L-Università ta' Malta

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

ADVANCED MATRICULATION LEVEL
2019 SECOND SESSION

SUBJECT:	**Engineering Drawing/Graphical Communication**
PAPER NUMBER:	I
DATE:	2nd September 2019
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.

Attempt any **FIVE** questions.

Programmable calculators cannot be used.

Unless otherwise stated:

a.   drawings should conform to B.S. or equivalent (ISO) standards;
b.   all dimensions are in millimetres;
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.

1. A loaded beam is simply supported at R^L and R^R with loads as shown in Figure 1.
    a) Using a linear scale of 10 mm representing 1 m, copy the diagram shown in Figure 1. A clear notation graphical system must be used to identify the loads acting along the beam. (2)
    b) Draw a vector diagram with a scale of 10 mm representing 1 kN and a polar diagram (polar distance of 120 mm). (4)
    c) Construct the bending moment diagram and indicate the 'closer line'. (3)
    d) Determine graphically:
        i) the magnitude and direction of each of the support reactions at R^L and R^R, (4)
        ii) the magnitude of the bending moment along the beam at 3 m to the right of the reaction R^L. (3)
    e) Draw the shear force diagram. (4)

    Show all necessary calculations.

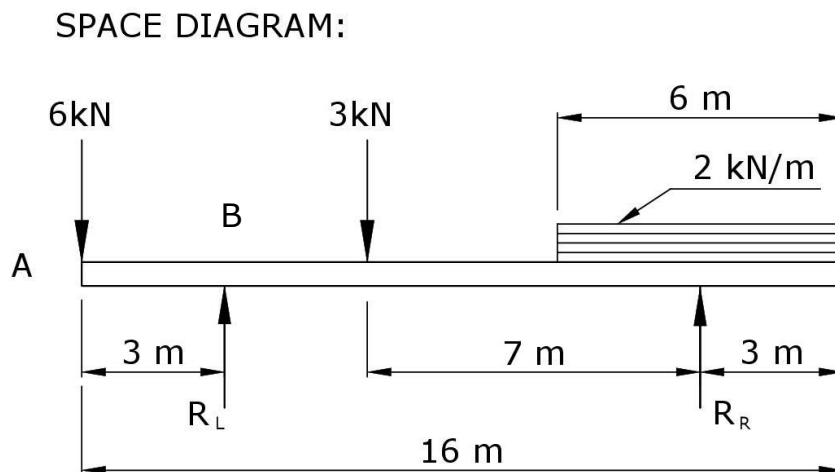   **(Total: 20 marks)**

    SPACE DIAGRAM:

    Figure 1

2. Part of a hyperbolic curve, a transverse axis and a vertical line representing the directrix are shown in Figure 2b. The point F indicates the position of the focus on the axis and V is the vertex of the conic curve.
   a) Plot, full size, the conic curve using an eccentricity of 5:4 for the hyperbola. Draw the hyperbolic curve on the upper part of the transverse axis and show the constructions. (6)
   b) Revolve the curve about the horizontal axis to generate a solid of revolution (hyperboloid). An inclined section plane passes through the vertex and cuts the front part of the solid as shown in Figure 2a and Figure 2b.
      i) Project an end view as seen from the right-hand side (in the direction of arrow E) of the upper half of the solid, showing the section. (7)
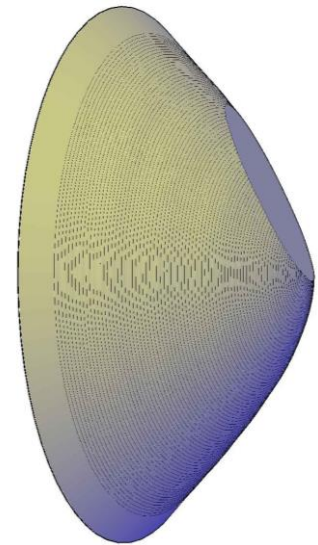   ii) Draw the true shape of the intersection between the inclined plane and the solid of revolution. (7)

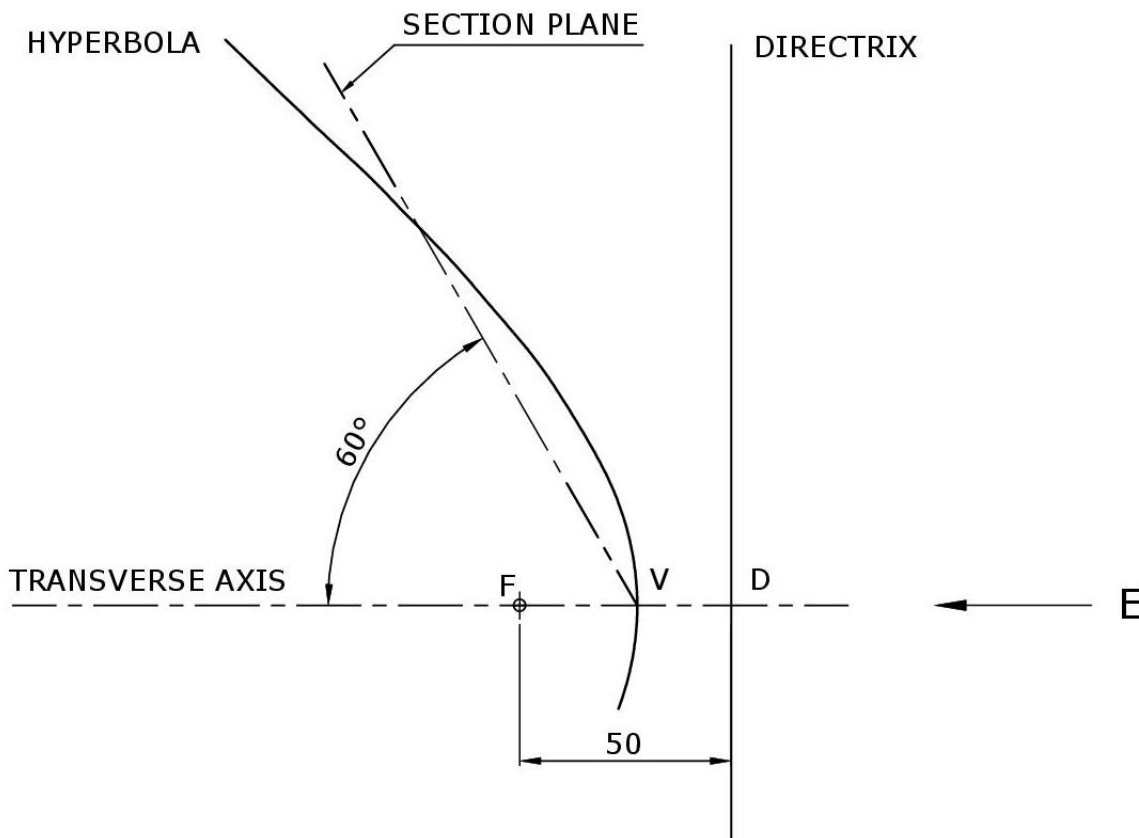**(Total: 20 marks)**

Figure 2a

Figure 2b

3. An illustration of a boat handrail fitting bracket is given in Figure 3a. Two incomplete views of the bracket are shown in Figure 3b. The centre line in both views represents the longitudinal axis of the pipe. The pipe has 40 mm diameter and is inclined at 45° to the vertical plane and the true inclination angle to the horizontal plane is 30°.
   a) Copy the given incomplete plan. (2)
   b) Project an auxiliary elevation with the 40 mm diameter pipe in position. Write down the true distance between centres A and B. (4)
   c) Complete the plan by showing the pipe and the curves at the joint line and at the open end. (5)
   d) Construct, by projection, the front elevation of the base plate and the inclined pipe. (9)
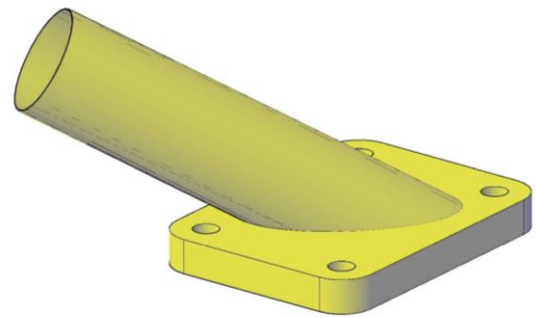
Figure 3a

Notes:
   • Neglect the thickness of the material of the pipe.
   • Points on all curves must be obtained by projection.
   • Show all hidden detail.

