

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD  
UNIVERSITY OF MALTA, MSIDA

MATRICULATION EXAMINATION  
ADVANCED LEVEL  
MAY 2016

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<b>SUBJECT:</b>	ENGINEERING DRAWING/GRAPHICAL COMMUNICATION
<b>PAPER NUMBER:</b>	I
<b>DATE:</b>	25 <sup>th</sup> April 2016
<b>TIME:</b>	9.00 a.m. to 12.05 p.m.

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**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:

- drawings should conform to B.S. or equivalent (ISO) standards;
- all dimensions are in millimetres;
- all answers are to be accurately drawn with instruments;
- unless otherwise stated, all construction lines must be left in each solution;
- drawing aids may be used.

Dimensions not given should be estimated.

Careful layout and presentation are important.

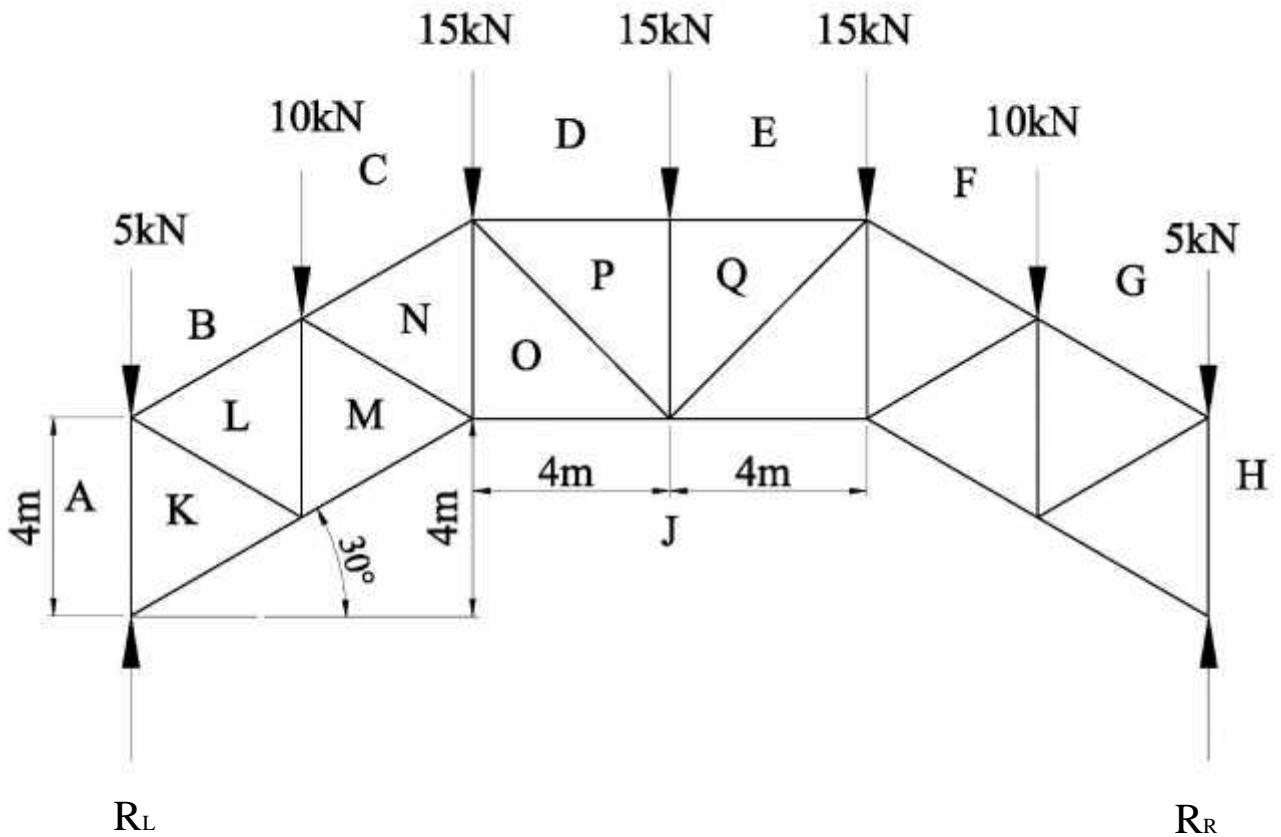
Marks will be awarded for accuracy, clarity and appropriateness of constructions.

**Question 1**

Figure 1 illustrates a Foot Bridge Truss.

- a) Copy the Foot Bridge Truss loaded as shown in Figure 1. Use a scale of 10 mm representing 1 metre. **(3 marks)**
  - b) Using a scale of 10 mm representing 5 kN, determine graphically the:
    - i) reaction on the left;
    - ii) reaction on the right;
    - iii) nature and magnitude of the forces in the members AK, KJ, KL, BL, LM, MJ, MN, CN, NO, OJ, OP, DP and PQ. **(13 marks)**
  - c) Show on the space diagram, by use of arrows, which members are in compression or/and in tension. **(3 marks)**
  - d) State, which member/s can be removed from the frame without theoretically causing its collapse while the remaining members maintain a static equilibrium. State the technical term for such members. **(1 mark)**
- (20 marks)**

SPACE DIAGRAM



**Figure 1**

**Question 2**

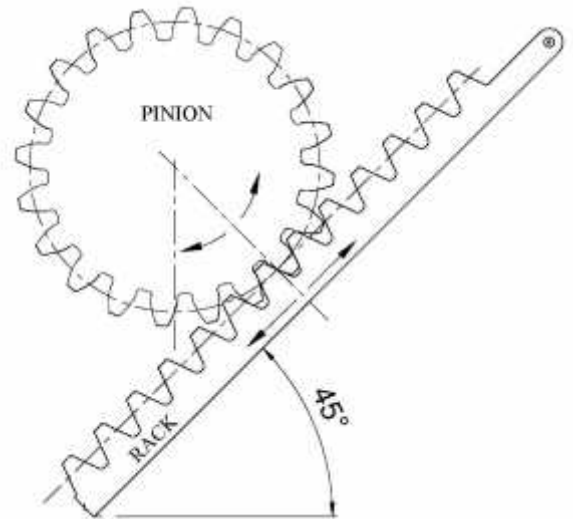
The rack and pinion illustrated in Figure 2a are connected to a part of a machinery. Various linkages are attached to the end of the rack so that when the pinion rotates other parts of the machinery are operated.

Draw full size:

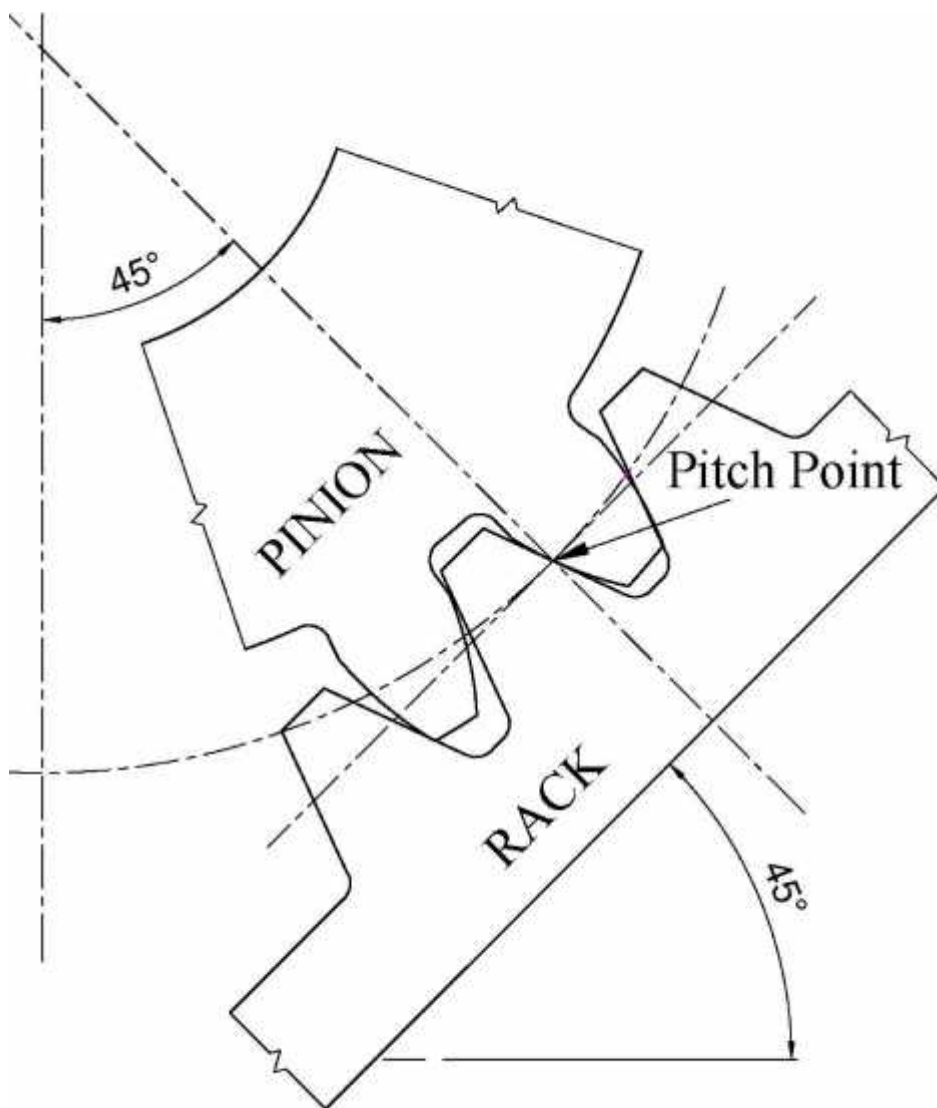
- a) Two teeth of the pinion. *The number of teeth on the pinion is 20 and the module is 16. The pressure angle is 20°.* Show the construction of the spur pinion tooth profile of true involute on one flank side. **(14 marks)**
- b) Show three rack teeth in mesh with the pinion as shown in Figure 2b. **(6 marks)**

