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SUBJECT:	<b>Engineering Drawing/Graphical Communication</b>
PAPER NUMBER:	I
DATE:	31 <sup>st</sup> May 2022
TIME:	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;
- 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.**

An illustration of a right cone cut by an oblique plane is given in Figure 1a.

Two orthographic views and the traces of the oblique plane (VT, HT) cutting the cone are given in Figure 1b.

You are requested to:

- a) copy the given views; (1)
- b) project an auxiliary view of the cone, showing the oblique plane as an inclined cutting plane; (3)
- c) project the truncated plan with the upper part of the cone removed; (3)
- d) project the truncated front elevation; (3)
- e) project the true shape of cut; (3)
- f) locate, by construction, the focal sphere in the first auxiliary projection; (2)
- g) determine the positions of the focus, vertex and directrix of the conic section; (3)
- h) state its ratio of eccentricity and its technical name. (2)

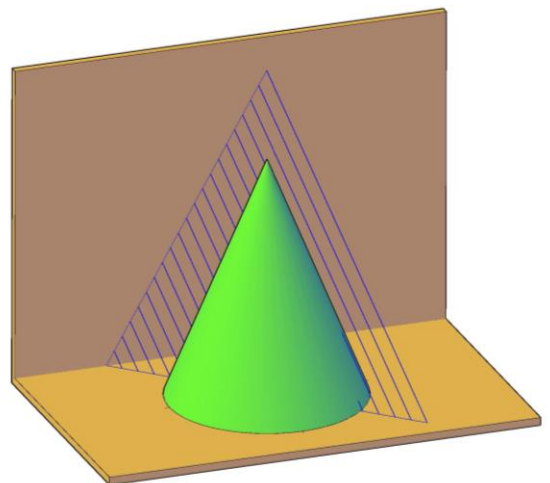


Figure 1a

**(Total: 20 marks)**

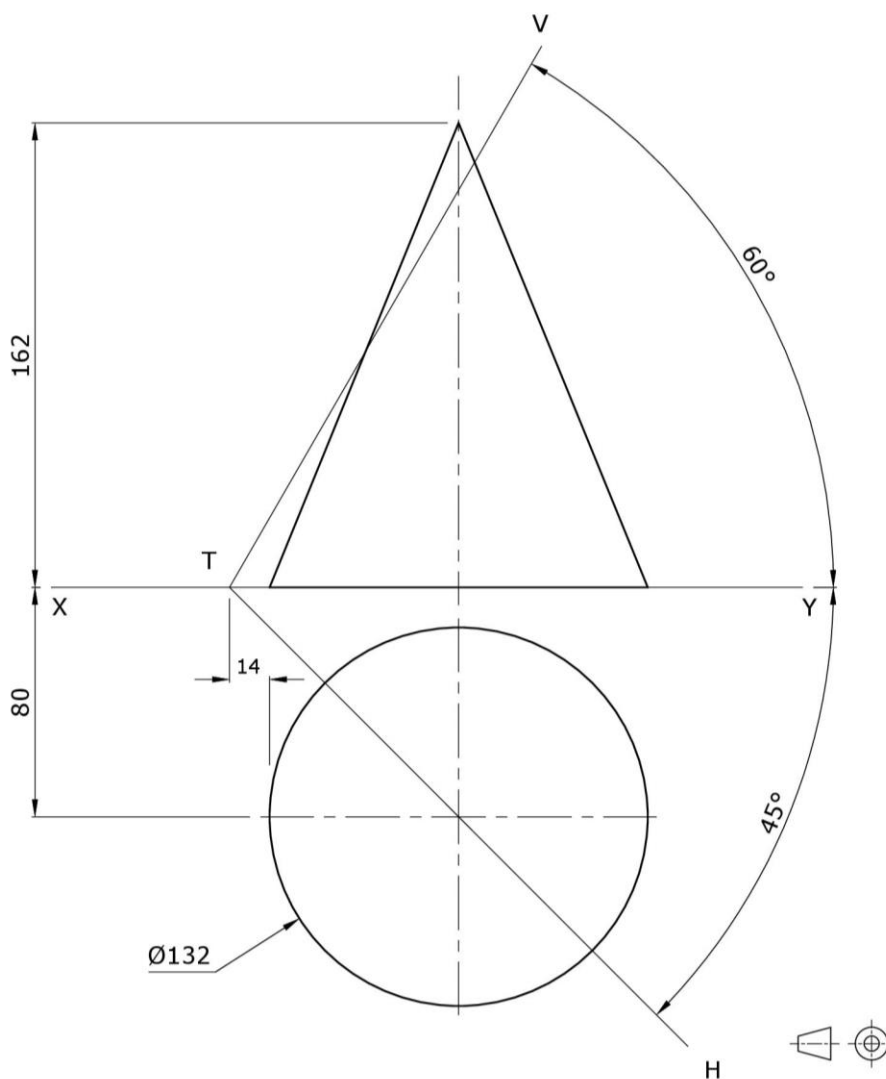


Figure 1b

**Question 2.**

Three orthographic views of a machined component are given in Figure 2.

You are requested to:

- a) copy the given views (do not show hidden details); (6)
- b) draw a small preparatory freehand isometric sketch of the component, placing corner X of the isometric crate in the lowermost position; (2)
- c) draw a full-size isometric view of the machined component. (12)