(Total: 20 marks)

78

CENTRE LINE OF PIPE

A

76

B

13

CENTRE LINE OF PIPE

A

78

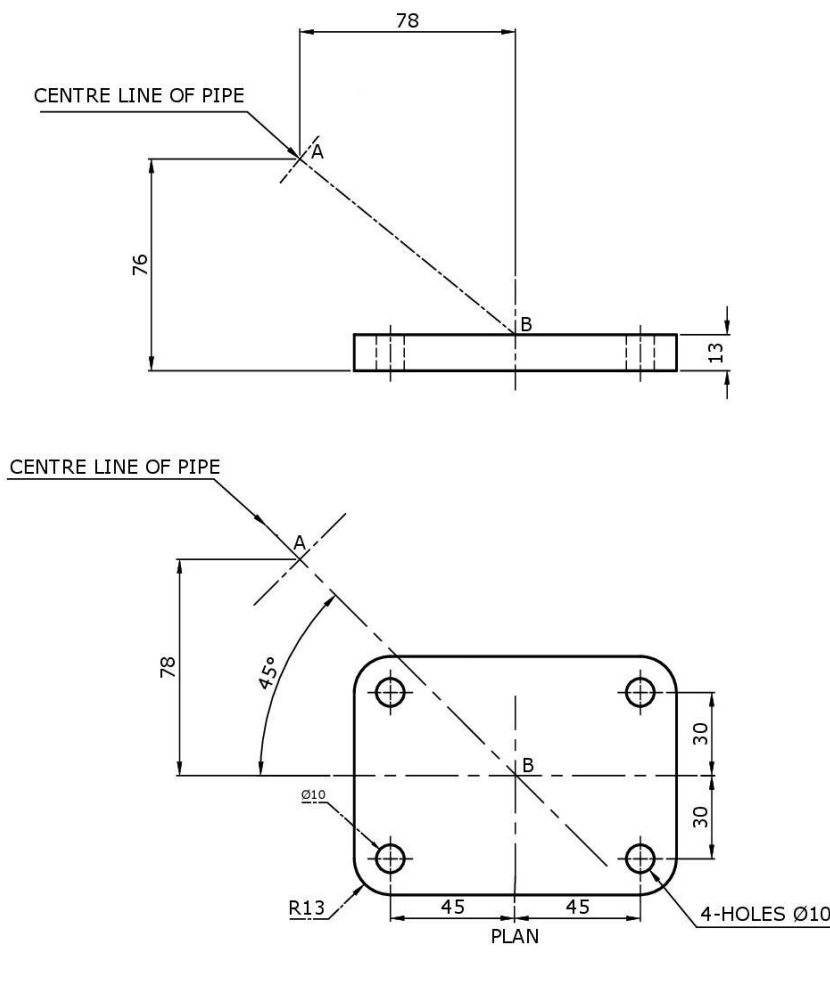45°

Ø10

B

30

30

R13

45

45

4-HOLES Ø10

PLAN

Figure 3b

4. The plan and elevation of a hexagonal pyramid and the traces, VT and HT, of an oblique plane which cuts it are shown in Figure 4b. The axis of the hexagonal pyramid is parallel to the horizontal plane and the vertical plane. The oblique plane cuts the pyramid as shown in Figure 4a.
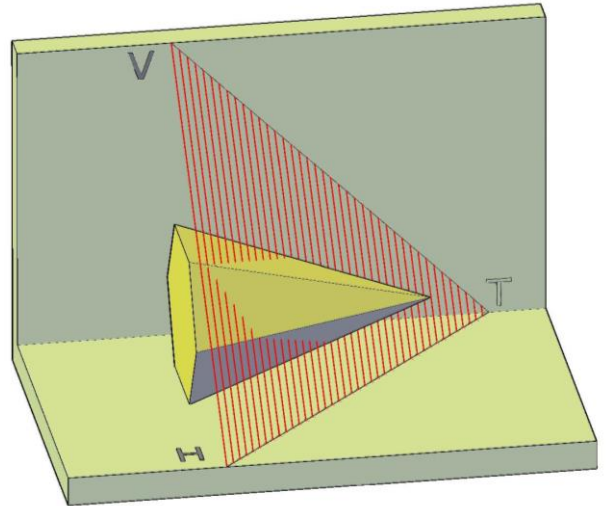   a) To a scale of 1:1, construct the given elevation and plan. (2)
   b) Convert the oblique plane to an inclined plane by projecting an auxiliary elevation and include the hexagonal pyramid into this view. Write down the angle of inclination of the oblique plane to the horizontal plane. (6)

   c) Draw the plan and elevation of the cut pyramid with the portion in front of the cutting plane removed, showing the section produced. (6)
   d) Project a view showing the hexagonal pyramid with the true shape of the section included. (6)

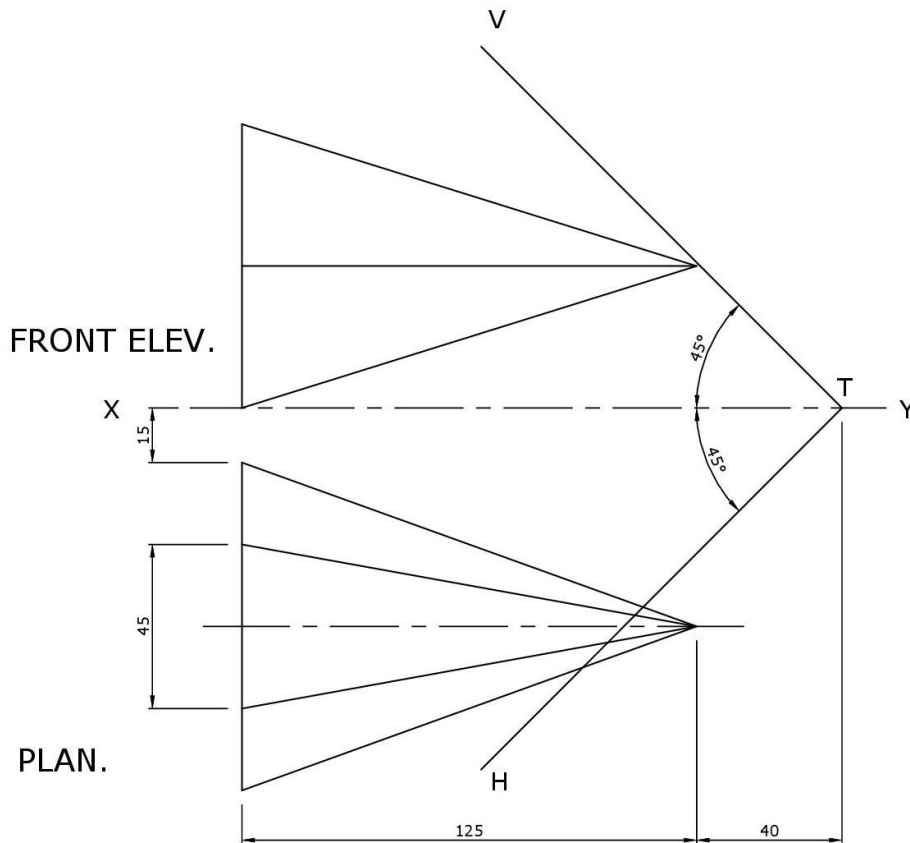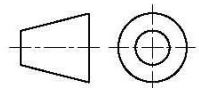Figure 4a

(Total: 20 marks)

Figure 4b

5. A front elevation and plan view of two equal spheres in contact with a right square pyramid are shown Figure 5b. The three solids (spheres and the square pyramid) are resting on a horizontal surface.
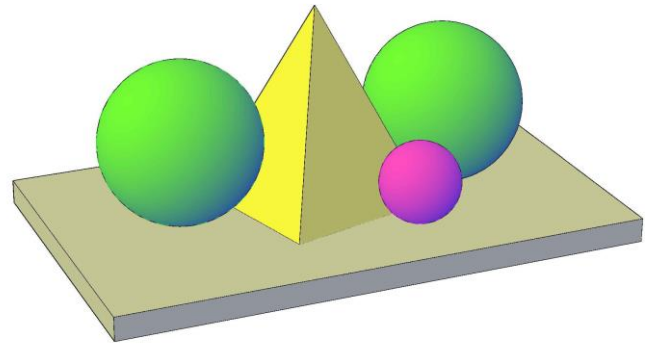
a) Construct, full size:
   i) the 80 mm diameter sphere in contact with the sloping face A of the square pyramid; (5)
   ii) the other 80 mm diameter sphere in contact with the sloping face C of the square pyramid. (5)

b) A third sphere of 40 mm diameter is then placed on the horizontal surface in front of and in contact with the sloping face B of the square pyramid and the sphere which is in contact with the sloping face C of the square pyramid (as shown in Figure 5a).
   Locate, by construction, the position of the third sphere in the front elevation and the plan view. (10)