*Note: Spur gear data is to be neatly presented.*

**(20 marks)**



**Figure 2a**



**Figure 2b**

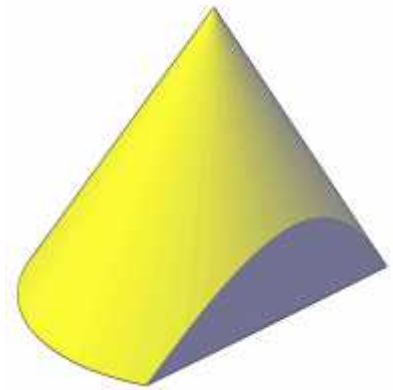
**Question 3**

A cutting plane passing through a right cone is shown in Figure 3a. The line SP is a cutting plane which cuts the conical surface of the cone. The position of the cutting plane SP in relation to the vertical axis A-A is shown in Figure 3b. O is the centre of the focal sphere tangent to the slant sides of the cone and the line representing the section plane SP.

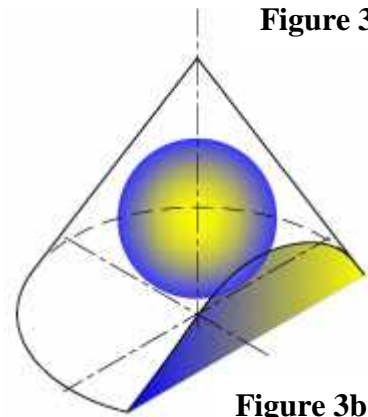
Copy, full size, Figure 3c, and:

- a) locate the position of the centre O of the focal sphere; **(4 marks)**
- b) find the position of the directrix, vertex and the focal point of the conic; **(3 marks)**
- c) state the ratio of eccentricity of the conic section; **(2 marks)**
- d) using a directrix line, a transverse axis, the position of the focus and vertex found in (b), draw the true shape of the section plane; **(10 marks)**
- e) name the shape of the generated conic. **(1 mark)**

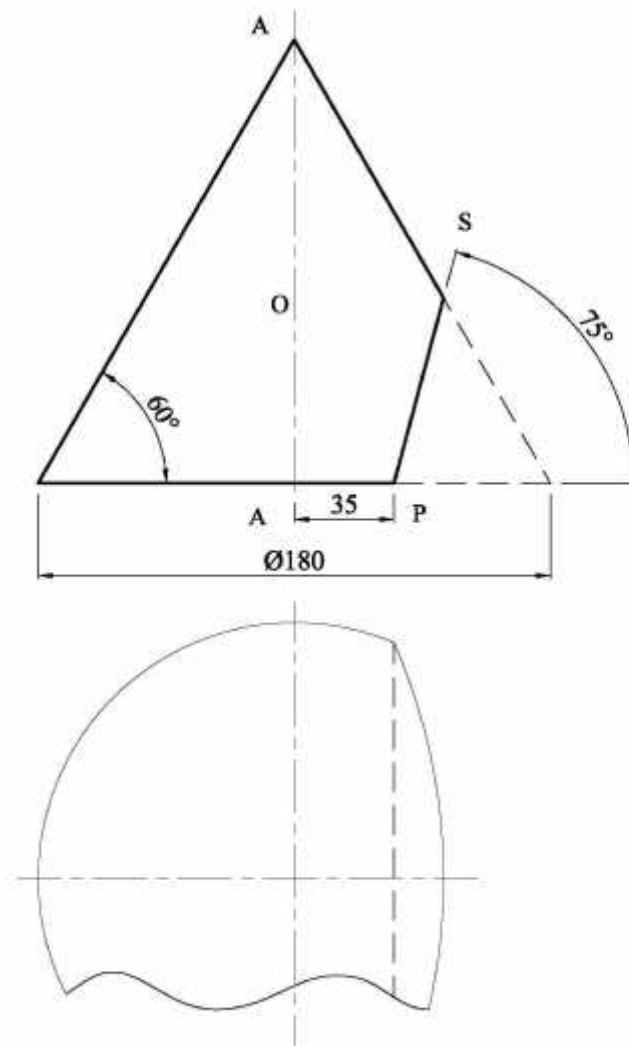
**(20 marks)**



**Figure 3a**



**Figure 3b**



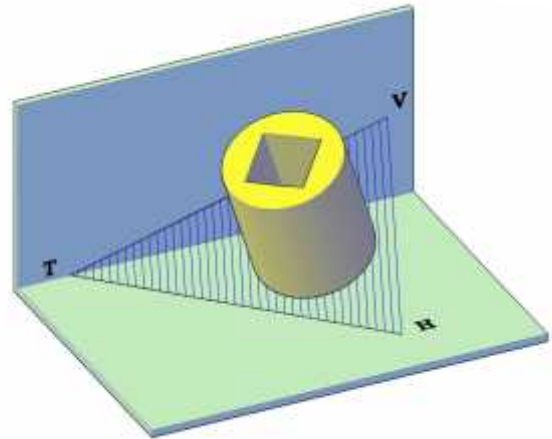
**Figure 3c**

**Question 4**

Figure 4a shows an illustration of a socket resting on an inclined plane.

Figure 4b shows the traces of the oblique plane and the location of the centre of the base of the socket (centre O).

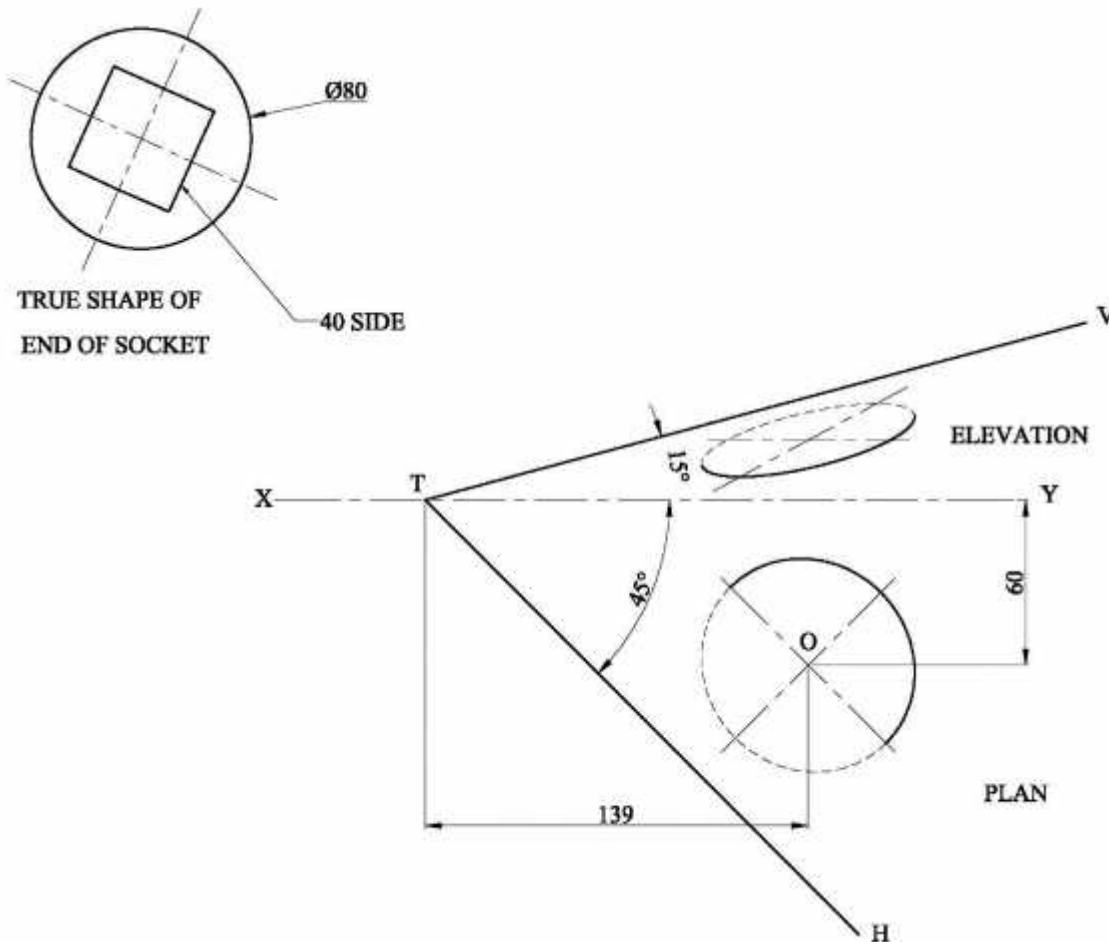
- a) Copy, full size, Figure 4b and draw an auxiliary elevation showing the oblique plane as an inclined plane. State the angle that the oblique makes with the horizontal plane. **(5 marks)**
- b) Draw the cylindrical socket  $\text{Ø}80$  mm and 90 mm long resting on the inclined plane. The 40 mm x 40 mm square hole on the top face is 45 mm deep. **(3 marks)**
- c) Complete the plan of the socket as in Figure 4b. **(6 marks)**
- d) Project the front elevation of the socket as in Figure 4b. **(6 marks)**