**(Total: 20 marks)**

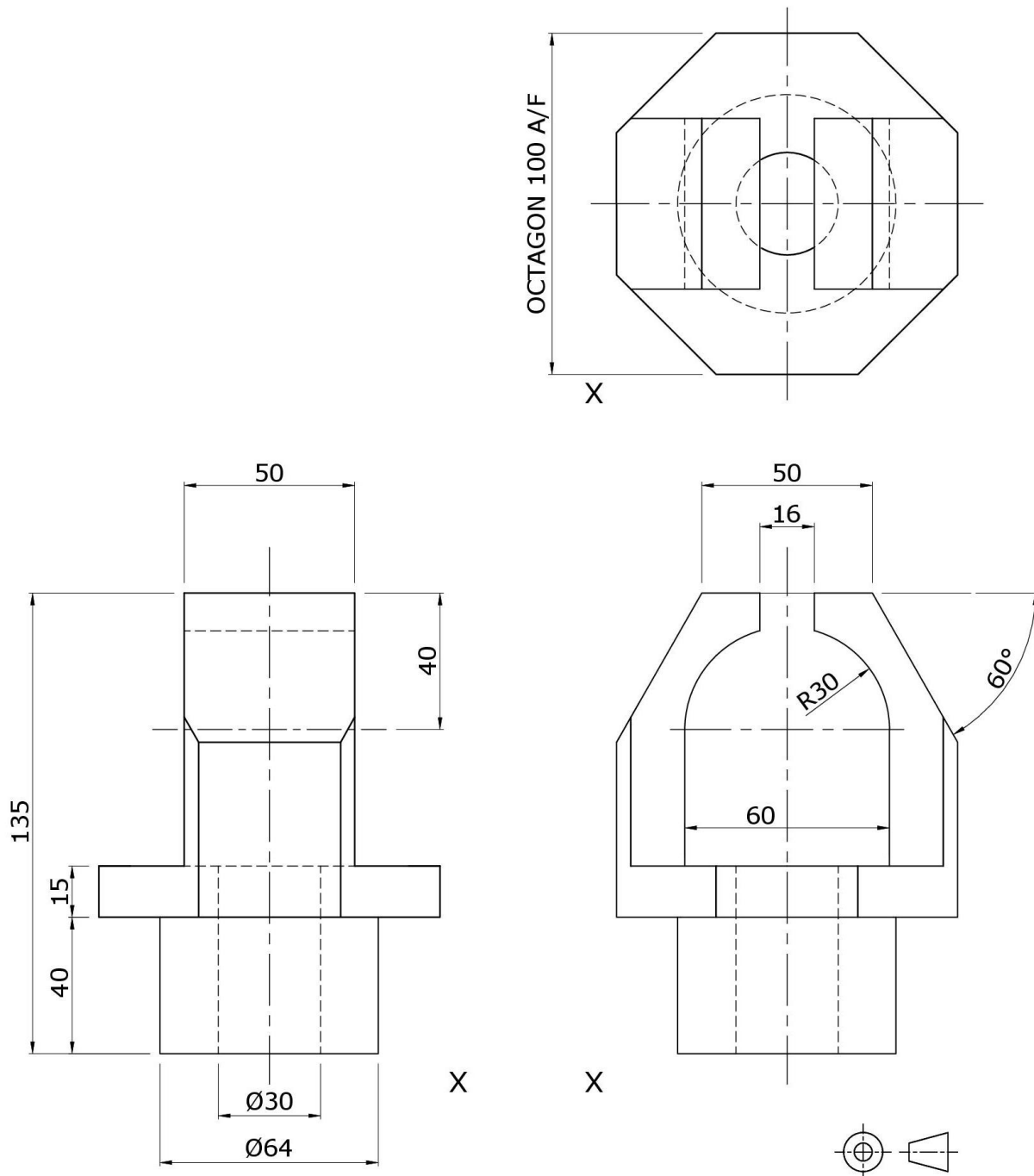


Figure 2

**Question 3.**

In the mechanism shown in Figure 3,  $O_1$ ,  $O_2$  and  $O_3$  are fixed points.

- $O_1 A$  is a crank which rotates in an anticlockwise direction about centre  $O_1$ .
- $O_2 B$  is a link pivoted at  $O_2$ .
- $O_3 D$  is a link pivoted at  $O_3$ .
- BAC is a link pivoted at A and pin jointed at B and C.
- A is the mid-point of link BAC.
- Link CD is pin jointed to links BAC and  $O_3 D$  at C and D.
- Point P is the mid-point of link CD.
- PQ is a link pivoted at P.
- End Q of link PQ slides along horizontal rail RS.

You are requested to:

- |   |     |
|---|-----|
| a) copy Figure 3;   | (2) |
| b) plot the locus traced out by pin joint C for one revolution of crank $O_1 A$ ; | (5) |
| c) plot also the locus of point P;  | (5) |
| d) determine the positions of slider Q along rail RS;                             | (3) |
| e) measure and state the length of stroke of slider Q;                            | (1) |
| f) draw the displacement diagram of slider Q.                                     | (4) |

Notes:

$O_1 A = 25$  mm,  $O_2 B = 105$  mm,  $BC = 130$  mm,  $CD = 135$  mm,  $O_3 D = 150$  mm,  $PQ = 160$  mm.

