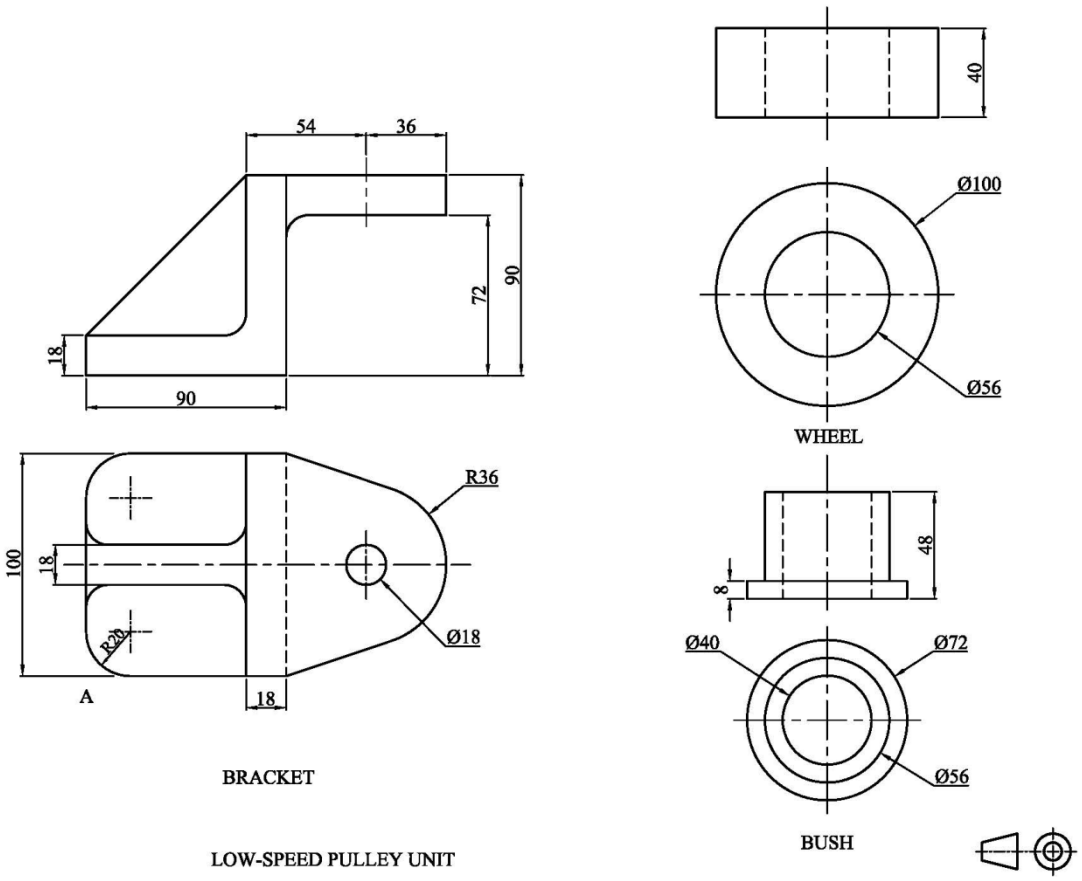


Figure 7b

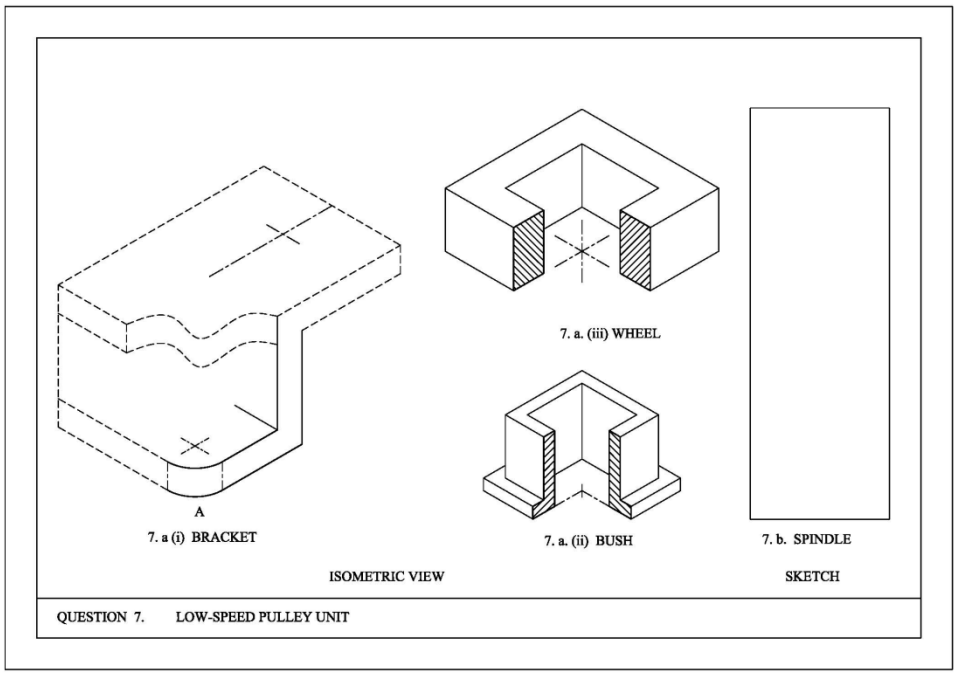


Figure 7c

SECTION C

Attempt only **ONE** question from this section.

Question 8

Table 8a shows the number of sea trips done between Cirkewwa (Malta) and Mgarr (Gozo) between January and June in 2015 and 2016 (*NSO, 2017*). Note that all figures have been rounded to the nearest multiple of ten.

Table 8a: Number of sea trips between Malta and Gozo for periods January till June of 2015 and 2016.

Months	Sea trips between Cirkewwa and Mgarr	
	2015	**2016**
January	770	860
February	720	830
March	800	890
April	810	870
May	880	890
June	890	950
Total	**4870**	**5290**

Design a poster to show the results of the statistics.

a) Label the poster with the heading "Sea trips". (2)

b) Draw a pictorial bar chart showing the number of sea trips between Cirkewwa and Mgarr for years 2015 and 2016, for all the given months. Label this bar chart "Trips per month". (11)

c) Draw a planometric pie chart showing the total number of sea trips between Cirkewwa and Mgarr for years 2015 and 2016. Label this pie chart "Trips for the first half of years 2015 - 2016". (11)

Poster design tips:

i. Use colour and shading to render the drawing;
ii. Make use of typography (fonts);
iii. Form an attractive presentation, clearly conveying the information.

(Total: 24 marks)

Question 9

A school is designing a small library consisting of several bookshelves and two tables. The front view and the plan are shown in Figure 9a. A pictorial view of all the bookshelves and tables is shown in the next page. Figure 9b is the pictorial drawing of bookshelves labelled A. Figure 9c is the pictorial drawing of the tables labelled C. Figure 9d is the pictorial drawing of bookshelf labelled C. Figure 9e is the pictorial drawing of bookshelf labelled D. Figure 9f. is the pictorial drawing of bookshelf labelled E. Figure 9g is the pictorial drawing of bookshelf labelled F.

Using the scale given below, construct an estimated one-point perspective view of the library. Take the vanishing point in the centre of the room, 189 mm above the bottom line.

Notes: Draw shelves for one bookshelf and render this bookshelf.

(Total: 24 marks)