**Figure 4a**

*Note: Do not show hidden detail.*

**(20 marks)**

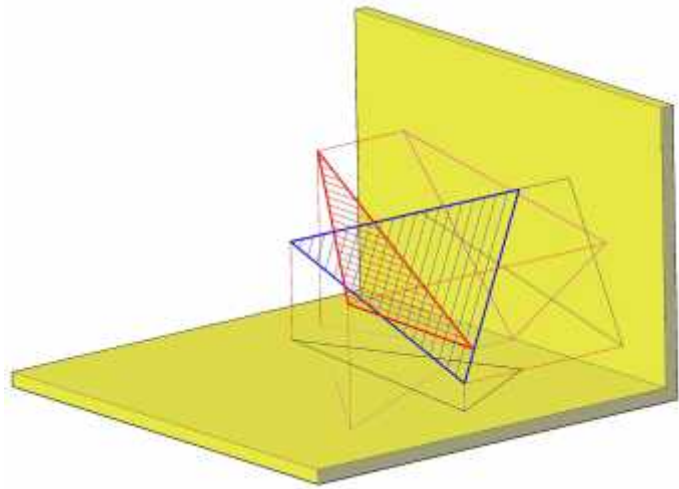


**Figure 4b**

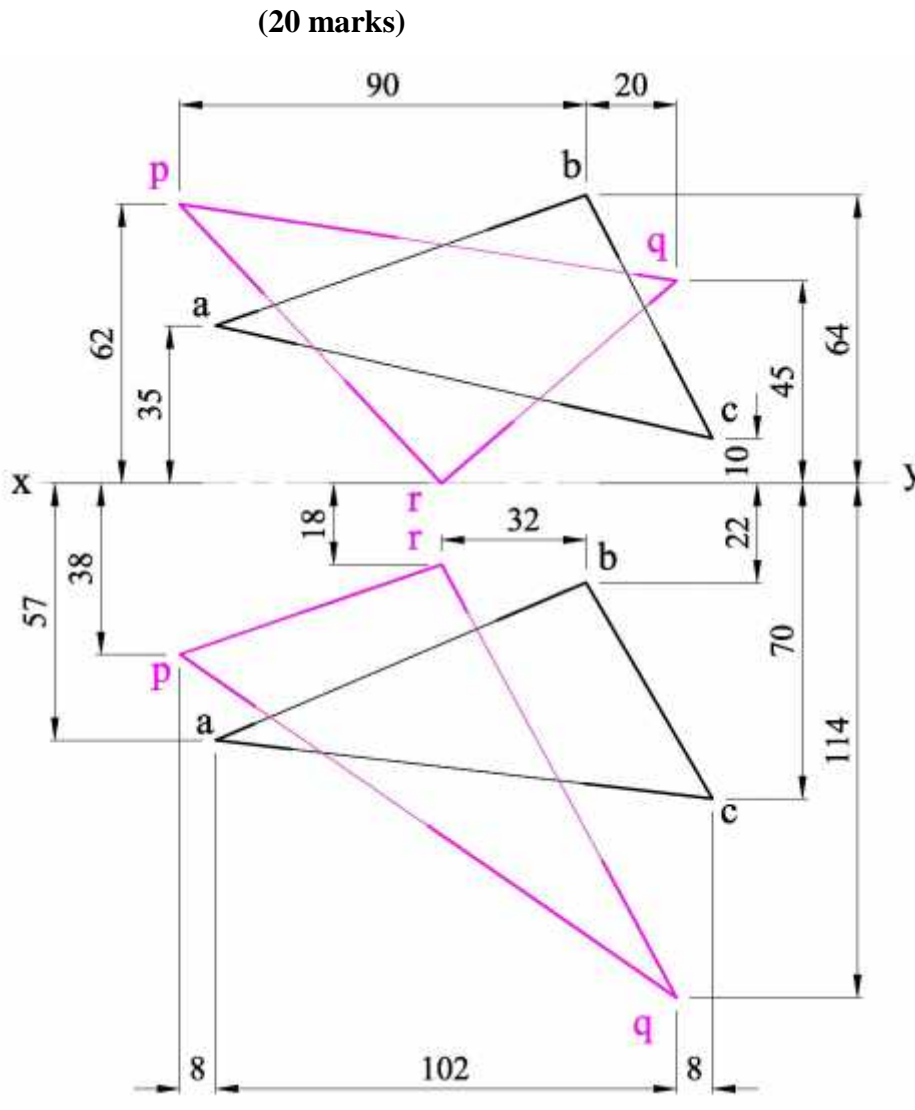
**Question 5**

Incomplete views of two intersecting triangles are shown in Figures 5a and 5b.

- a) To a scale of 1:1, copy the elevation and plan in their correct position. **(4 marks)**
- b) Construct an auxiliary elevation of the planes, showing one of the triangle as an edge view and locate the points of intersection. **(4 marks)**
- c) Project the points of intersection to complete the plan and elevation of the two triangles. **(5 marks)**
- d) Draw an auxiliary view of the two triangles showing the line of intersection as a true length. **(3 marks)**
- e) Create a second auxiliary view showing the two triangles as two intersecting lines. State the true angles between the two triangles. **(4 marks)**