**(Total: 20 marks)**

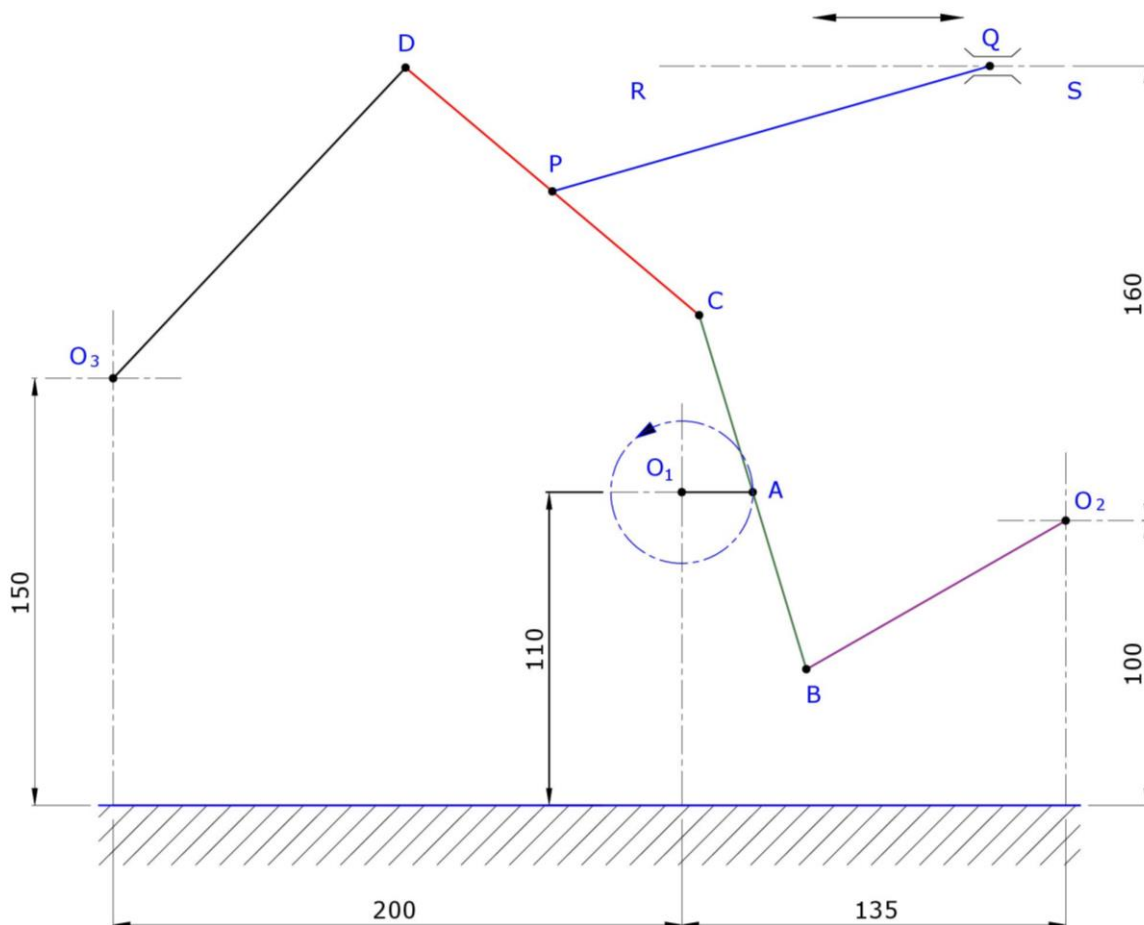


Figure 3

**Question 4.**

Figure 4a on the right shows an 'S' scroll consisting of two Archimedean spirals joined by means of a common tangent.

Figure 4b shows details of the starting lines.

You are requested to:

- a) copy the starting lines of Archimedean spiral 1; (2)
- b) construct 11/12 of a convolution of an Archimedean spiral starting from point A and ending at point B; (6)
- c) calculate and construct a normal and a tangent to the Archimedean spiral at point B (show calculations); (6)
- d) draw tangent BC 95 mm long; (1)
- e) locate, by construction, centre  $O_2$  of Archimedean spiral 2; (1)
- f) complete the second 11/12 of a convolution of an Archimedean spiral from point C to point D. (4)

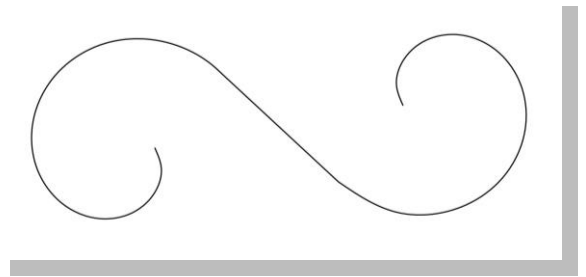


Figure 4a

**(Total 20 marks)**

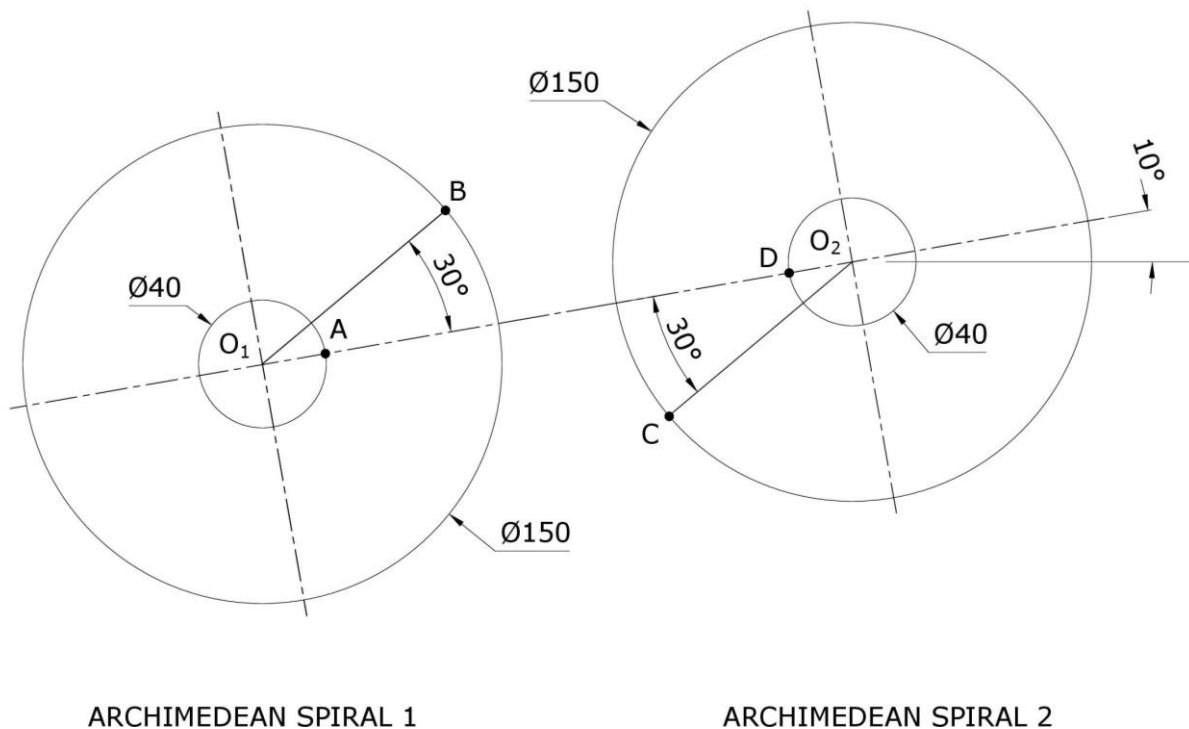


Figure 4b

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**Question 5.**

Figure 5a shows an illustration of a custom shaped funnel. The funnel consists of an inverted oblique cone pierced at the sides by a cylindrical hole and cut at the bottom to fit the corner of a square tank.