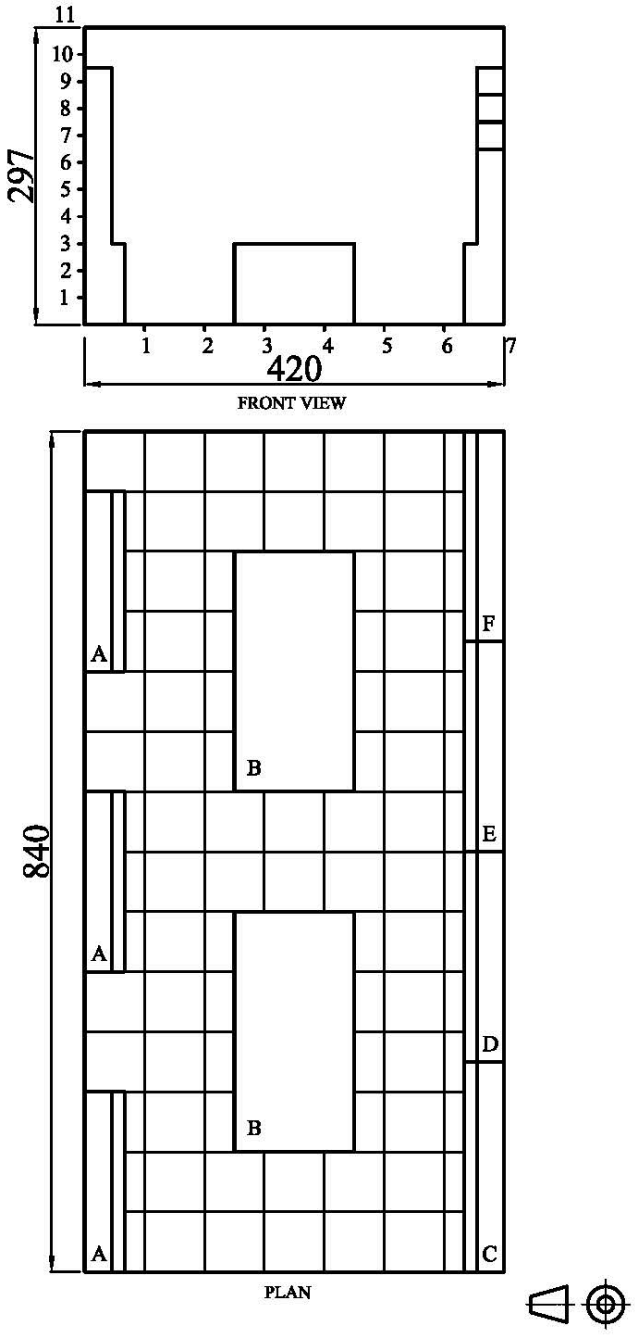


Figure 9a

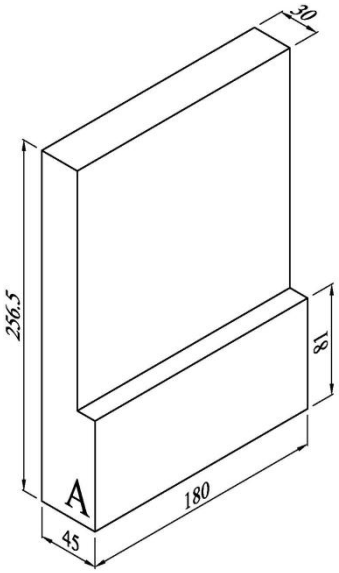


Figure 9b

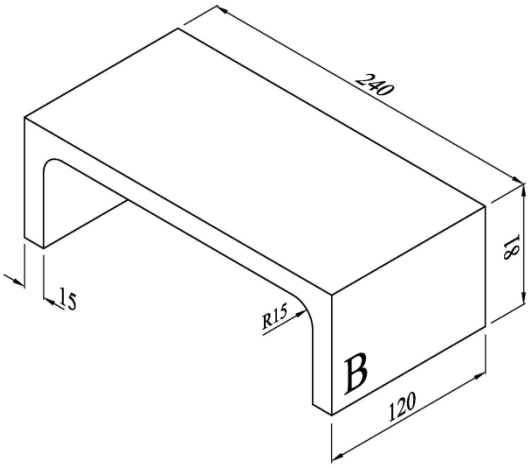


Figure 9c

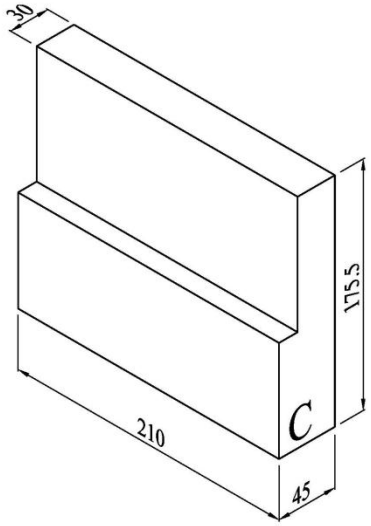


Figure 9d