Figure 5a

Notes:
- All contact points between the spheres and the sloping faces of the square pyramid must be clearly marked
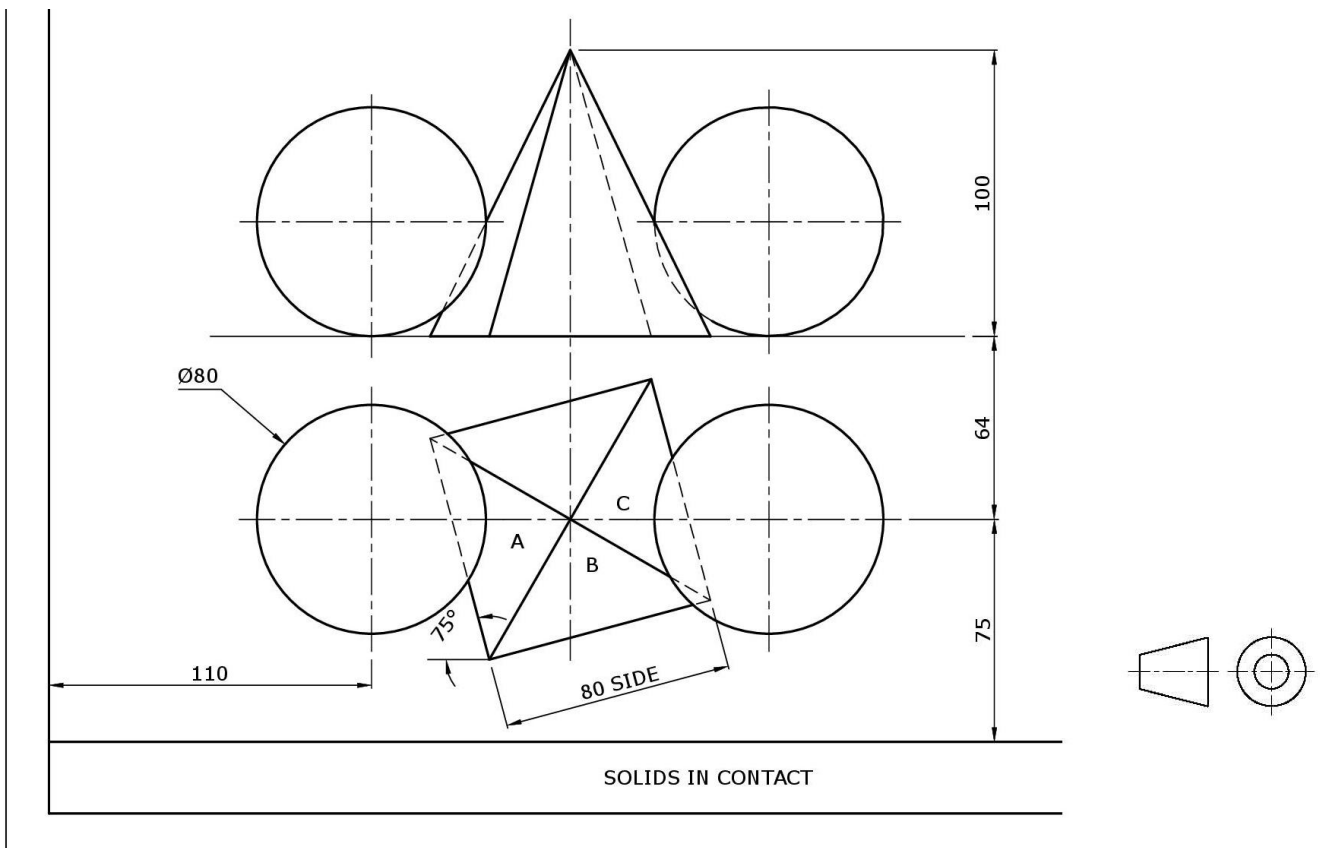- Show all hidden details.

(Total: 20 marks)

Figure 5b

6. The mechanism of a moveable worktable of a machine is driven by a rack and pinion. The rack and pinion have a pitch of 37.76 mm and a pressure angle of 20°.

a) From the data given derive the dimensions of the module and the necessary dimensions to draw the rack. (2)

b) The rack is operated by a pinion and a small motor-driven gear (shown in Figure 6a), the gear train giving a speed reduction of 3:1. The pitch circle diameter of the small motor-driven gear is 120 mm. Calculate the pitch circle diameter of the pinion gear and derive the other necessary data. (2)

c) Construct, full size, the true involute of **ONE** flank face of the pinion. (4)

d) Draw **THREE** teeth of the pinion gear using a standard geometric approximate construction for the flank faces. (7)

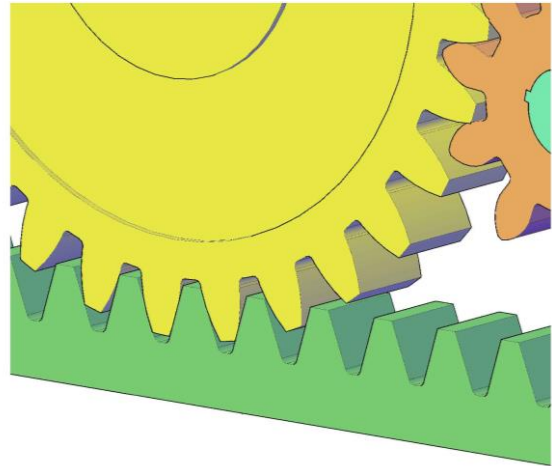e) Draw **THREE** teeth of the rack in mesh with the gear. (5)

Figure 6a

Notes:
- The small motor-driven gear is not required in your drawing.
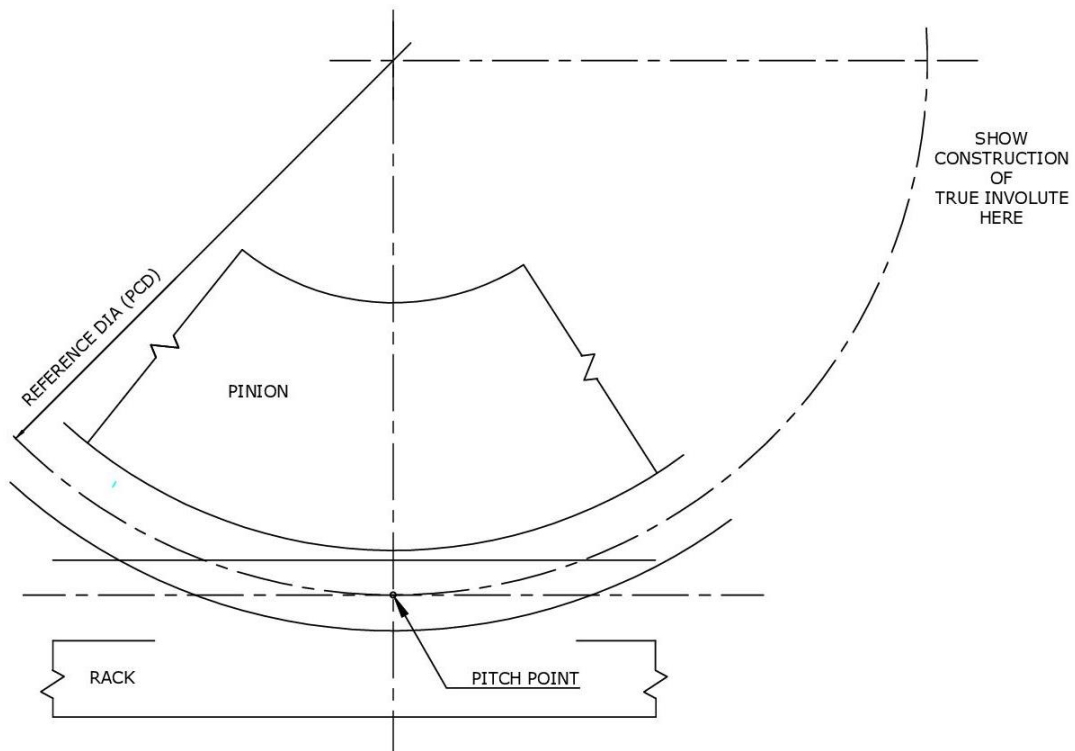- All necessary calculations must be shown.