Figure 5b shows a dimensioned front elevation of the resulting oblique cone.

You are requested to:

- a) copy the given elevation; (2)
- b) determine, by construction, the true lengths of the generators of the oblique cone; (6)
- c) construct the surface development clearly showing the lower cut and the hole resulting from the intersection between the oblique cone and the  $\varnothing 60$  cylinder. (12)

**(Total 20 marks)**

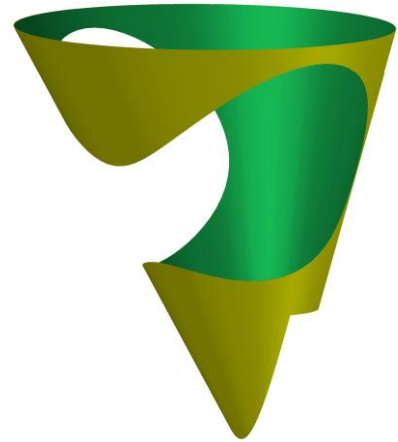


Figure 5a

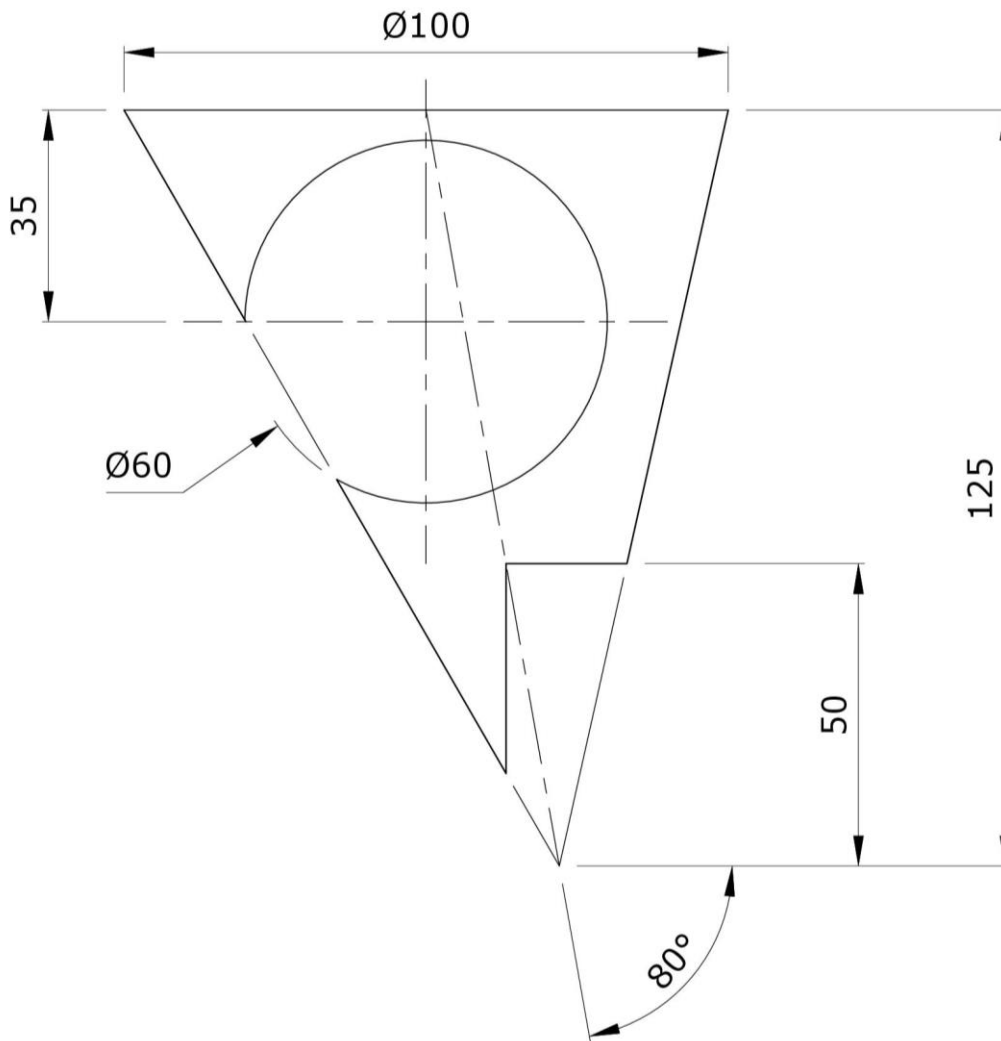


Figure 5b

**Question 6.**

An illustration of a semi-pentagonal gutter being intersected by a cylinder is given in Figure 6a.

An end elevation and an incomplete front elevation of the gutter and pipe are given in Figure 6b.

You are requested to:

- a) copy the given views; (5)
- b) project the curve of intersection in the front elevation; (6)
- c) draw the surface development of the gutter, including the resulting hole; (4)
- d) draw the surface development of the branch cylindrical pipe. (5)