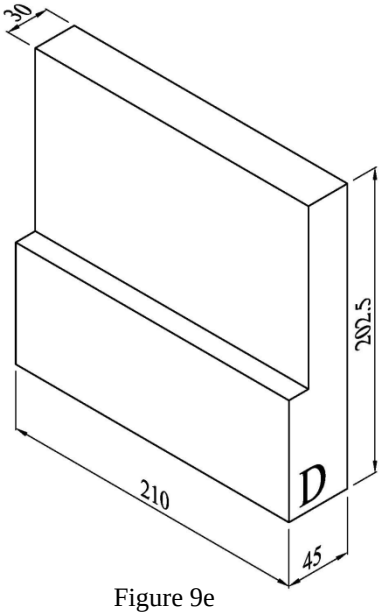


Figure 9e

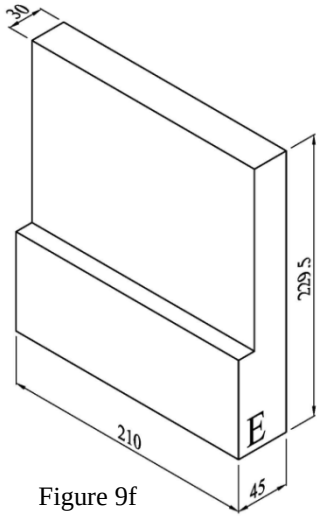


Figure 9f

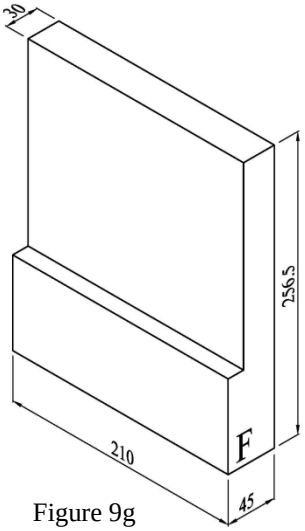
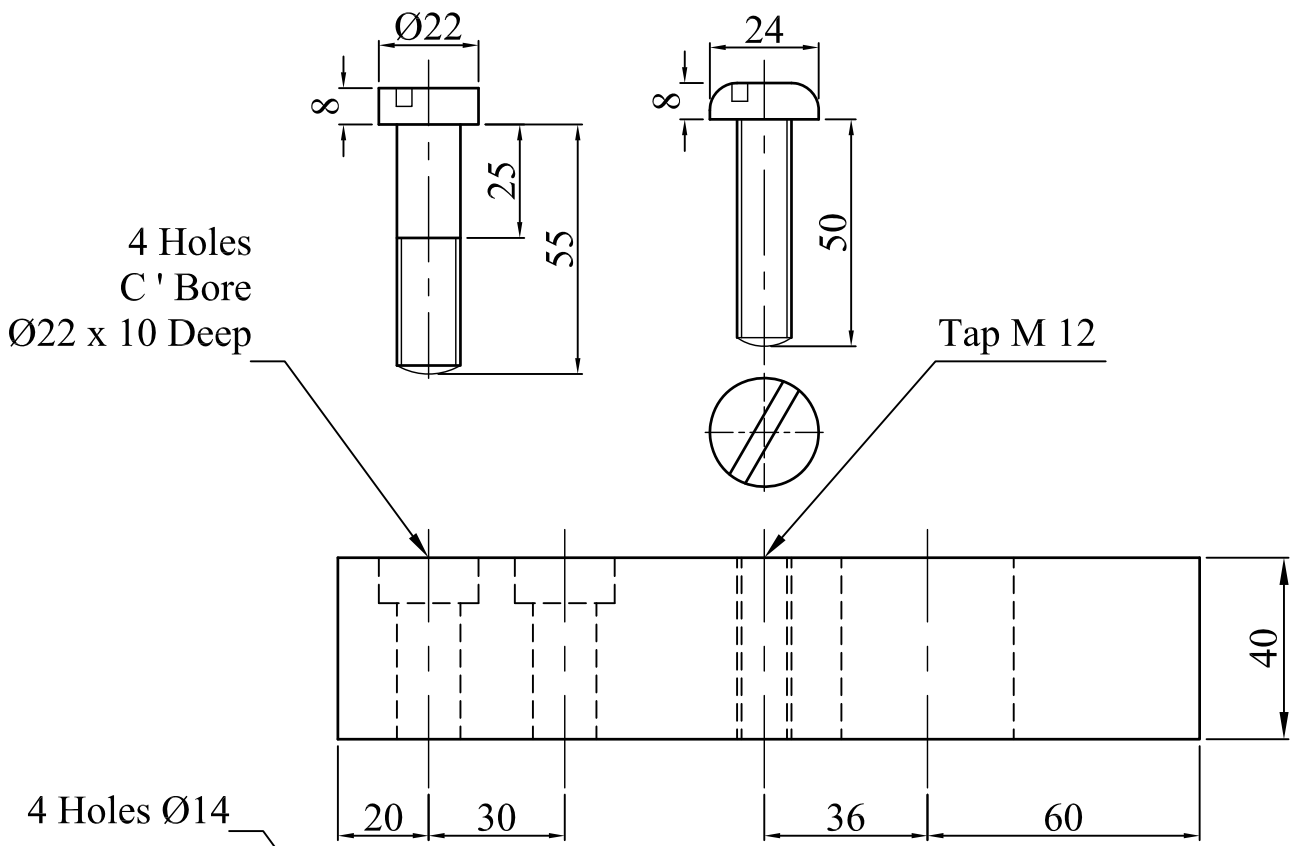
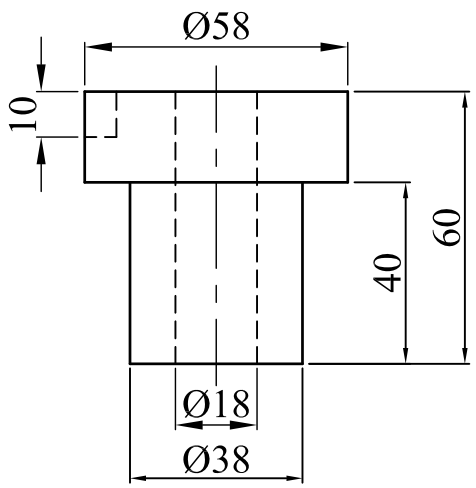