(Total: 20 marks)

Figure 6b

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
EXAMINATIONS BOARD

**ADVANCED MATRICULATION LEVEL
2019 SECOND SESSION**

SUBJECT:	**Graphical Communication**
PAPER NUMBER:	II
DATE:	3rd September 2019
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.

Attempt **all** questions.

Programmable calculators **cannot** be used.

Unless otherwise stated:

a.   drawings should conform to B.S. or equivalent (ISO) standards;
b.   all dimensions are in millimetres;
c.   answers are to be accurately drawn with instruments;
d.   all construction lines must be left on 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 should be used where appropriate.

Mark allocations are shown in brackets.

Question 1 carries 34 marks. Questions 2, 3 and 4 carry 22 marks each.

1. Three orthographic views of a model kids' playground equipment are shown in Figure 1. The equipment consists of a flight of steps and a slide connected by a passageway which has a pyramidal top. The passageway has a doorway on each side and two windows, one at the front and the other at the back. The slide and steps have a low safety wall on each side. Rubber tiles surround the equipment.

   The given orthographic views constitute an integral part of the design process but fail to convey a feeling of the **3D** proportions of the playground area.

   You are to meet this requirement by drawing a one-point estimated perspective drawing. The viewing direction required is indicated by the arrows in the plan view.

   a. Using **THREE** preliminary sketches of the equipment (in rectangles 48 mm x 32 mm), explore alternative positions of the horizon line and identify the one which, in your opinion, best describes the spaciousness of the playground area. (3)

   b. Based on the choice made in part (a), use the given scale to produce the required illustration on a single side of an A2 size paper. (26)

   c. Enhance your drawing by colouring small areas of the different items appearing in your illustration. (5)

   (Total: 34 marks)

320

480

480

SLOPE

SLOPE
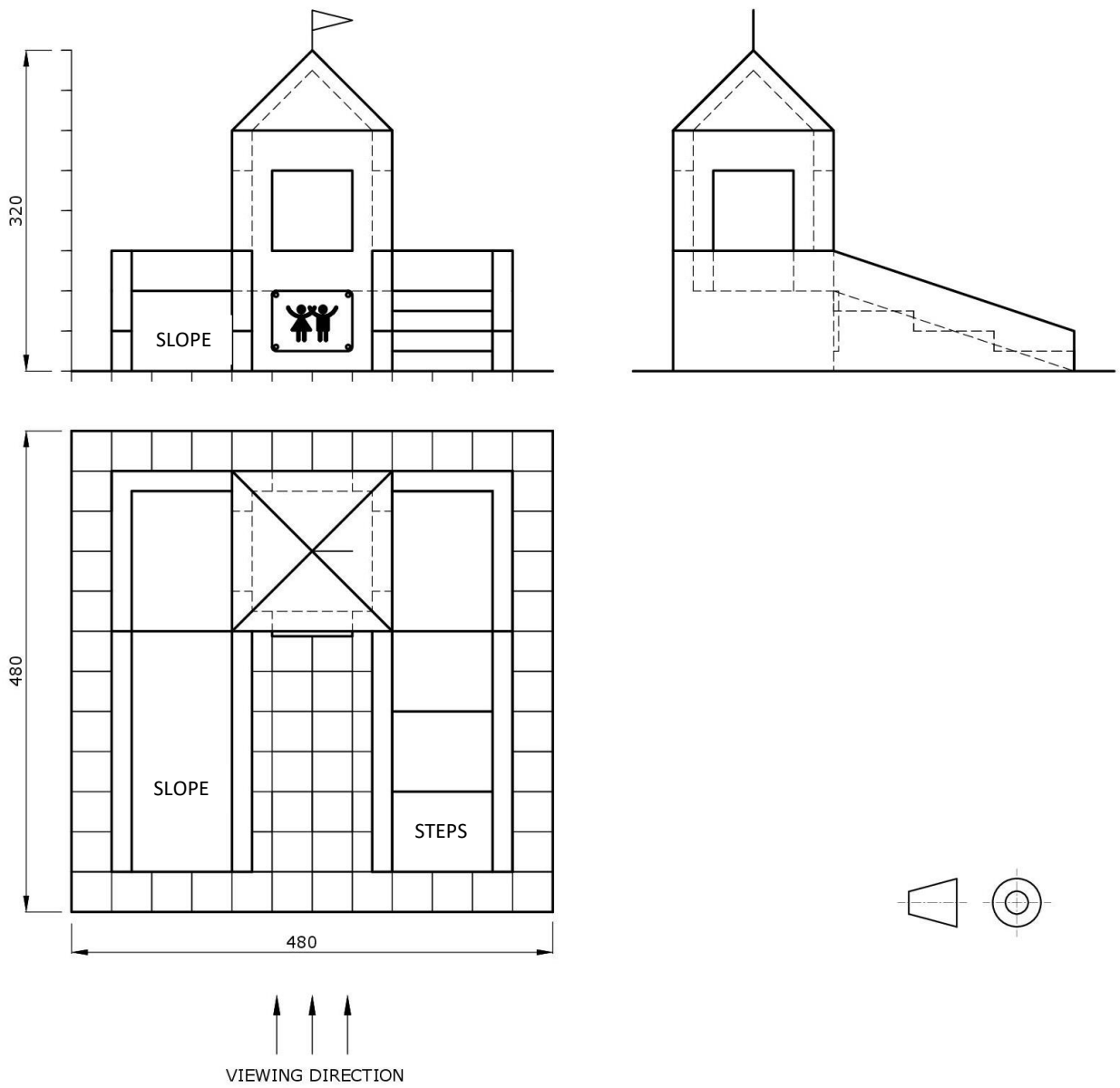
STEPS

VIEWING DIRECTION

Figure 1

2. Five orthographic views of a spring horse rider are shown in Figure 2. The horse is made of polyethylene sheets and rods which are bolted together. The base plate and the spring are made of steel.
    You are requested to:
    a. draw a well-proportioned pictorial freehand sketch of the spring rider;   (16)
    b. colour and shade your sketch, paying attention to the representation of the different materials and textures.   (6)

    Note: You are expected to make the best use of the given A2 drawing sheet.
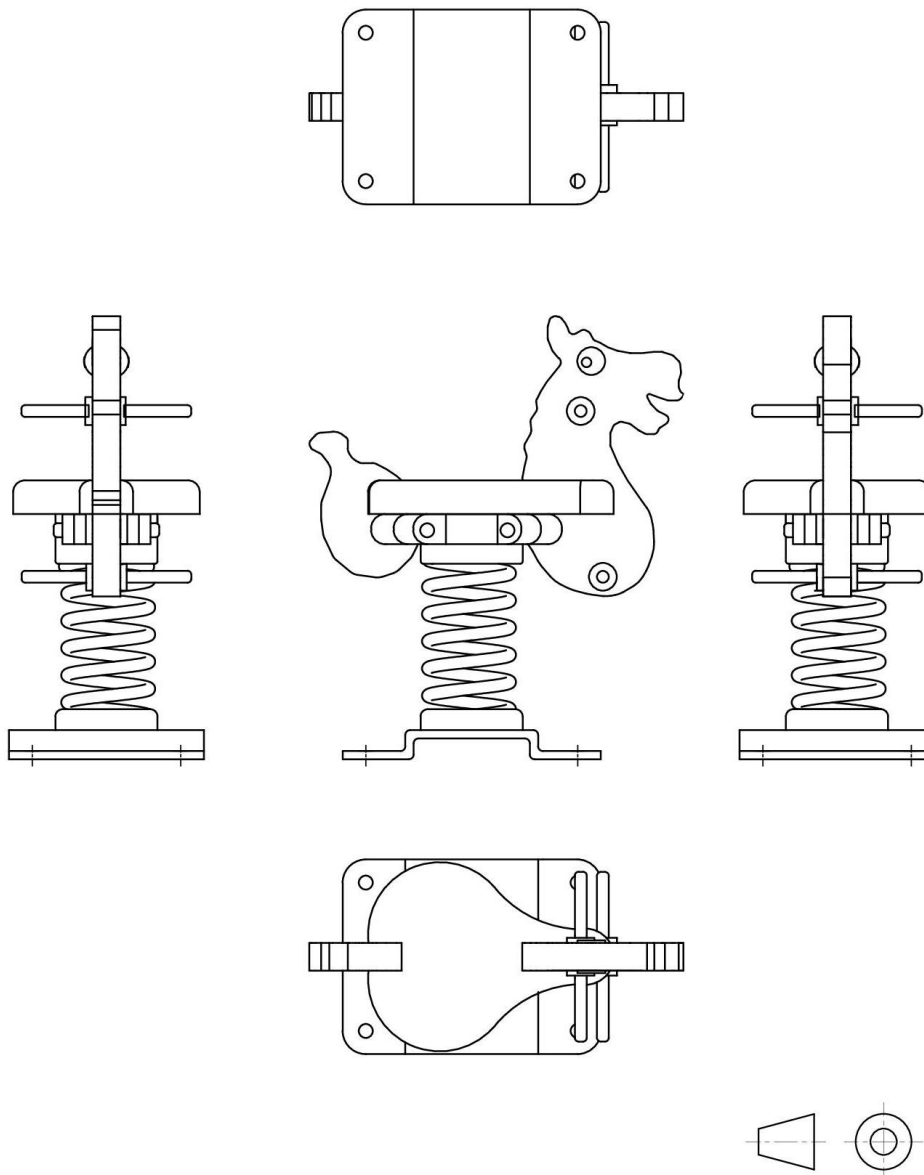
    (Total: 22 marks)