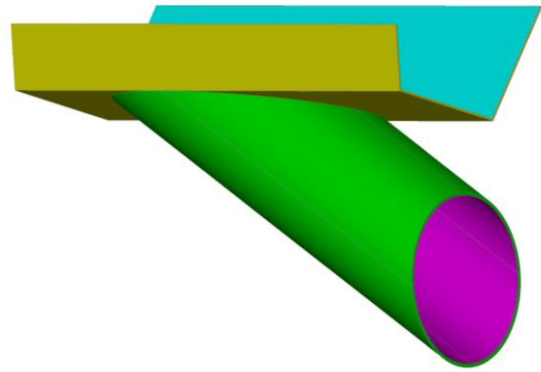


Figure 6a

**(Total: 20 marks)**

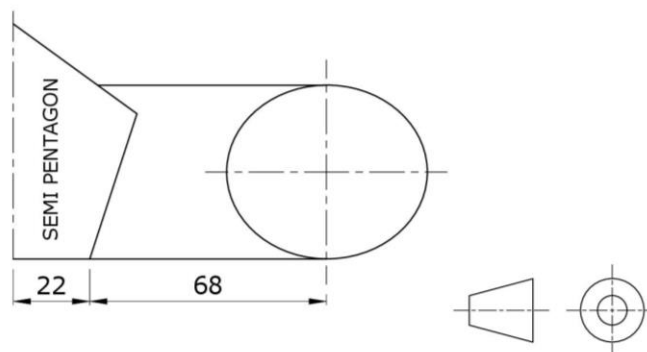
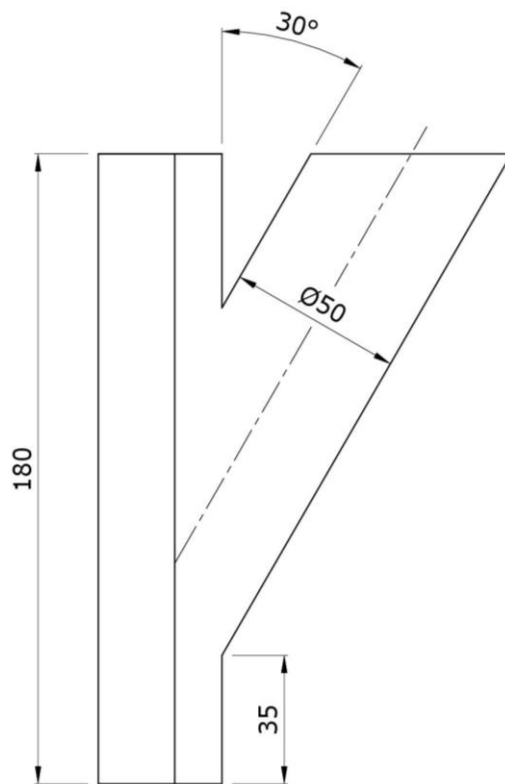


Figure 6b

***Please turn the page.***

**Question 7.**

An elevation and a plan of two lines skew are given in Figure 7. You are requested to:

- a) copy full size the given orthographic views; (3)
- b) draw an auxiliary elevation showing the true length of line C-D; (3)
- c) measure and state the true length of line C-D; (1)
- d) determine and state the length of the shortest connector between lines A-B and C-D; (10)
- e) locate the position of the shortest connector in all views. (3)

**(Total: 20 marks)**

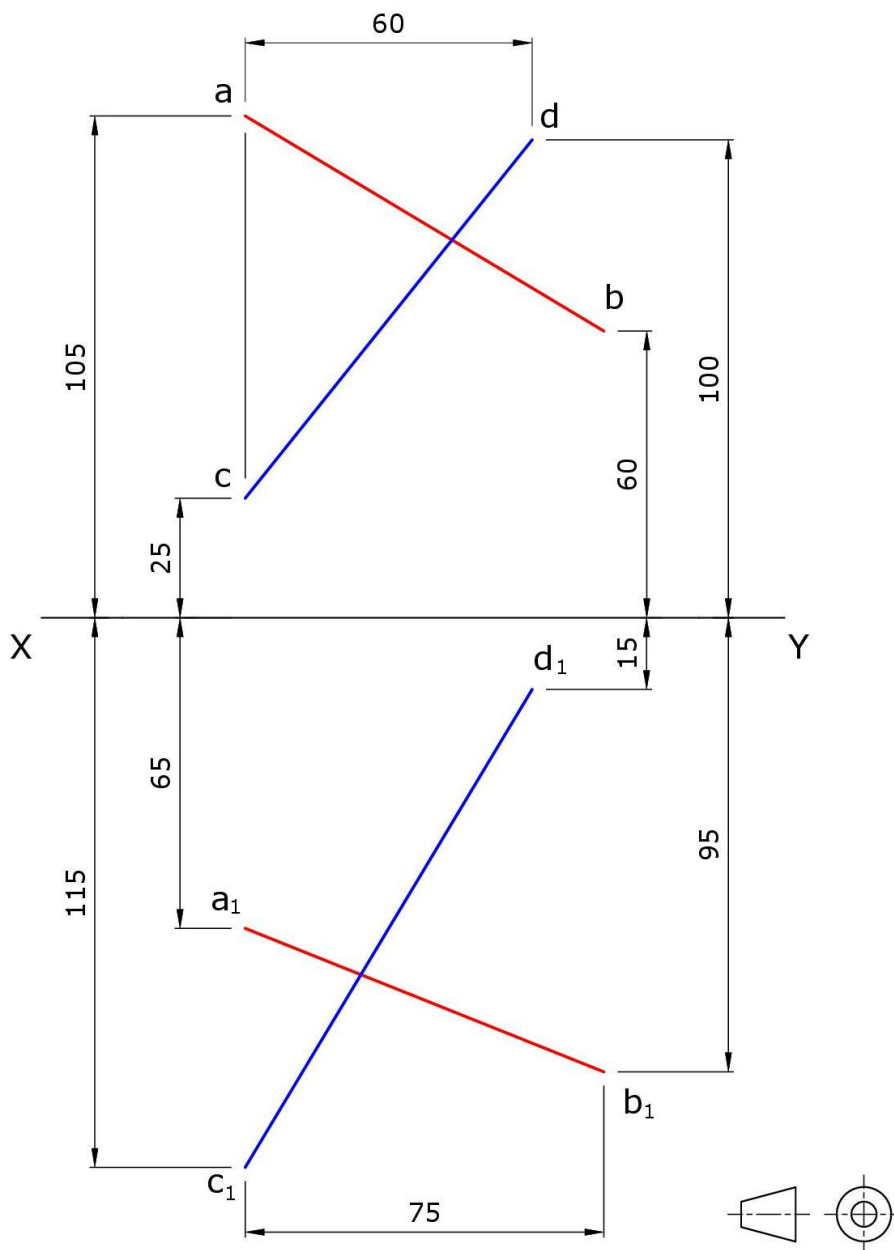


Figure 7



**Question 8.**

A cantilever 4.5 m long, securely built-in at the wall, carries a partial uniformly distributed load of 3 kN per metre and, in addition, two concentrated loads of 5 kN and 2 kN as shown in Figure 8. You are requested to:

- a) copy the space diagram of the cantilever using a scale of 40 mm representing 1 metre; (2)
- b) label the diagram by using the Bow's notation; (1)
- c) draw the polar diagram, using a scale of 10 mm representing 1 kN and a polar distance of 120 mm; (5)
- d) draw the shear force diagram; (5)
- e) construct the bending moment diagram and print the length of the closer on the funicular polygon; (5)
- f) write the ordinate scale for the bending moment diagram; (1)
- g) state the nature and magnitude of the greatest bending moment. (1)