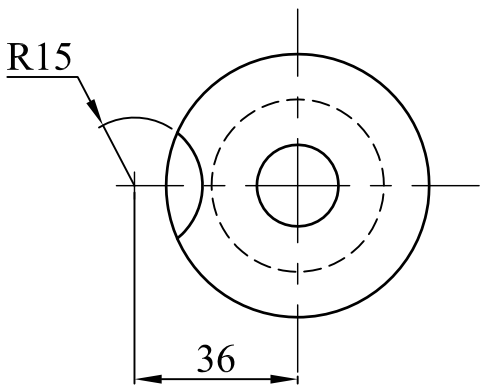
Figure 9g

CHEESE-HEAD (Item 4)
SCREW M 14

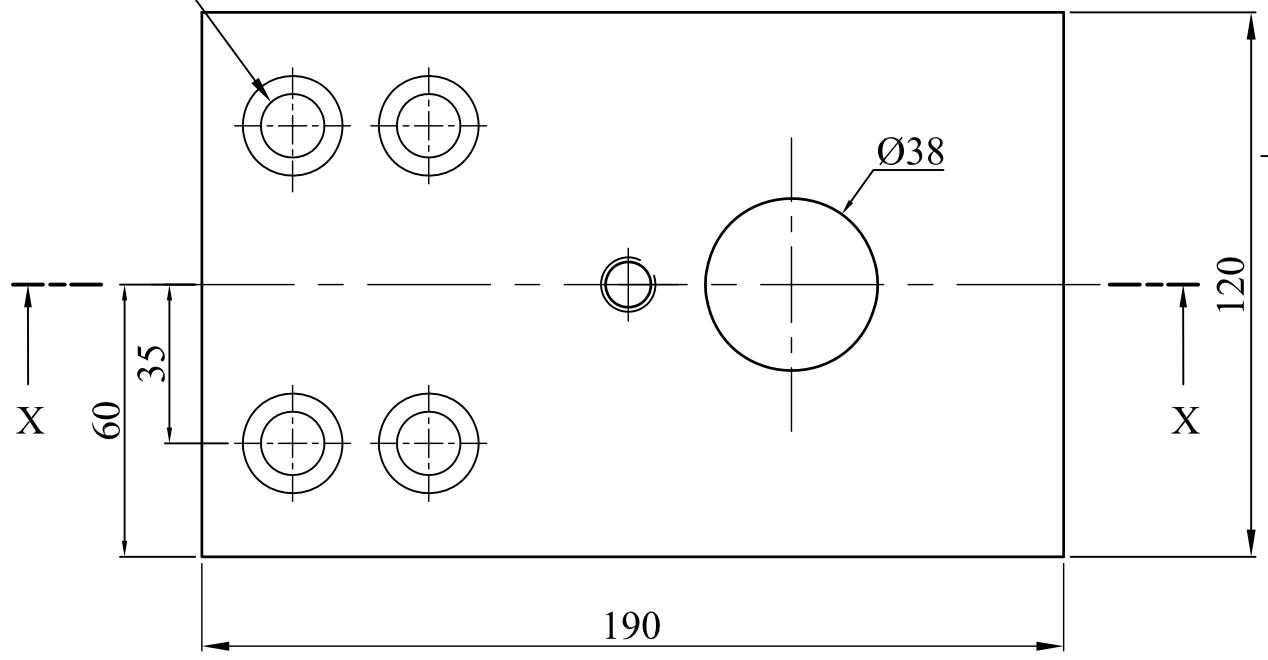
PAN-HEAD (BUSH RETAINING) (Item 6)
SCREW M 12