**Figure 5a**



**Figure 5b**

**Question 6**

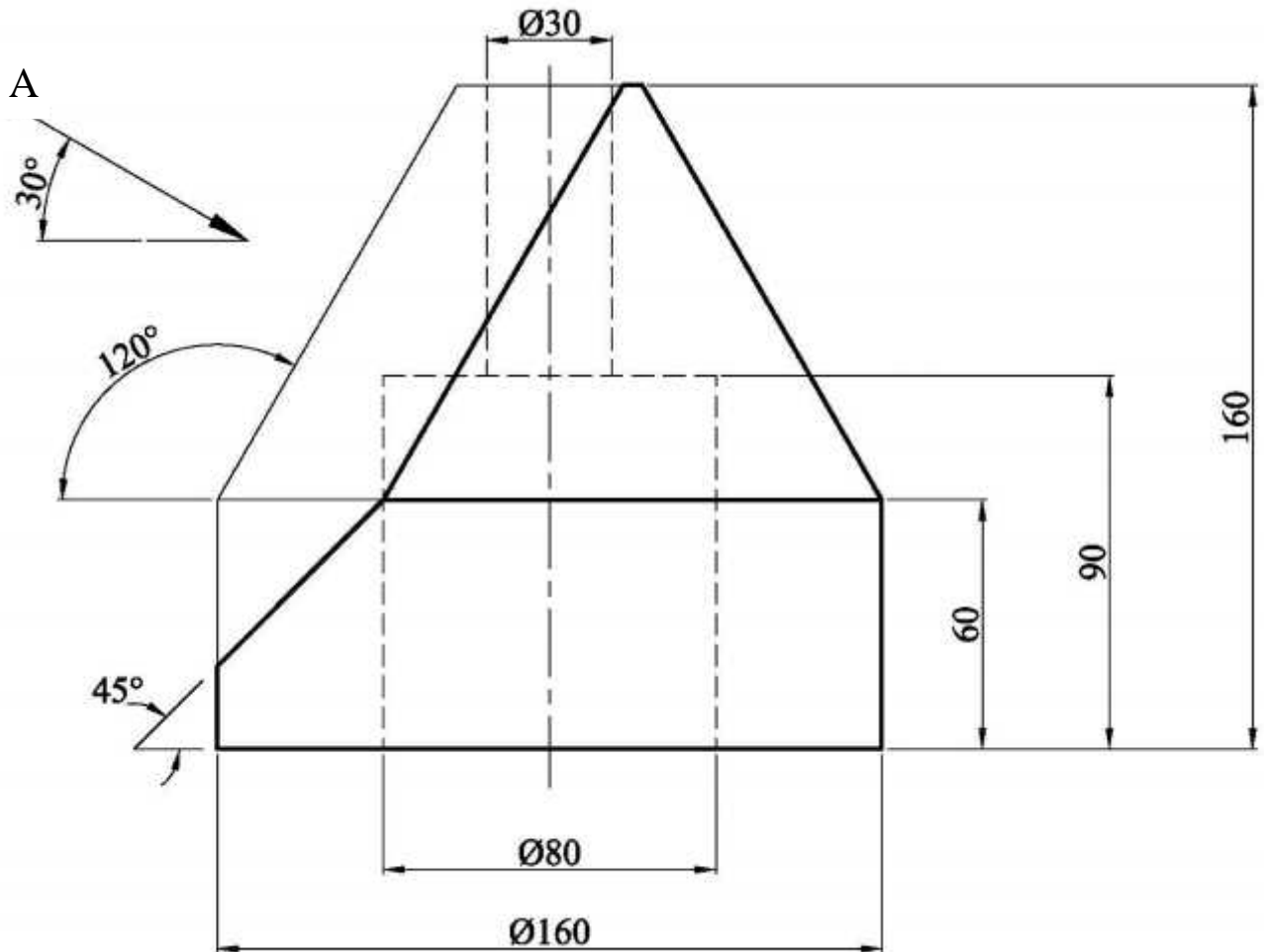
A jig is formed from a solid cylindrical rod. The lower part of the jig is a right cylinder and the upper part is machined to form a frustum of a cone. Two cylindrical holes are drilled centrally through the jig. The jig is finally machined by sectioning the conical portion by a cut parallel to the slant height and the cylindrical portion by a section plane of 45° to the horizontal.

- a) Copy, full size, the elevation of the jig detail as shown in Figure 6. **(3 marks)**
- b) Project an auxiliary plan in the direction of arrow A, perpendicular to the slant height of the cone. **(15 marks)**
- c) Label the names of the profiles generated by the cut cone and the cut cylinder. **(2 marks)**

Use third or first angle projection.

*Do not show hidden detail.*

**(20 marks)**



**Figure 6**

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<b>SUBJECT:</b>	ENGINEERING DRAWING
<b>PAPER NUMBER:</b>	II
<b>DATE:</b>	25 <sup>th</sup> April 2016
<b>TIME:</b>	4.00 p.m. to 7.05 p.m.

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**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.

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.



### Question 1

An exploded view of a mechanism for the operation of a Clutch is shown in Figure 1(a). Detail drawings of the individual components are given in Figure 1(b) and 1(c) on the attached A3 sheets. The clutch is assembled as follows:

- The base (Item 1) with the 30 mm horizontal bore is to receive the 30 mm diameter shaft (Item 2).
- Two M12 hexagonal bolts, washers and nuts (not shown) secure the left and right thrust pieces (Item 3 & 4) together.
- The left hand rocker arm (Item 5) with the 30 mm bore is located on the left hand side of the shaft with the taper pin hole of the left rocker arm in line with the taper pin hole of the shaft marked 'P'. The face marked 'A' of the rocker arm is to be assembled on the shaft facing inwards towards the face marked 'A' of the base. A taper pin at 'P' (not shown) locks the rocker arm and the shaft together.
- The 18 mm diameter x 22 mm end of the thrust piece is located in the 18 mm diameter bore of the rocker arm.
- The 30 mm diameter bore of the right rocker arm (Item 6) is fitted on the shaft with face 'B' facing inwards towards the face 'B' of the base.
- The 18 mm diameter x 22mm end of the right thrust piece is located in the bore of the right 18 mm bore of the rocker arm. The pin hole of the rocker arm 'Q' is to be in line with the pin hole marked 'Q' of the shaft. Another taper pin at 'Q' (not shown) locks the rocker arm and shaft together, with the assembled thrust pieces free to swivel about the rocker arms ends.
- The handle (Item 7) is secured to the lever arm (Item 8) by two M10 hexagonal bolts, washers and nuts (not shown). The handle is assembled with the rounded semi-circular chamfered end on the top side. Handle and lever arm are located on to the right hand end of the shaft. The lever arm is to be installed with face 'C' of the 30 mm bore oriented as face 'C' of the right hand end of the shaft.
- A rectangular 8 x 4 mm key locks the lever arm and shaft together.

Draw, to a scale of 1:1, the following views of the assembly:

- a) a front elevation showing:
- (i) an outside front elevation on the left hand side about the vertical centre-line and;
  - (ii) a sectional front elevation on the right hand side about the vertical centre-line;
- (49 marks)**
- b) an end elevation as seen from the left hand side. **(11 marks)**

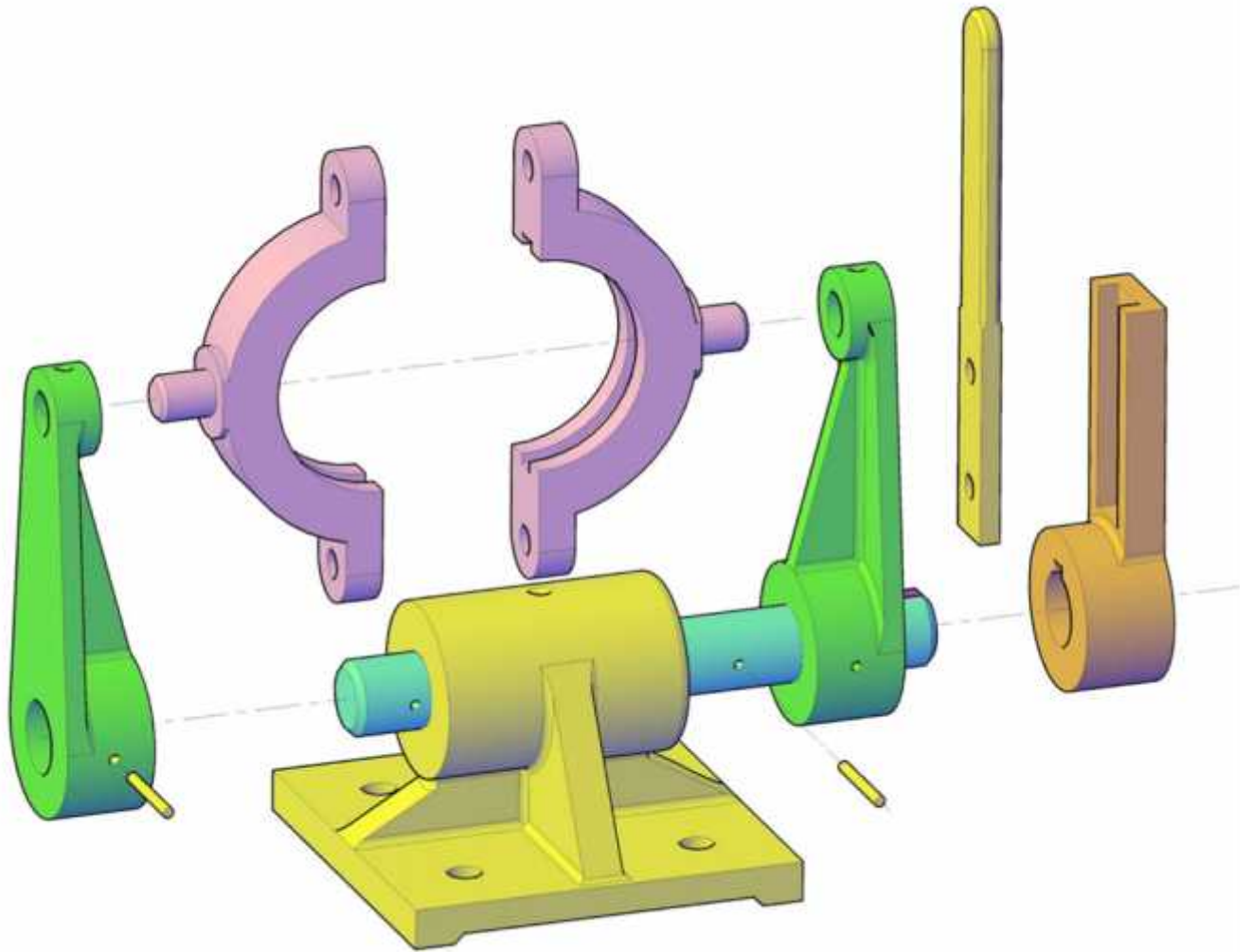
*Note:* Show on the assembly:

- One suitable bolt, washer and nut on the top of the thrust piece.
- A key on the shaft. (use local section)

*Do NOT show any hidden detail.*

**(60 marks total)**

## EXPLODED VIEW OF CLUTCH MECHANISM



**Figure 1**

**Question 2**

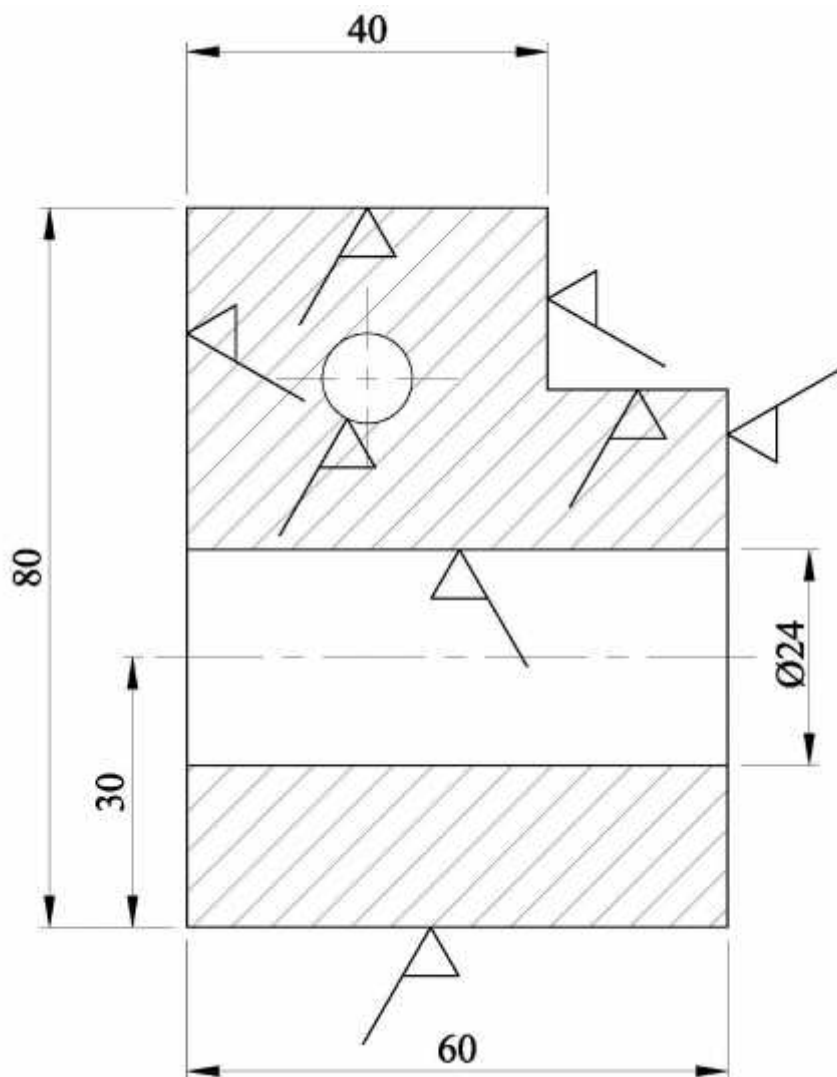
**(a) Machining Symbols**

Each manufacturing process produces a surface texture. Surface texture is one of the important factors that control friction and transfer formation during sliding. If a surface has to be finished by a machining process, the general machining symbol is used.

Figure 2(a) below shows incorrect presentations of applying the general machining symbol to a drawing.

Copy, the given figure and include the machining symbol correctly. Leader lines and projection lines may be used for machining symbols. Do not show dimensions (to this view.)

**(9 marks)**



**Figure 2 (a)**

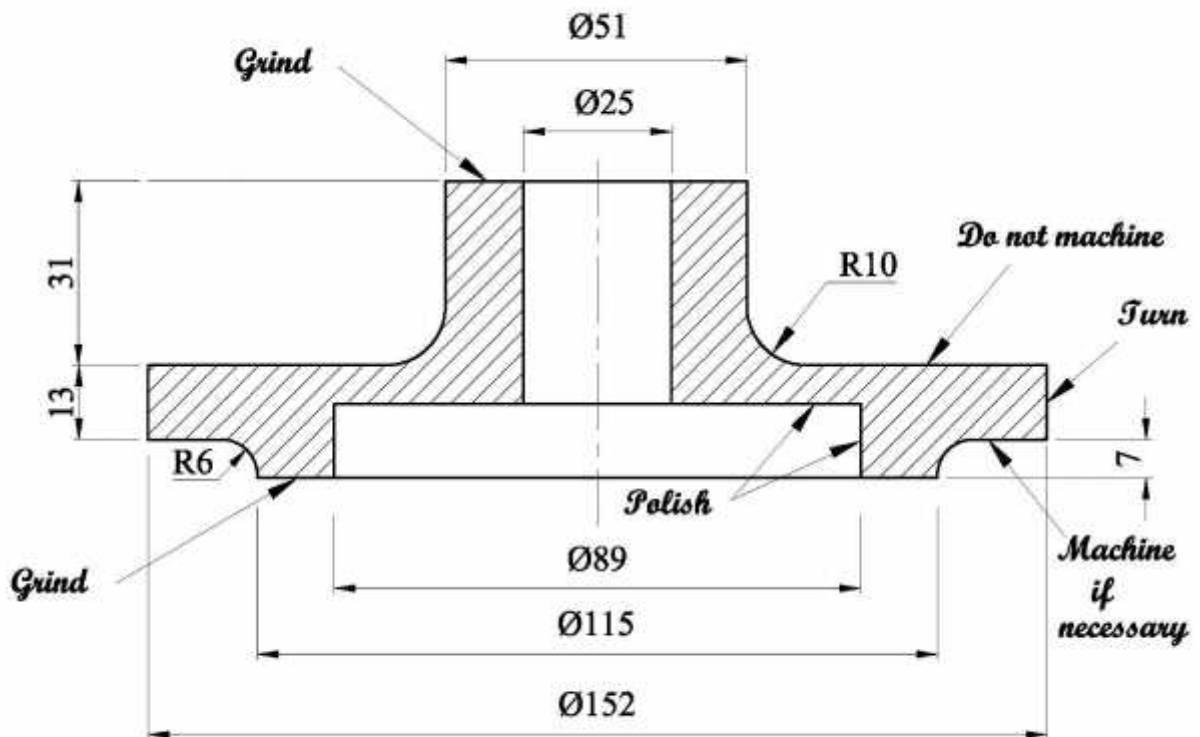
**Question 2 (b)**

Figure 2 (b) shows a sectional elevation of a cover.

- (i) Use a suitable scale to copy the given sectional elevation.
- (ii) Replace the text labelling by showing the surface finish machining symbols with the appropriate texture roughness value.

**(11 marks)**

**(20 marks total)**



**Figure 2 (b)**

**Question 3 (a)**

Welding is a process of uniting two pieces of metal by fusing them together to form a permanent joint. In engineering drawing, welding requirements are made clear and unambiguous by using welding symbols. These symbols give instructions as to the type of welds and their positions. The type of weld to be made is indicated by the type of weld symbol.