**(Total: 20 marks)**

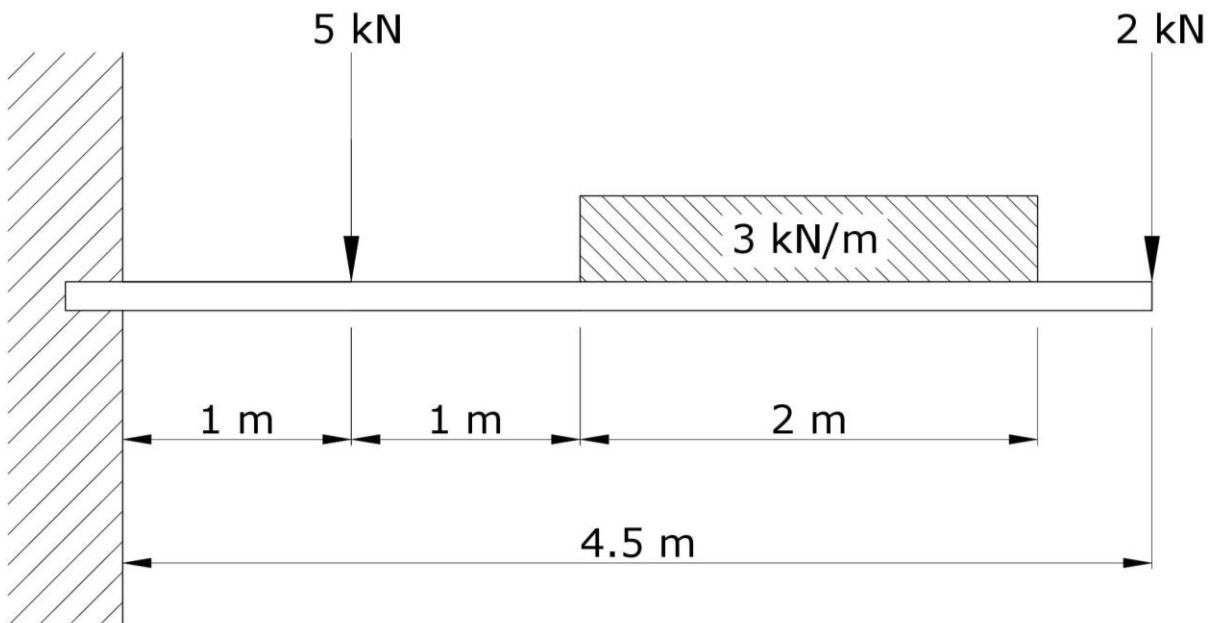


Figure 8



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SUBJECT:	<b>Graphical Communication</b>
PAPER NUMBER:	II
DATE:	31 <sup>st</sup> May 2022
TIME:	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 **THREE** questions.

Programmable calculators **cannot** be used.

Unless otherwise stated:

- drawings should conform to B.S. or equivalent (ISO) standards;
- all dimensions are in millimetres;
- answers are to be accurately drawn with instruments;
- all construction lines must be left on 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.

Colour/shading should be used where appropriate.

Mark allocations are shown in brackets.

Question 1 carries 34 marks. Questions 2, 3, 4 and 5 carry 22 marks **each**.

**Question 1.**

Figure 1 shows four orthographic views of a theatrical stage designed for a Shakespearean play. These orthographic views give indication of the proportion of every element within the stage. Use this information to draw a one-point estimated perspective of this stage. The viewing direction is indicated by the arrows on the Plan.

- a. Using **THREE** preliminary sketches, explore alternative positions of the horizon line and identify the one which, in your opinion, best describes the spaciousness of the entire area. (3)
- b. Based on the choice made in part (a), use a suitable scale to produce the required illustration on a single side of an A2 size paper, making the best use of the space available. (26)
- c. Enhance your drawing by colouring small areas of the different items appearing in your illustration. (5)

Notes:

- The rectangular ceiling, which covers the whole area of the plan, has been removed to reveal the contents of the stage beneath it.
- The rendering of the stairs and tiles is to represent marble.
- The rendering of the throne to represent wood.
- The rendering of the columns to represent stone.

**(Total: 34 marks)**

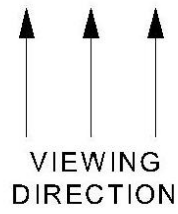
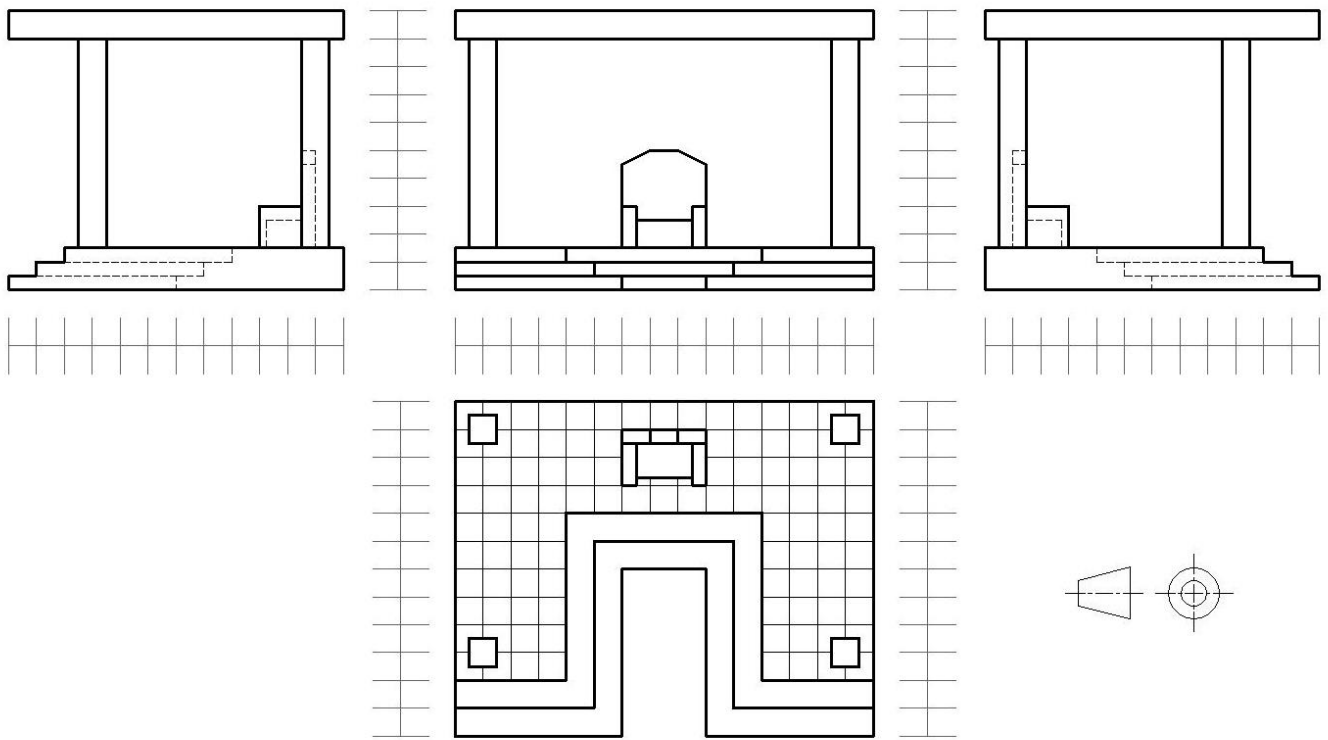