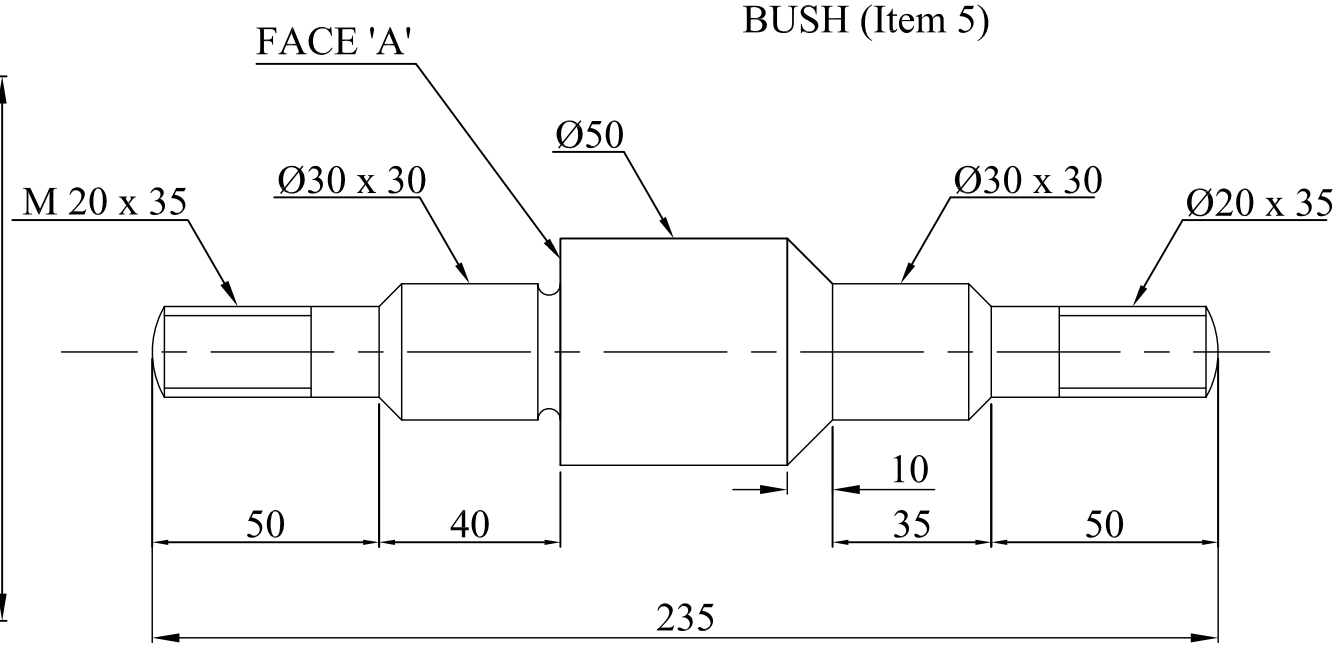




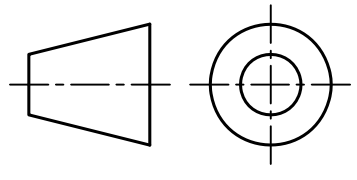
BUSH (Item 5)



DRILL PLATE (Item 3)