Figure 2

3. Playgrounds offer a chance for children to be active. Playgrounds are also sites where injuries can happen.

   A study about playground safety was commissioned. The following recommendations to minimise injury risk were made:

   a. The equipment and its installation must comply with ISO guidelines.
   b. The area around playground equipment is to be covered with rubber tiles.
   c. Children are to wear proper footwear.
   d. Clothes that have hoods, drawstrings and cords are to be prohibited.
   e. Shades to protect children from the harsh sun are to be provided.
   f. The playgrounds should be regularly inspected.
   g. Children are to be continuously supervised by accompanying adults.
   h. Children are to be educated how to be safe and act responsibly at the playground.

   A public discussion about the above-mentioned recommendations is being planned. The organising committee felt the need to commission a design of an infographic chart to facilitate the presentation of the recommendations.

   You have been requested to design the infographic chart titled **Playground Safety** consisting of keywords together with visual representations of the eight recommendations.

   Notes:
   - Marks will be awarded for an appropriate layout, the use of suitable fonts and the overall visual appeal.
   - Examples of infographic chart layouts are shown in Figure 3.
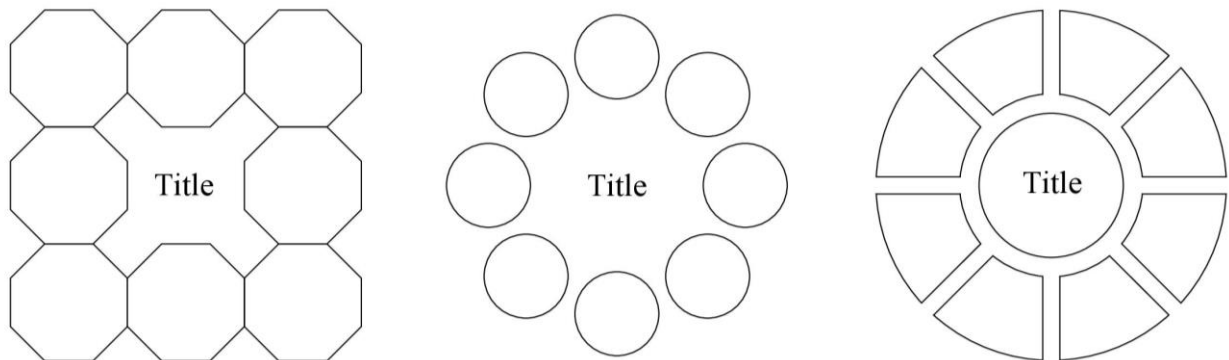
   (Total: 22 marks)

Figure 3

4. **Kids' Fantasy** is the name of a new children's playground. The management of the playground placed an online advert inviting interested graphic artists to take part in their logo design competition. An excerpt of the advert is shown below.

    *   *We want a captivating logo that kids and their parents would love and memorise.*
    *   *The logo must be lively and colourful.*
    *   *The name of the playground is to be combined with simplified graphic elements that remind children of fun at the parks.*
    *   *The font used needs to harmonise with the message described above.*
    *   *The logo is to be printed on the entrance billboard, on tee-shirts and other merchandise.*

    You are required to respond to this advert and present your work as indicated below:

    a. **Written analysis**
        Write down keywords/short phrases associated with kids' playgrounds.   (2)

    b. **Graphical analysis**
        Based on your response to part (a), produce a series of sketches that graphically illustrate your developing ideas.   (4)

    c. **Graphical synthesis**
        Clearly identify those elements produced in your response to part (b) that you intend to use in your final design.   (2)

    d. **Final realisation**
        Produce your final solution in a rectangle 297 x 210 (A4 size) in landscape format as indicated in Figure 4.   (14)

    (Total: 22 marks)

Figure 4

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE
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**ADVANCED MATRICULATION LEVEL
2019 SECOND SESSION**

L-Università
ta' Malta

SUBJECT: **Engineering Drawing**
PAPER NUMBER: II
DATE: 3rd September 2019
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.

Attempt **Question 1** and any other **TWO** questions.

Programmable calculators **cannot** be used.

Unless otherwise stated:

a.   drawings should conform to B.S. or equivalent (ISO) standards;
b.   all dimensions are in millimetres;
c.   all answers are to be accurately drawn with instruments;
d.   all construction lines must be left on each solution;
e.   drawing aids may be used.

Dimensions not given should be estimated using engineering judgement.

Careful layout and presentation are important.

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

Mark allocations are shown in brackets.

Question 1 carries 60 marks. Questions 2, 3 and 4 carry 20 marks each.

1. An illustration of a bench vice, with all the components detached from each other, is shown in Figure 1a. The vice may be easily clamped on and off a work bench when required.

    Detailed dimensions of all the components of the vice are shown in Figures 1b, 1c and 1d on the attached A3 sheets. The component parts are assembled as follows.

    *   The spindle (item 1) is inserted into the 24 mm diameter hole in the fixed jaw (item 2) and fed through until the face of the 38 mm diameter collar is in contact with the flat face of the fixed jaw.
    *   The locking ring (item 3) is screwed onto the M24 thread until the 3 mm diameter hole of the collar is in line with the 3 mm diameter hole of the spindle. The hole is reamed to suit the taper pin.
    *   The taper pin (item 4) is inserted in the reamed hole to secure the collar to the spindle.
    *   The sliding jaw (item 5) is aligned (located) with the slide extending from the fixed jaw until the M18 internal threaded portion of the sliding jaw is located with the M18 external thread of the spindle. The sliding jaw is screwed forward along the slide towards the fixed jaw.
    *   The M16 end of the clamping screw (item 6) is threaded into the M16 internal thread in the 40 mm diameter boss of the fixed jaw.
    *   The pressure cap (item 7) is placed onto the 10 mm diameter end of the clamping screw with the open side facing upward.
    *   An M4 cheese headed screw (item 8) is fitted into the M4 threaded end of the clamp screw. The cap is free to turn when the clamp screw is secured to a bench.
    *   The handle (item 9) of the vice is inserted into the 12 mm diameter hole of the 24 mm diameter end of the spindle (item 1), 14 mm from the end. An end cap is fitted to the M4 thread end of the handle to retain the handle to the spindle.

    Draw, full size:

    a) A sectional elevation about the plane X-X of the assembled vice.

    *   The jaws of the vice are to be drawn 40 mm from each other (apart).
    *   The clamping screw is to be drawn as if the vice is to be fixed to a bench worktop 20 mm thick.
    *   The handle is to be shown vertical with its upper end raised by 24 mm above the horizontal centre line of the spindle.
    *   The pressure cap is to be represented in full section.   (48)