Figure 1

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**Question 2.**

The tables below show mean-statistical information about passenger and vehicle traffic between Malta and Gozo from 2019 to 2021, for every quarter of the year.

Passengers				
	January - March	April - June	July - September	October - December
2019	400,000	550,000	650,000	450,000
2020	450,000	100,000	450,000	300,000
2021	350,000	450,000	550,000	600,000

Vehicles				
	January - March	April - June	July - September	October - December
2019	150,000	200,000	150,000	100,000
2020	150,000	50,000	200,000	175,000
2021	125,000	100,000	150,000	200,000

You are required to draw an infographic chart displaying the information above. The chart should contain text, graphs, and symbols. The title of this chart should be 'SEA TRAFFIC BETWEEN MALTA AND GOZO (2019-2021)'.

Suitable typefaces should be used to show all written information. Graphic symbols should complement this information. (17)

In a separate section within the same A2 sheet, provide preparatory freehand sketches that show how you developed your ideas. (5)

**Total: (22 marks)**

**Question 3.**

A freight services company by the name of 'Arrow Freight International' needs a new design to place on their fleet of land vehicles.

You need to produce this new design, which has to include both graphics and text.

Figure 3a shows a sketch of one of these vehicles, including the space where the intended design is to be placed.

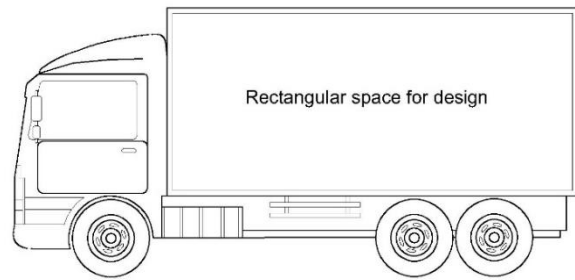


Figure 3a.

You need to present your work broken down according to the following steps and as shown in Figure 3b.

- a. Written analysis  
Identify, using keywords/short phrases the main parameters of the design brief. (2)
- b. Graphical analysis  
Based on your response to the written analysis, produce a series of preparatory sketches that illustrate your developing ideas. (4)
- c. Design synthesis  
Clearly identify those elements present in your sketches that you intend to use in your final design. (2)
- d. Final realisation  
Use colour and shading to produce your final realisation in a rectangle as shown in Figure 3b. (14)

Notes:

- Use suitable typefaces for your design.
- Details of the page layout and the design space are given in Figure 3b below.

**(Total: 22 marks)**

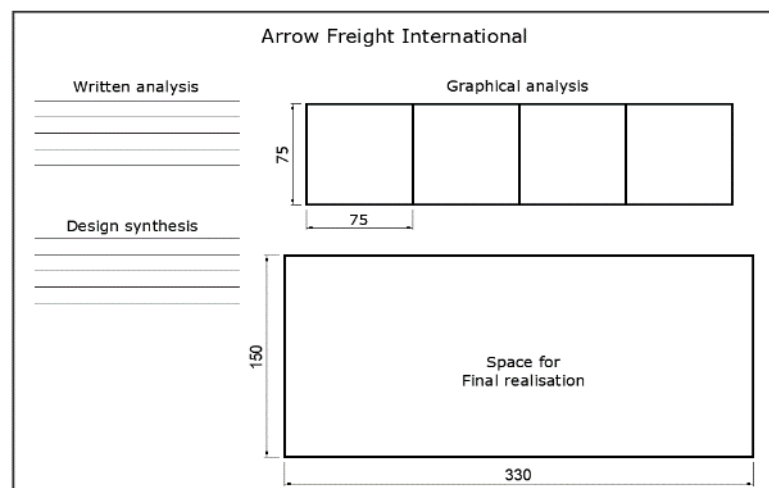


Figure 3b

***Please turn the page.***

### Question 4.

Figure 4 shows six orthographic views of a DSLR prototype camera.

You are requested to:

- a. Make a well-proportioned freehand isometric drawing of this camera. The viewing direction, that best describes the main features of the camera, is left to your discretion. (14)
- b. Colour and shade your drawing paying attention to the representation of the different materials and textures. (8)
  - Main body – brown leather covering.
  - Front zoom lens – metal & glass.
  - Dials, battery & memory card doors – durable textured plastic.
  - Top prismatic viewfinder – durable textured plastic.
  - Rear view finder and screen – glass.