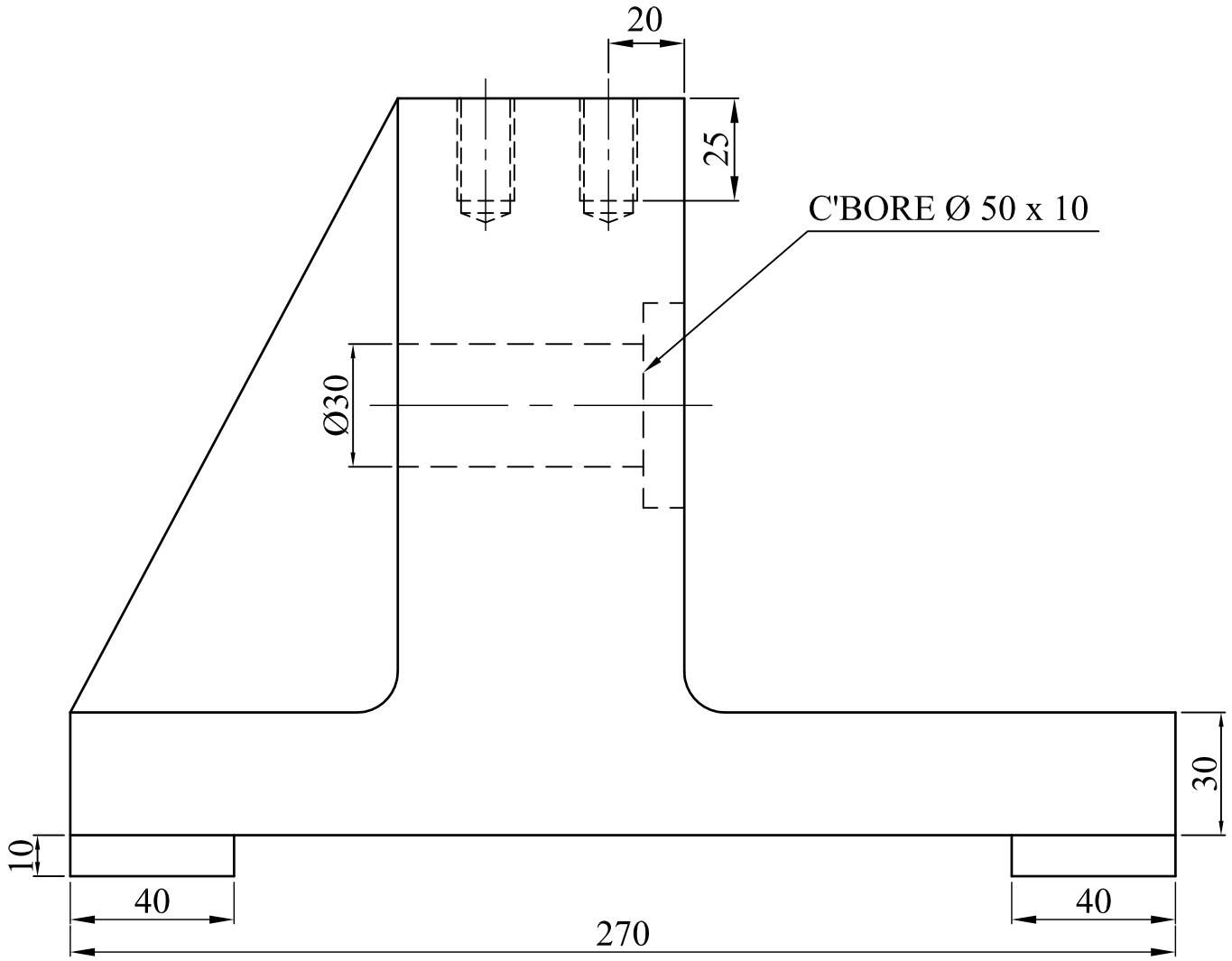


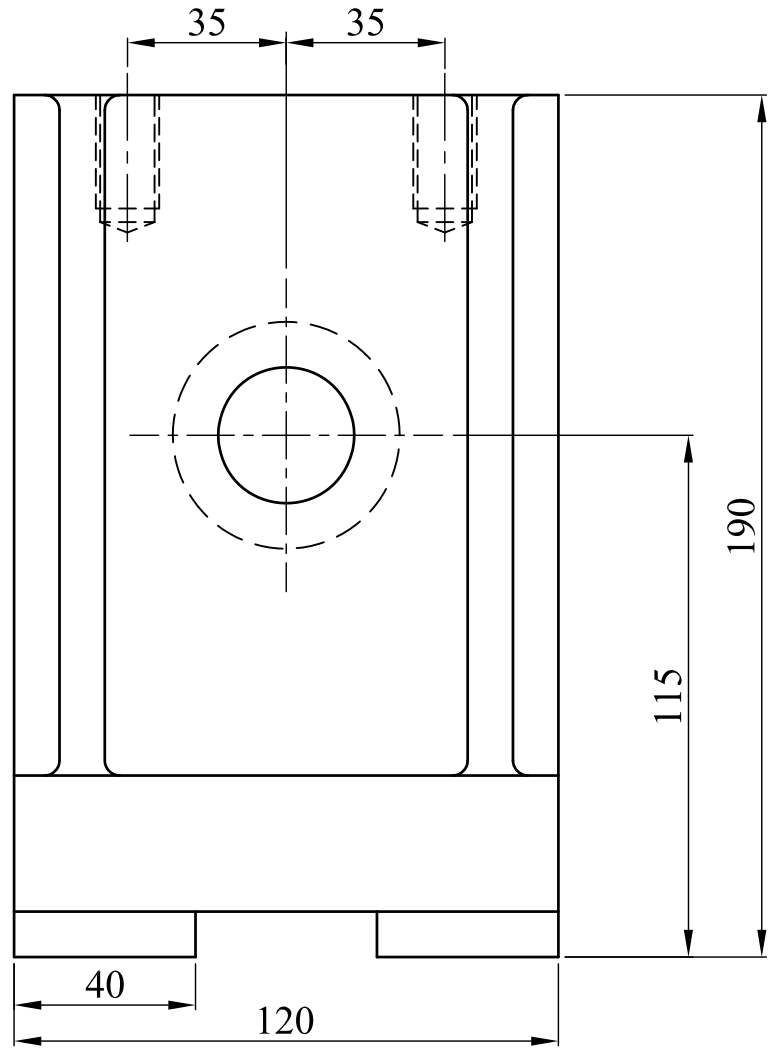
BOLT (Item 2)