    b) An outside elevation of the assembled vice looking in the direction of the arrow A.   (12)
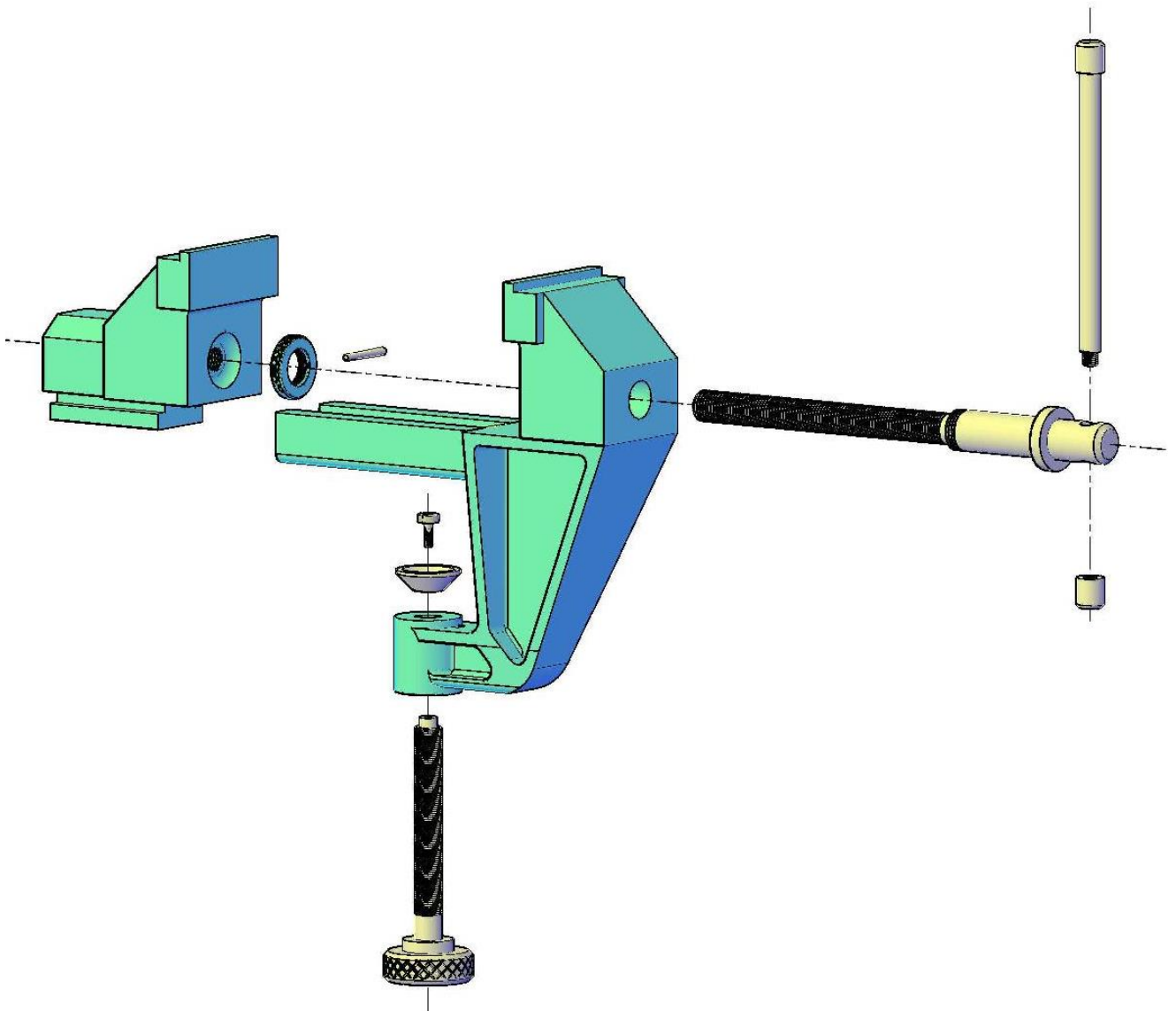
    (Total: 60 marks)

Figure 1a

2. Figure 2 shows five drawings of machine features.
    a) Copy the given figures and substitute the proper method of dimensioning instead of the dimensions shown. (10)
    b) State the technical term used for each feature, write down the meaning of the term and their use. (5)
    c) Explain the function of a lug and draw an isometric freehand sketch of such a feature. (5)
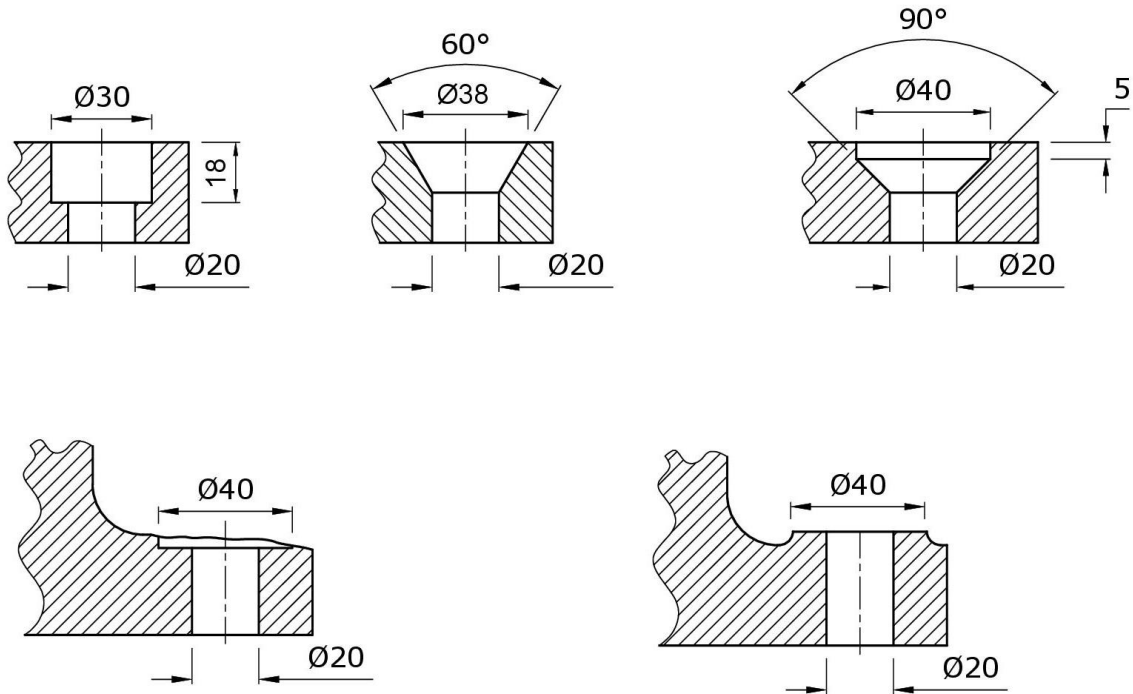
(Total: 20 marks)

Figure 2

3. The basic details of a coupling which is to connect two shafts that have a small degree of misalignment (allows slight axial displacement) is shown in Figure 3.

   a) Sketch neatly, approximately full size and in good proportion, a suitable isometric design of the coupling. The left fork, centre and right fork are to be on the same centre line and are to be shown pulled apart. (14)

   b) Draw a dimensioned orthographic view of the component that is to secure the forks to the centre so as to complete the coupling. (4)

   c) (i) The above coupling is referred to by a particular name, write down the name. (1)

      (ii) State the name of a suitable feature that is to be incorporated between the shafts and the 30 mm diameter bore of the coupling. (1)

(Total: 20 marks)

40   Ø16

16

Ø50   Ø30   50

10   18   R 16

FRONT VIEW OF FORK (2 OFF)

Ø30

Ø30   Ø16

Ø16

FRONT VIEW OF CENTRE (1 OFF)