**(Total: 22 marks)**

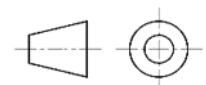
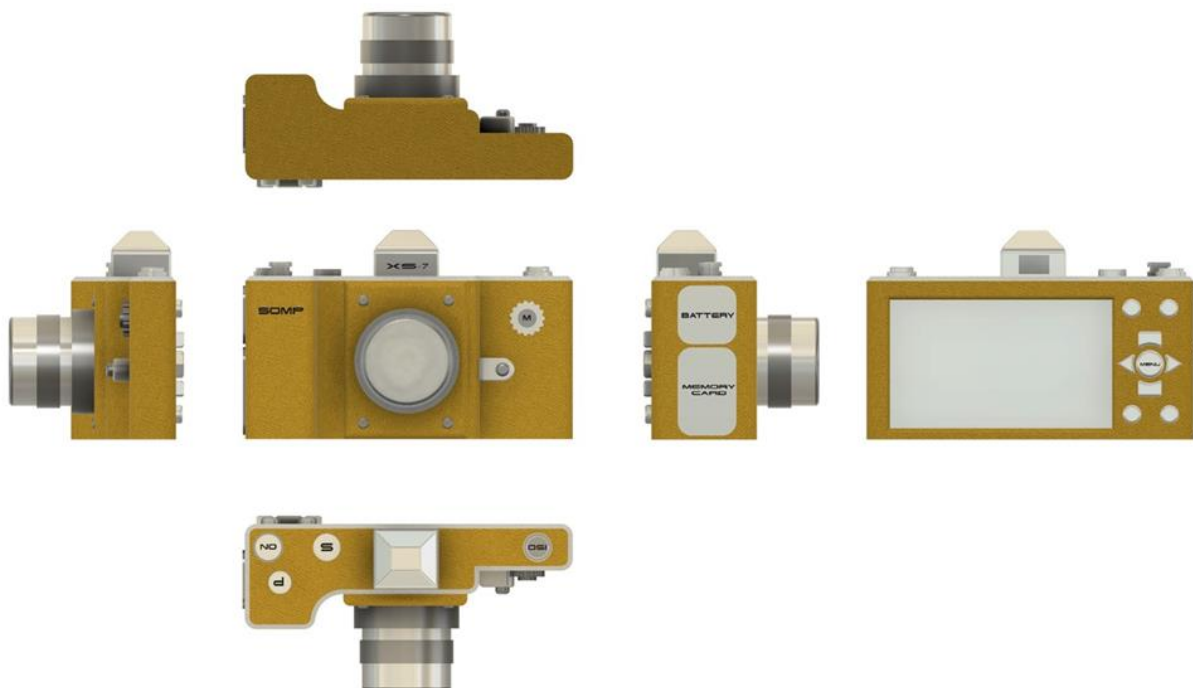


Figure 4

**Question 5.**

Figure 5 shows a three-dimensional line sketch of a water dispenser.

You are requested to draw the following orthographic freehand sketches of the water dispenser:

- a. a front elevation as seen when looking from the direction indicated by arrow F; (7)
- b. an end elevation as seen when looking from the direction indicated by arrow E. (7)

Finally, you are requested to apply colour and shading to your sketches to show the volume of each item composing the water dispenser. (8)

Notes:

- Main Body – Copper Finish.
- Side Panels – Glossy White Finish.
- Water Bottle – Translucent Plastic.
- Water Bottle Holder – Plastic.
- Operation Buttons – Plastic.
- Ice Dispenser – Stainless Steel.
- Glass Recess – Opaque Glass.
- Drain Tray – Stainless Steel.

**(Total: 22 marks)**

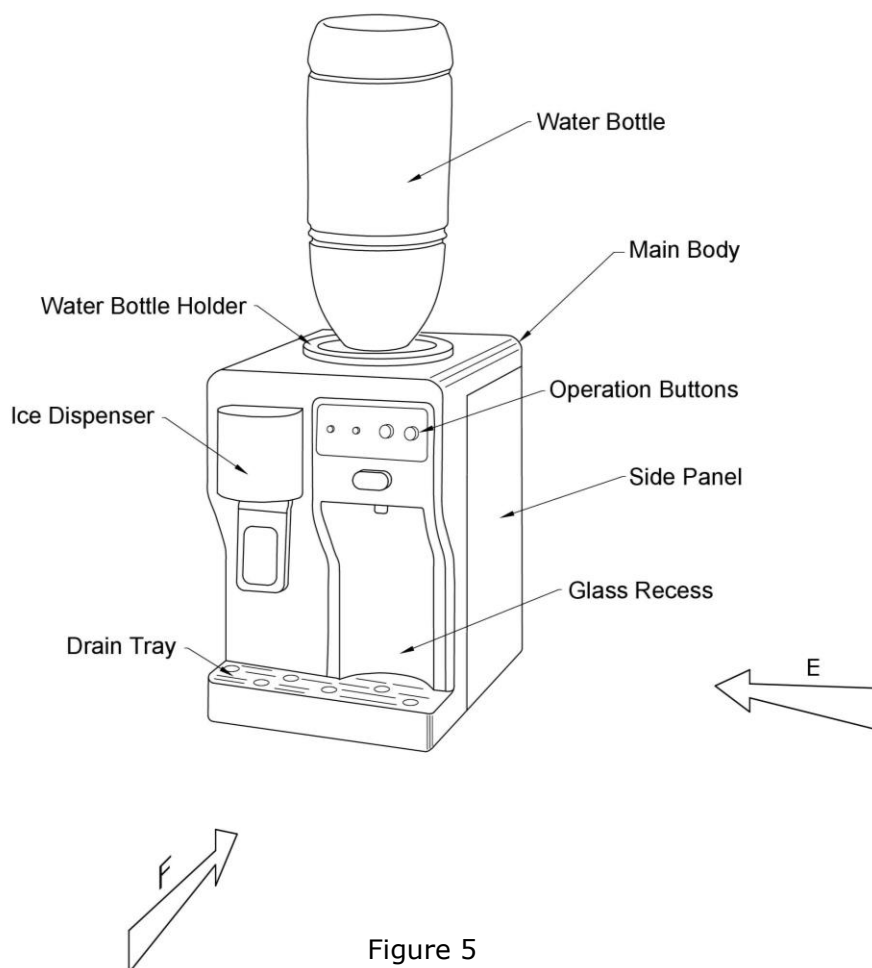


Figure 5