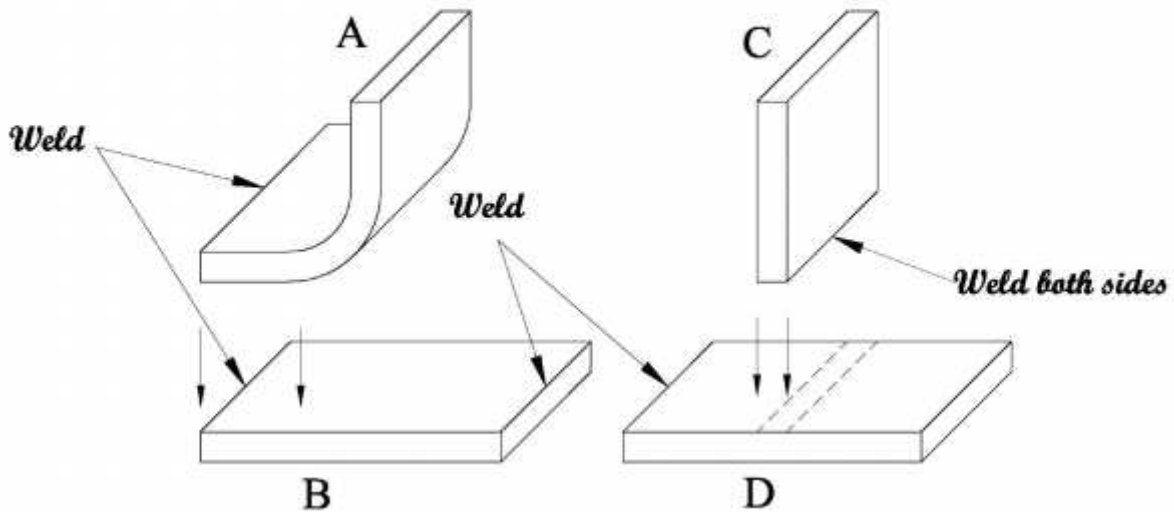
The four plates shown in Figure 3(a) are to be welded together. Plate A welded to plate B, plate C to plate D and plate B to plate D. The weld between the plate B and plate D is required to have a 'flush' finish at the lower part of the base.

Draw, using a suitable scale, an elevation of the four plates welded together, showing:

- (i) the most suitable type of weld used;
- (ii) the weld symbol.

Label each type of weld chosen.

**(9 marks)**



**Figure 3 (a)**

**Question 3 (b)**

The component shown in Figure 3 (b) shows

- a square bar 60 x 30 x 30 with a cylindrical rod 50 x 20 diameter welded to it;
- an angle bar 50 x 20 x 20 x 5 is shown welded to the square bar at right angles to the cylindrical rod;
- an upright flat bar 50 x 20 x 5 welded at right angles to the square bar. This bar is to be welded to the square bar 'on site'.

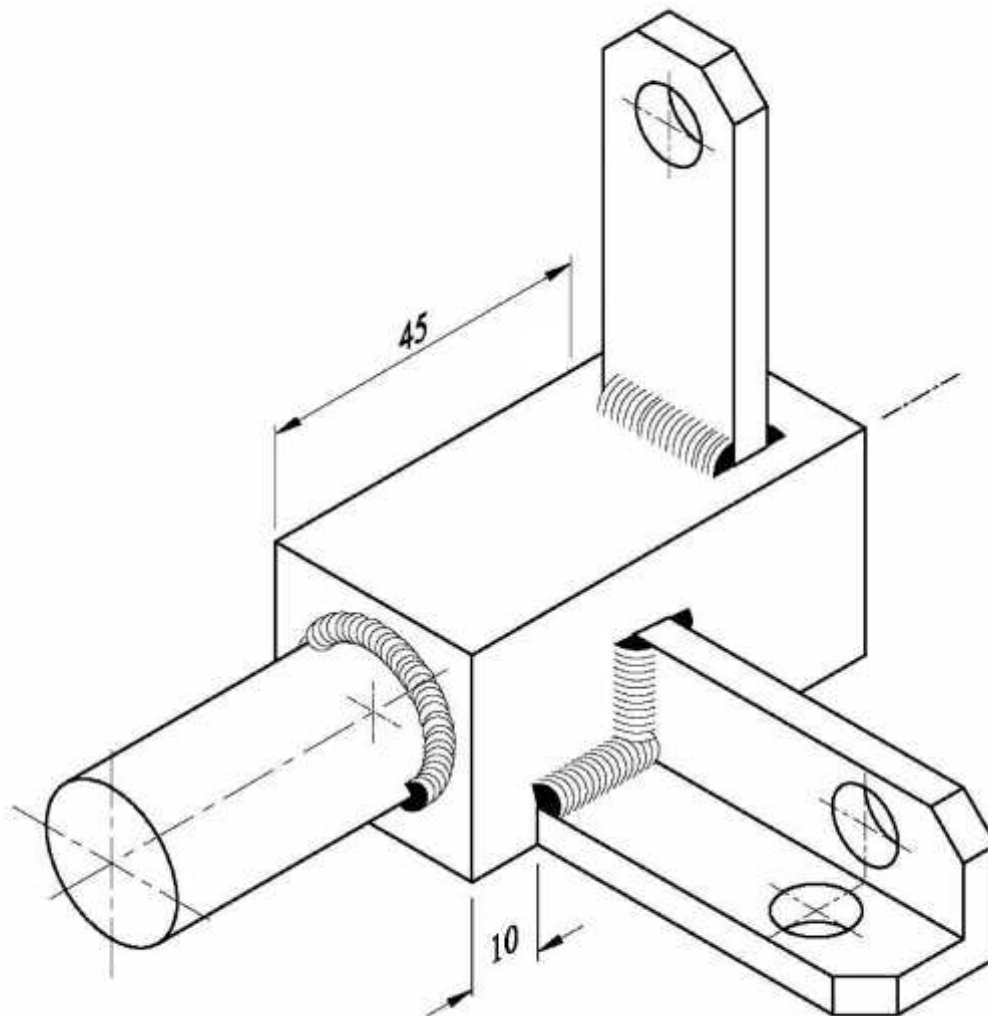
Draw, approximately full size or using a suitable scale, an elevation of the component with the appropriate weld symbols at the joints.

Name the type of weld used at the joints.

*Do not show hidden detail.*

**(11 marks)**

**(20 marks total)**



**Figure 3 (b)**

**Question 4**

Valves are the components in the piping system that control and regulate the flow of fluids. Certain valves prevent a backflow in a pipe.

Details of the flanged lift- plug check valve in a piping system bolted to two flanged pipes are given in Figure 4.

Draw, approximately full size, and in proportion, a sectional elevation of the Lift-plug check valve. The design is to show the main housing with a top cover to allow assembly and inspection of the valve. The design of the valve is to permit the lift-plug;

- to move upwards to allow fluid to surge in the direction of flow;
- to return to its original position and block the passage in reverse flow, to prevent back flow.

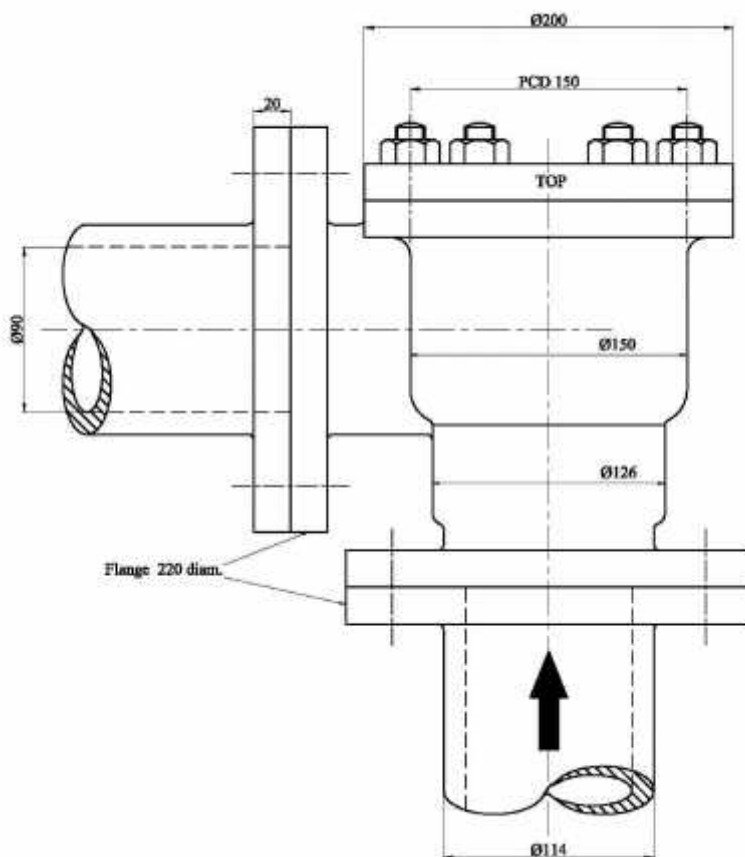
In the design include a feature that:

- limits the lift of the plug;
- keep the lift-plug aligned.