50

18

PLAN OF CENTRE

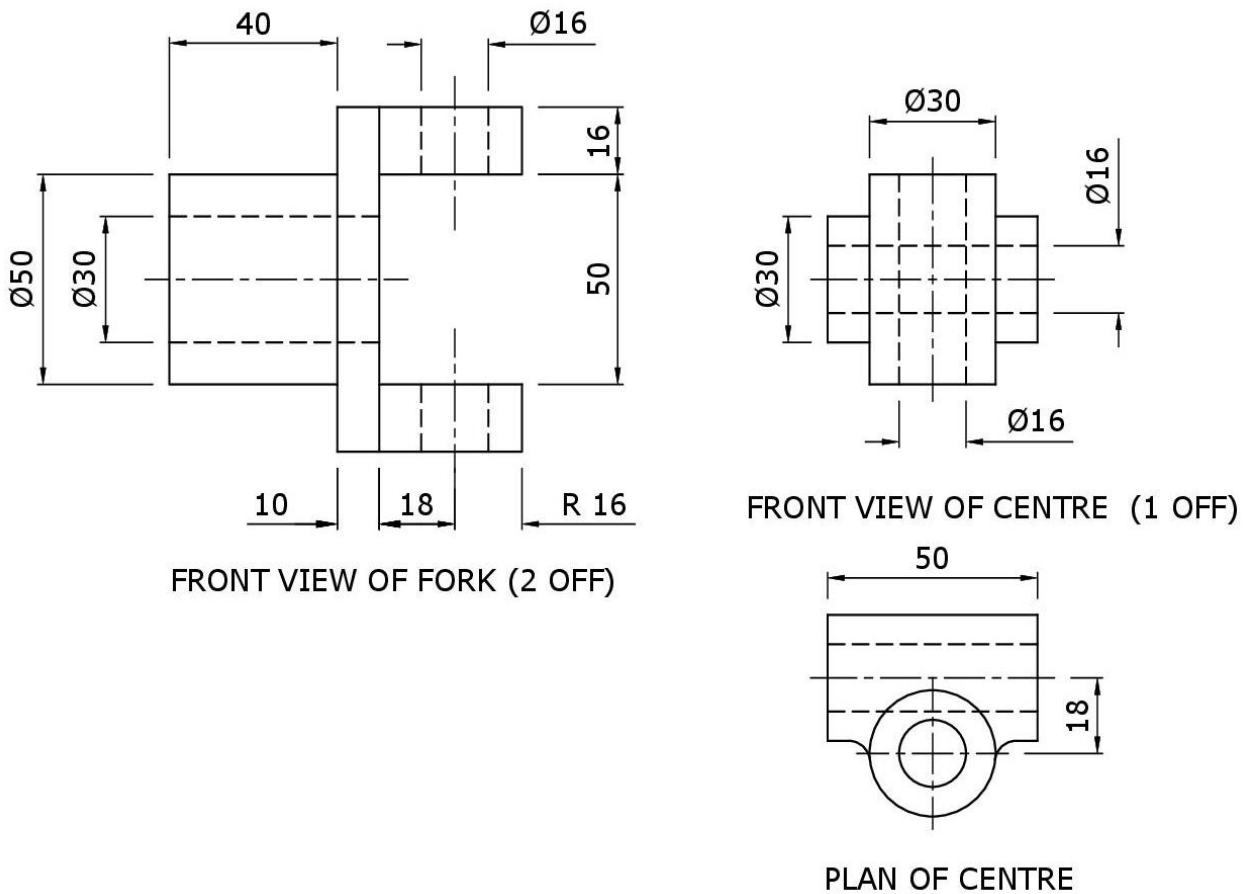Figure 3

4. Four engineering items are illustrated below. You are requested to draw a:
   a) full sectional front elevation of the sliding bracket, assuming a vertical cutting plane to be passing through the line of symmetry of the component; (5)
   b) half sectional front elevation of the bracket assuming an appropriate vertical cutting plane; (5)
   c) front elevation of the chisel with a revolved section to indicate that the main body of the tool is made up of an octagonal bar; (5)
   d) front elevation of the connecting rod with a removed section to indicate the intersecting vertical and horizontal webs. Both webs have the same thickness. (5)

   Notes:
   - Dimensions are to be assumed while maintaining approximately the correct proportions.
   - The front elevations of the four components are to be taken from the direction indicated by the arrows.
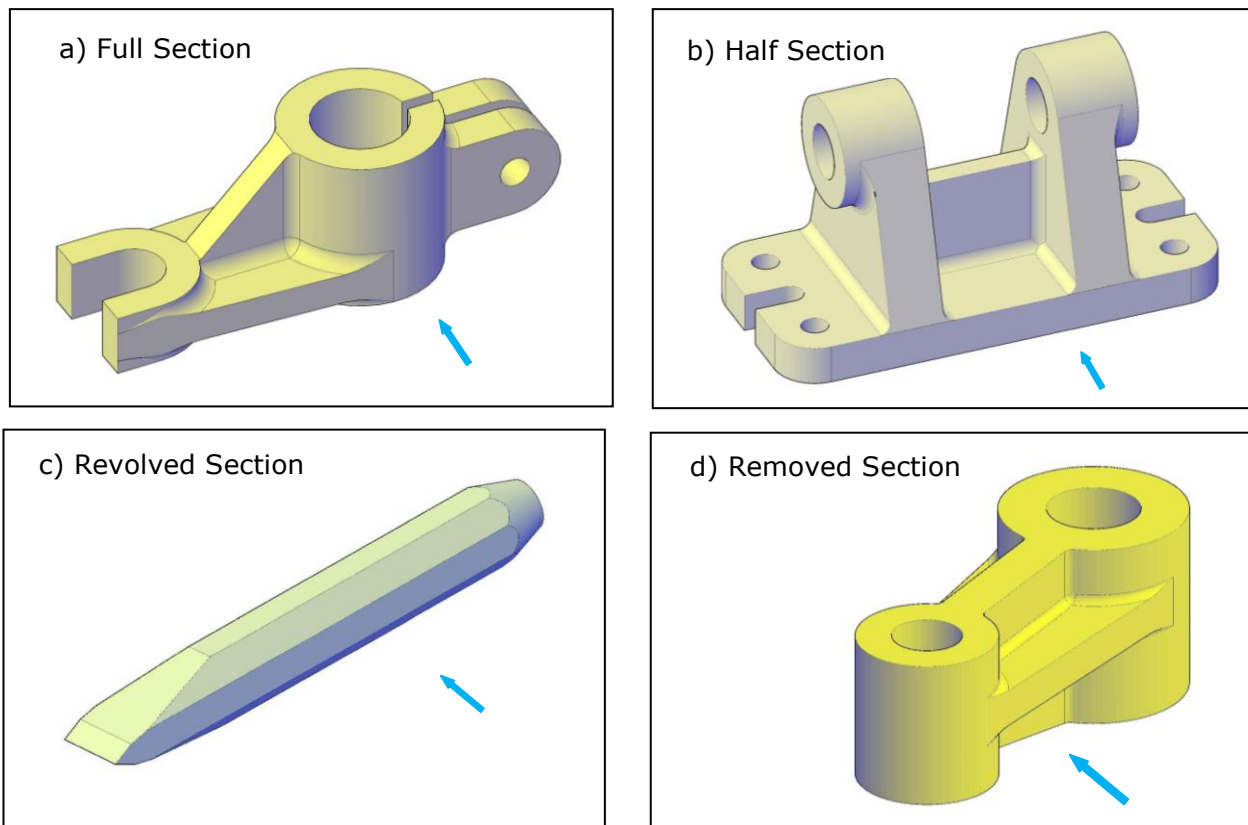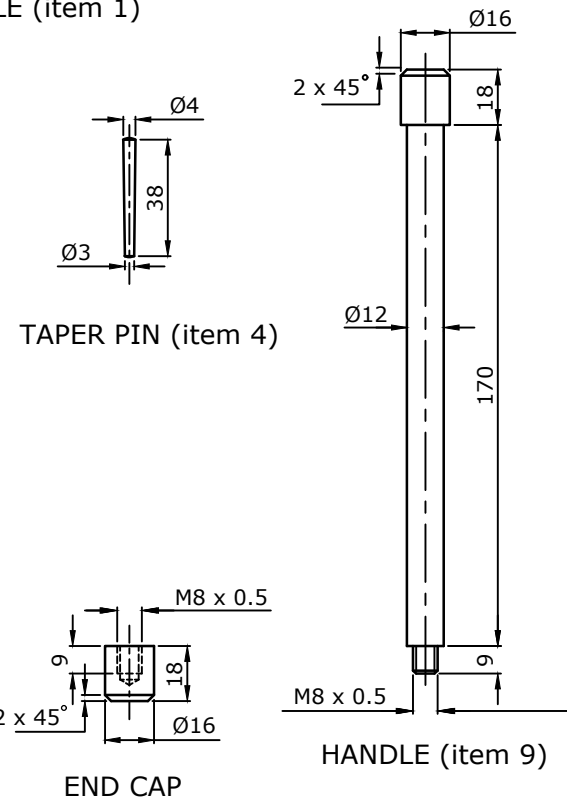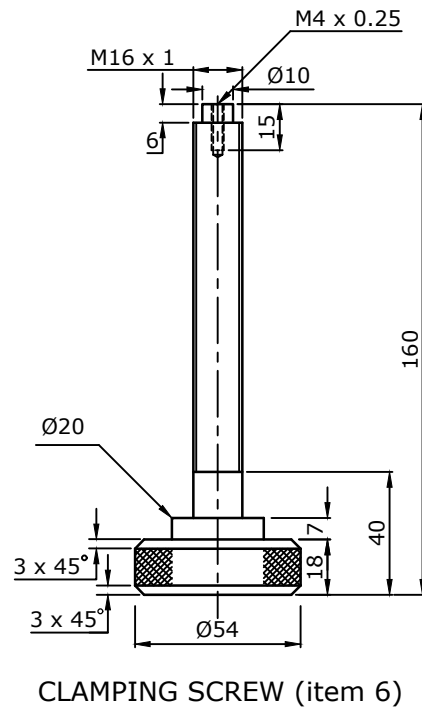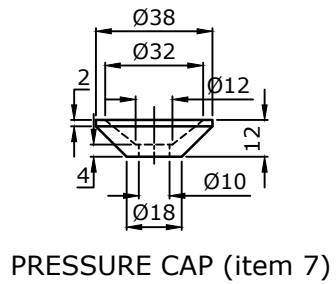
(Total: 20 marks)

a) Full Section

b) Half Section

c) Revolved Section

d) Removed Section

Figure 4

DRILLED & REAMED TO
SUIT TAPER PIN

1 x 45°   Ø38

7

M24 x 0.5

LOCKING RING (item 3)