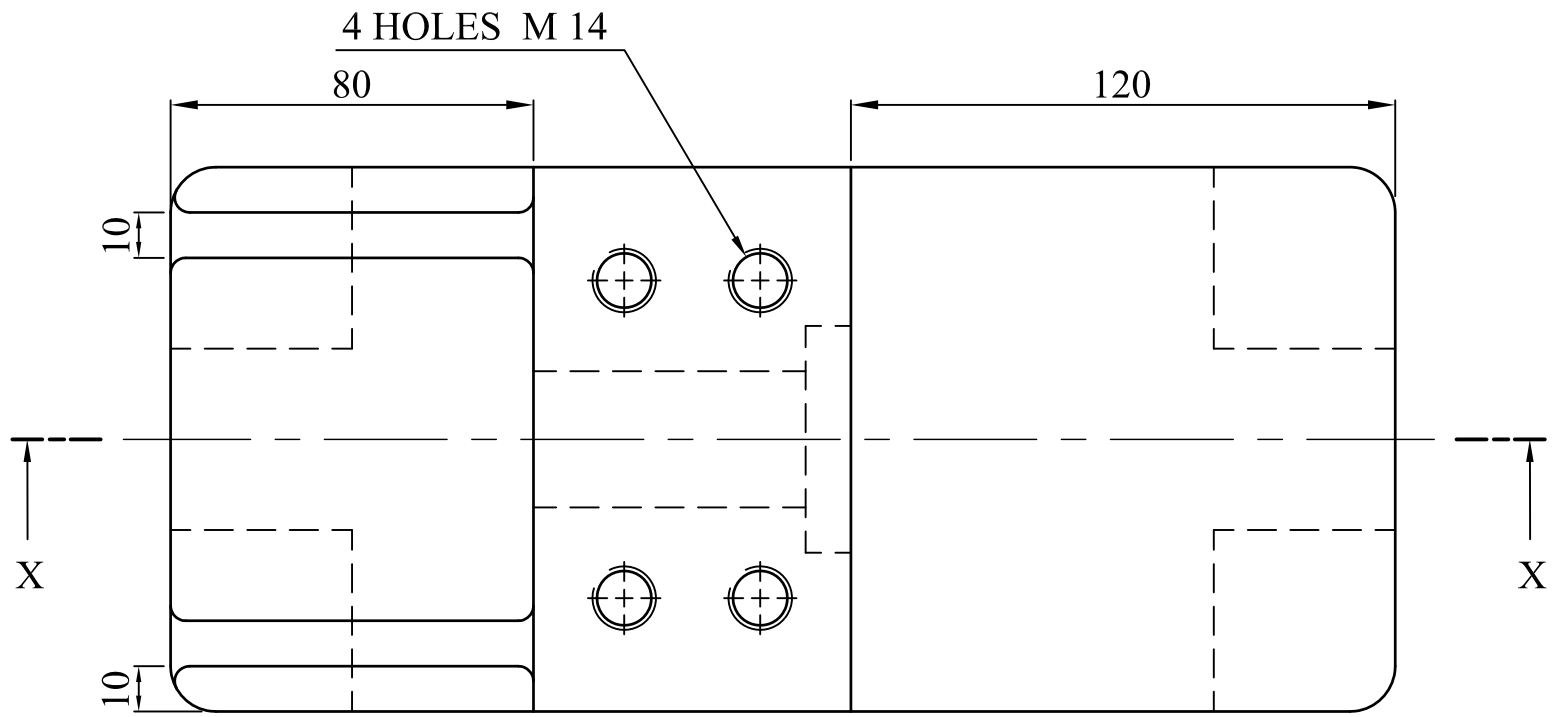


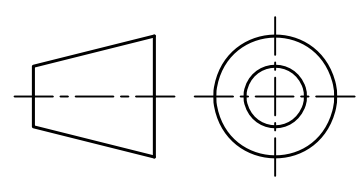
JIG

UNIVERSITY OF MALTA	MATRICULATION CERTIFICATE EXAMINATION	IM 09.17S	ENG DRG & GRAPH COMM SEC B QUES 6 FIG. 6b







JIG

BASE (Item 1)