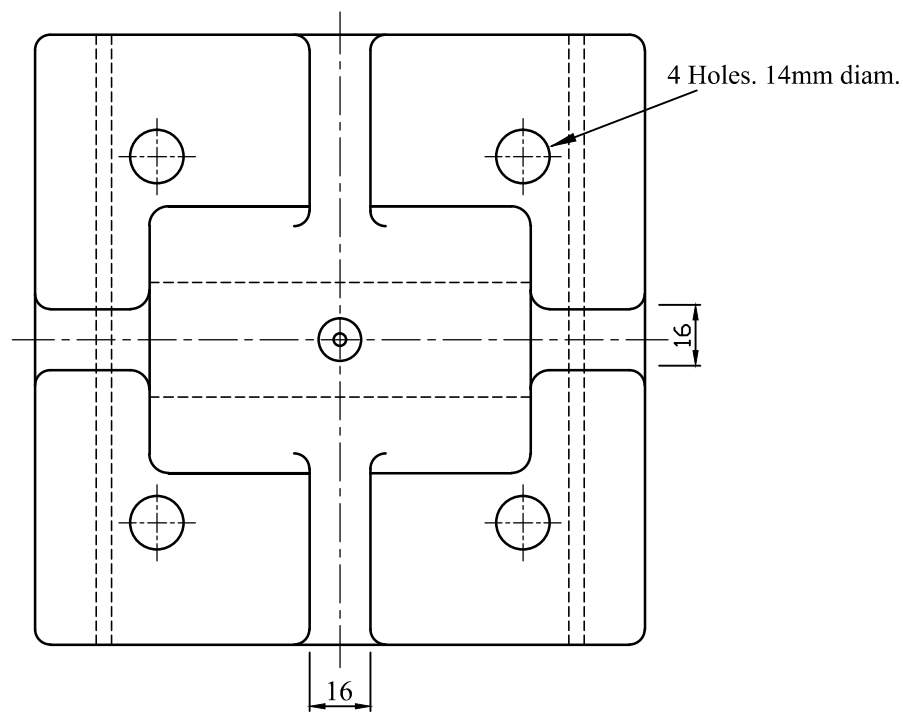
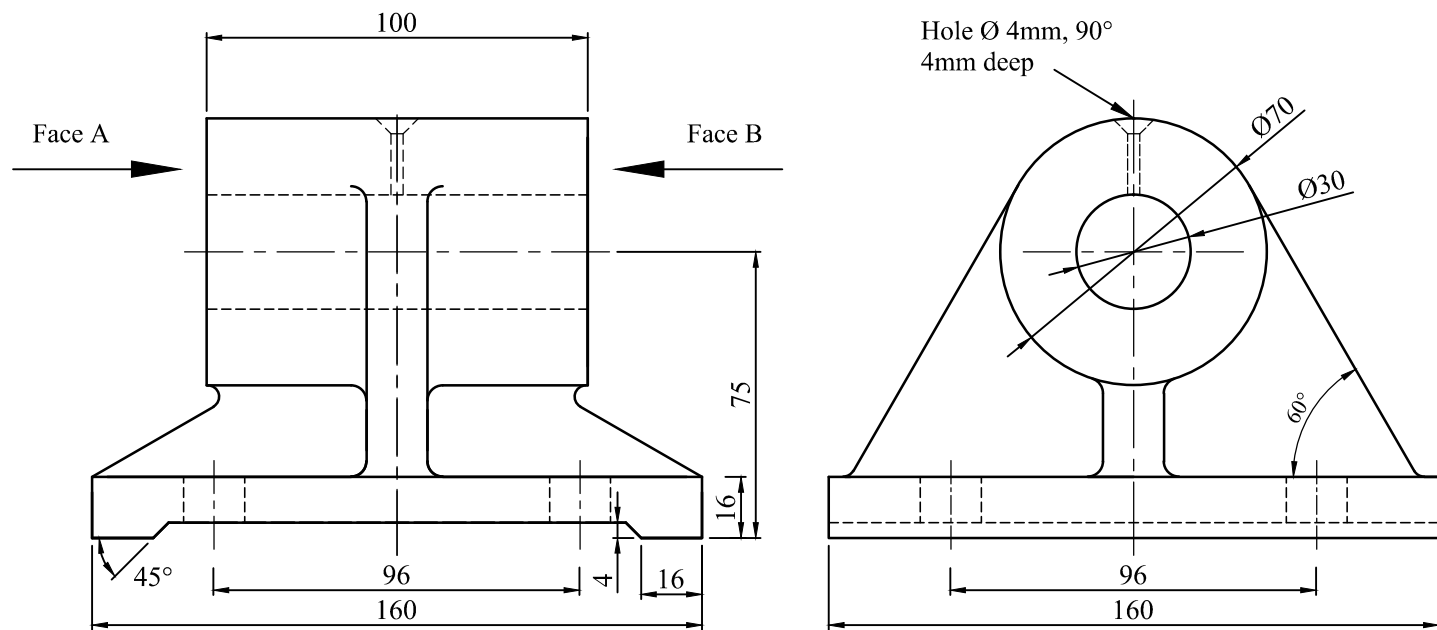
The lift-plug is to be shown in the closed position resting on the bush surface.