M24 x 0.5   Ø24   Ø38   Ø24   3 x 45°

2 x 45°

M18 x 2

DRILL TO SUIT TAPER PIN   7 7   62   7   24   DRILL Ø12

45

305

SPINDLE (item 1)

Ø12

15   19

M4 x 0.25

CH. HD. SCREW (item 8)

M16 x 1   M4 x 0.25   Ø10

6   15

Ø16

2 x 45°   18

Ø4

38

Ø3

TAPER PIN (item 4)

Ø12

170

Ø38

Ø32   Ø12

2

12

4   Ø10

Ø18

PRESSURE CAP (item 7)

160

Ø20

3 x 45°

3 x 45°   Ø54

7

40   18

CLAMPING SCREW (item 6)

M8 x 0.5

9   18

2 x 45°   Ø16

END CAP

M8 x 0.5   9

HANDLE (item 9)

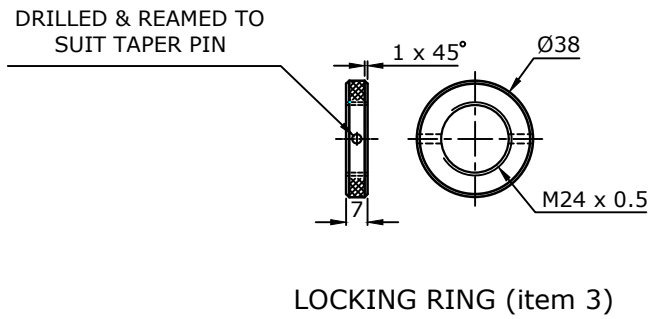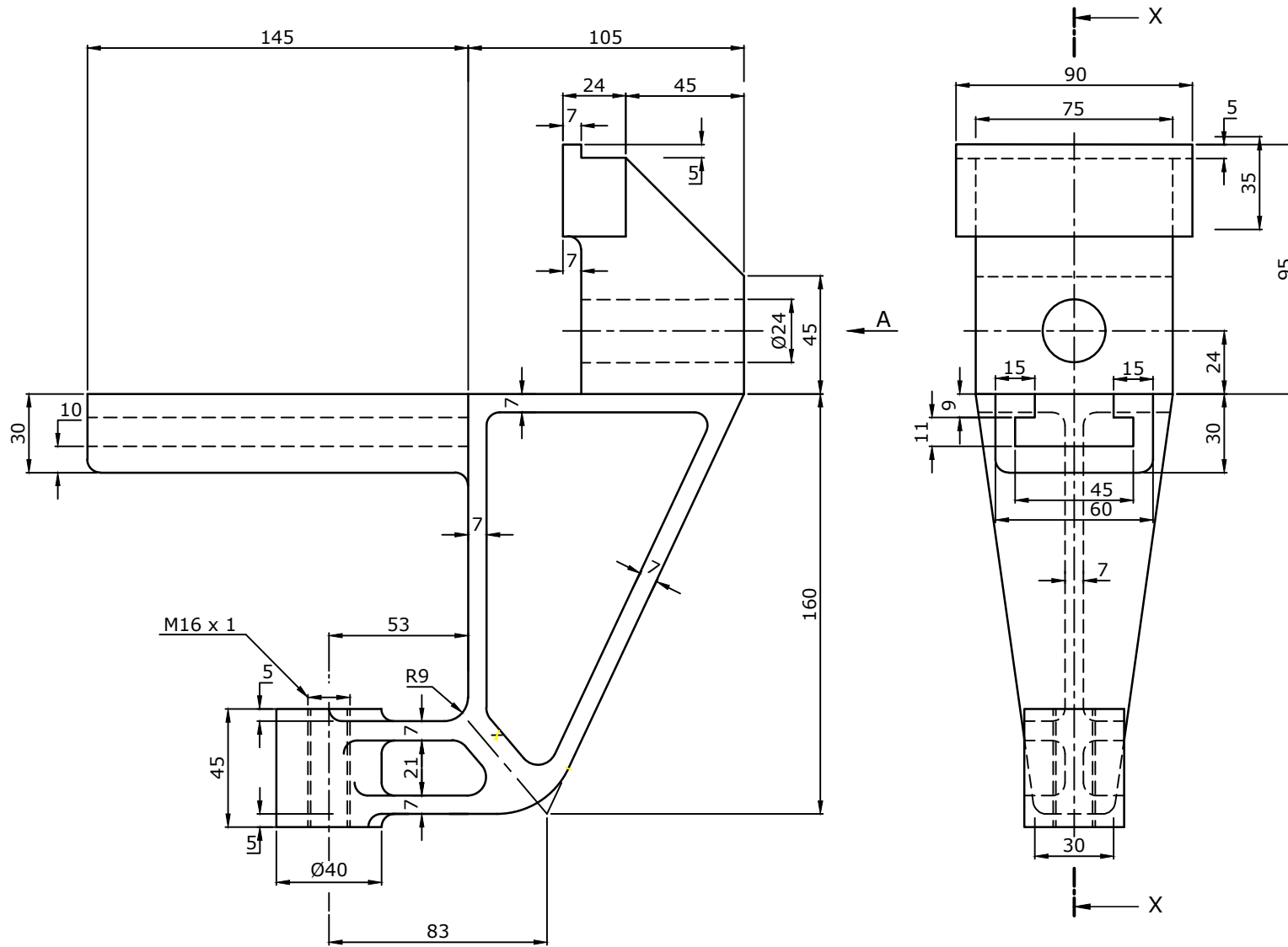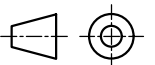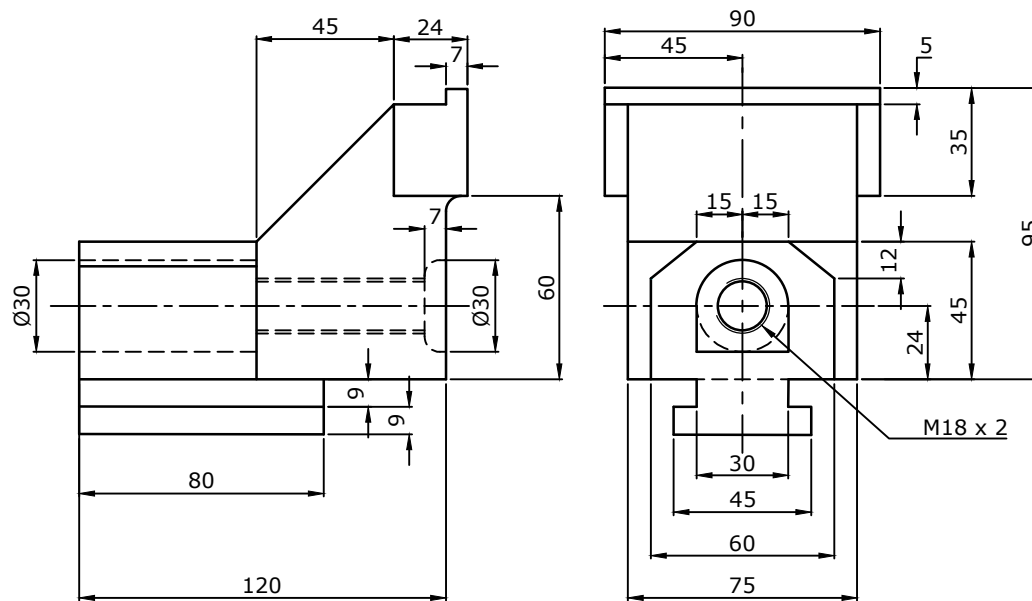UNIVERSITY OF MALTA   MATRICULATION CERTIFICATE EXAMINATION   AM 09 19s ENGINEERING DRAWING PAPER II   QUESTION 1   FIGURE 1b

FIXED JAW (item 2)

SLIDING JAW (item 5)

UNIVERSITY OF MALTA   MATRICULATION CERTIFICATE EXAMINATION | AM 09 19s ENGINEERING DRAWING PAPER II   QUESTION 1 | FIGURE 1d