*State the material of the main housing case, the valve and the bush.*

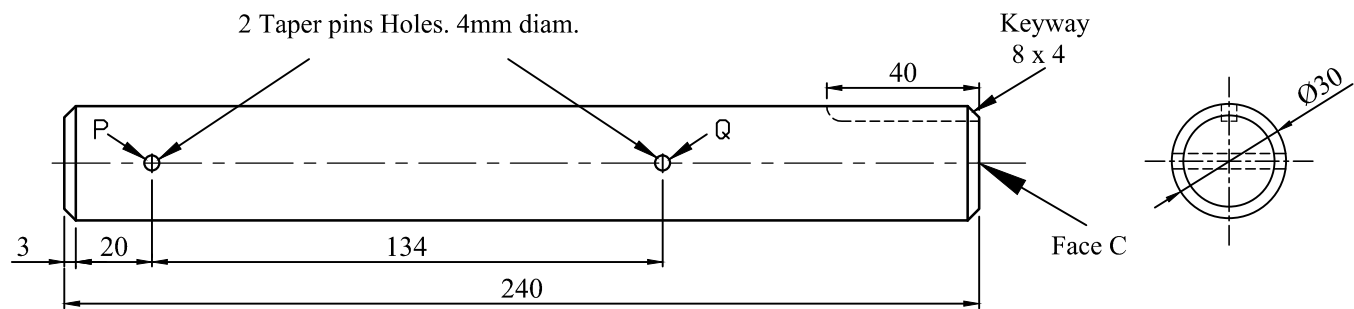
**(20 marks)**



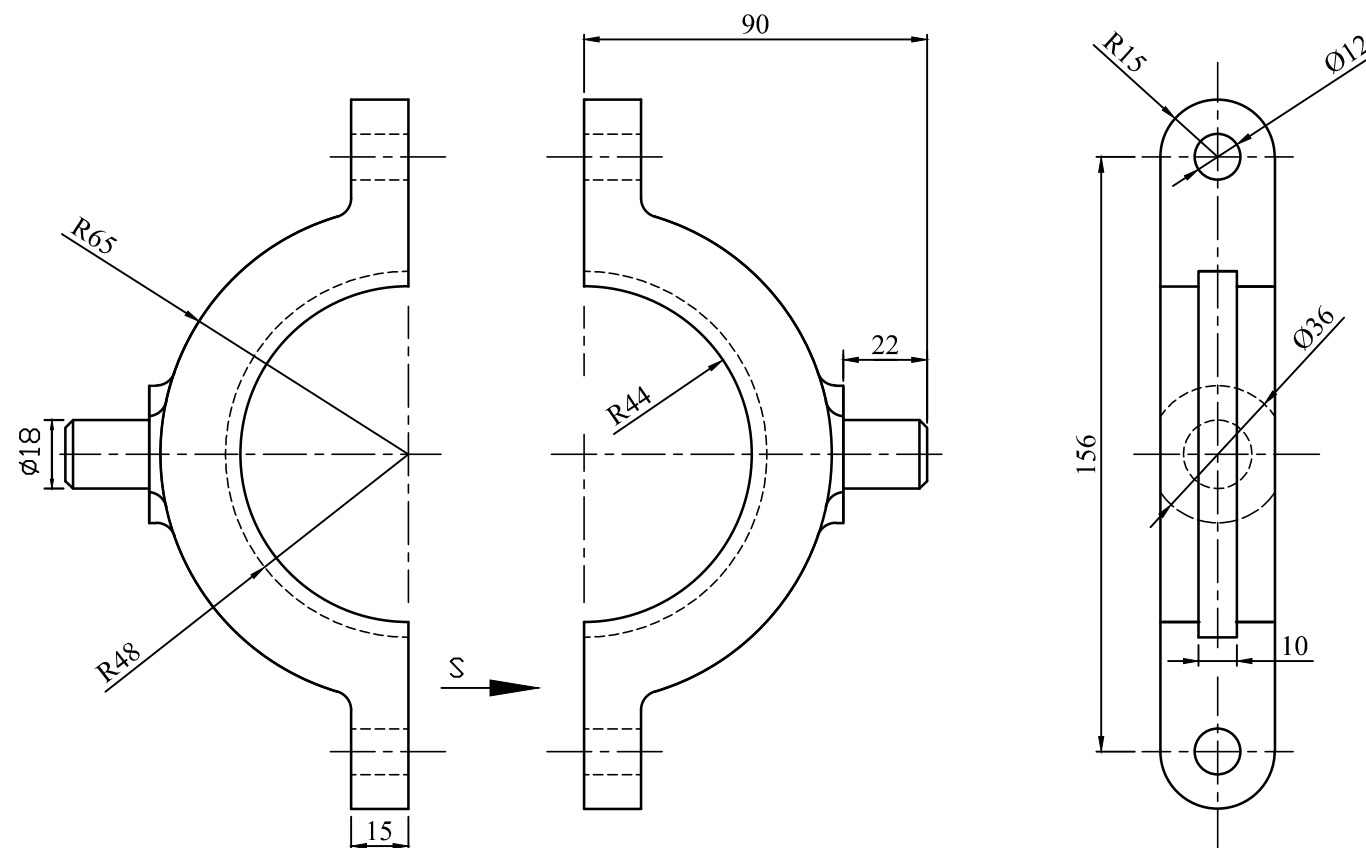
**Figure 4**



BASE (Item 1)



SHAFT (Item 2)

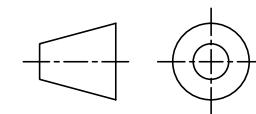


THRUST PIECE (Item 3)

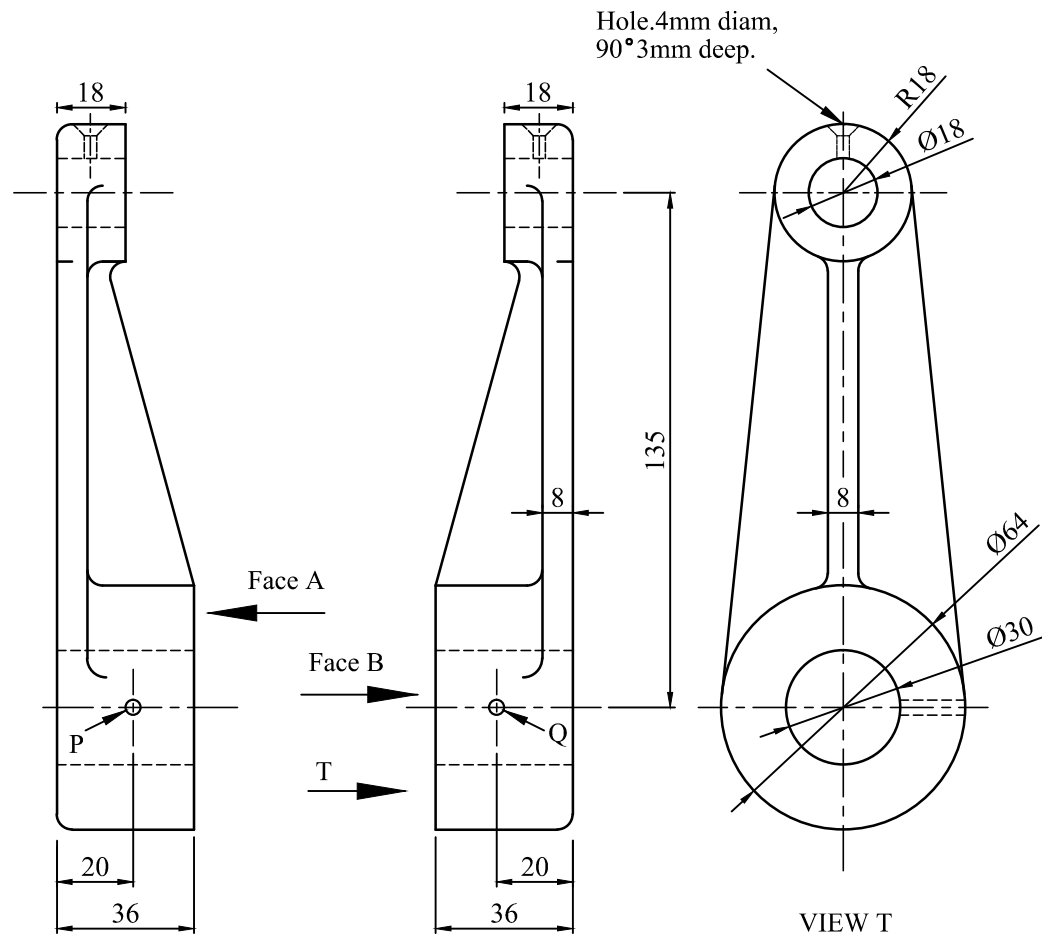
THRUST PIECE (Item 4)

VIEW S

CLUTCH

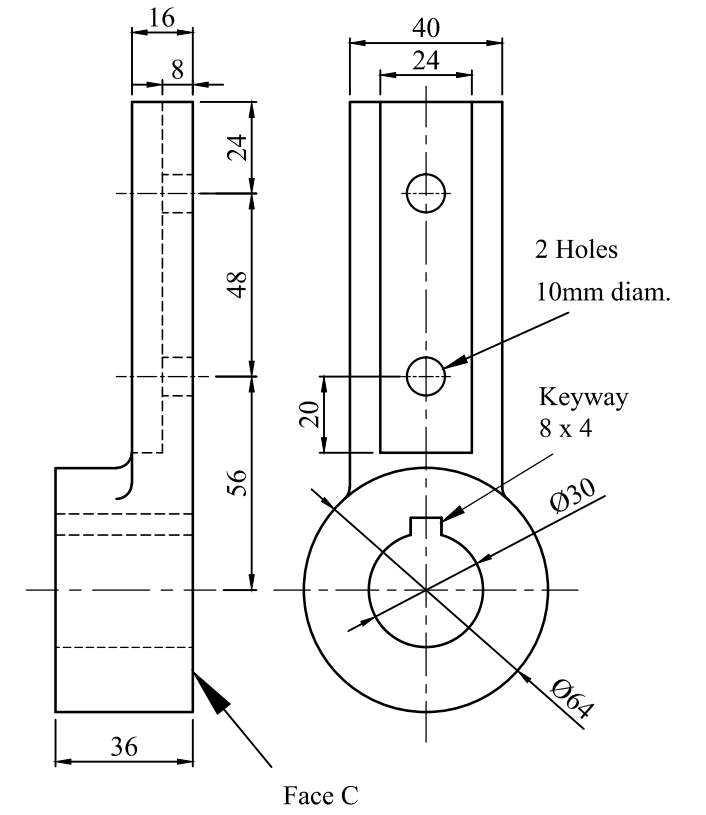
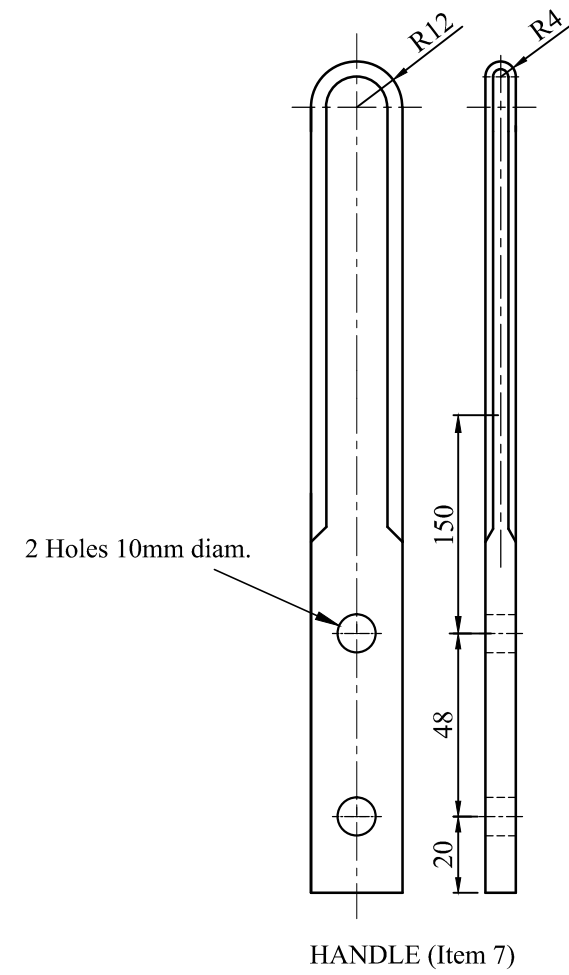






ROCKER ARM (Item 5)

ROCKER ARM (Item 6)



LEVER ARM (Item 8)

