18.0 METALWORK (445)

The 2009 KCSE examination for Metalwork consisted of two papers namely Paper 1 (theory) and Paper 2 (project). As in the previous years, Paper 1 was worth 60% of the overall mark while the project was worth 40% of the final mark.

18.1 CANDIDATES' GENERAL PERFORMANCE

The table below shows the candidates performance in Metalwork in the year 2009. The statistics for the previous two years have also been included for comparison.

Table 23: Candidates Overall Performance in Metalwork in the years 2009, 2008, and 2005

Year	Paper	Candidature	Maximum Score	Mean Score	Standard Deviation
2005	1		60	23.40	9.60
	2		40	34.90	3.24
	Overall	**311**	**100**	**57.74**	**12.00**
2008	1		60	23.62	6.95
	2		40	35.62	4.57
	Overall	**89**	**100**	**59.24**	**9.39**
2009	1		60	25.38	9.09
	2		40	35.34	3.38
	Overall	**231**	**100**	**58.74**	**13.32**

From the table above, the following observations can be made:

18.1.1 The number of candidates rose significantly from **89** to **231**.

18.1.2 The general performance for the three years was almost the same but the standard deviation for Paper 2 went down probably due to the fact that the marking of the project was done by the teachers without the involvement of the Council assessors.

The questions which were reported to have been poorly done will be analyzed with a view to identifying the candidates' weaknesses and offer suggestions on some remedial measures to be taken in order to improve the performance in future. The questions for discussion include 3, **8, 10, 12** and **13** in **Paper 1.**

18.2 PAPER 1 (445/1)

Question 3

(a) With reference to cutting external thread:
  (i) name two types of dies used;
  (ii) state two reasons for using cutting oil.

(b) An M10 internal thread is to be cut in a mild steel plate. Given that the thread pitch is 1.5mm, determine the size of the drill to be used.

The first part of this question tested the candidates' mastery of thread cutting process while the second part (3b) of the question required the candidates to calculate the drill size to be used to drill a hole for threading.
Question 3(a) was quite well done but most of the candidates found it very difficult to determine the required drill size.

Expected response

Tapping diameter	Root diameter	pitch
	10	1.5
	8.5 mm	

Question 8
Outline the differences between:
(a) the oxygen set and the actulene set in oxy-acetylene equipment;
(b) brazing and gas welding.

The candidates were required to point out the differences between the acetylene set and the oxygen set in gas welding equipment and also distinguish between brazing and gas welding processes. The majority of the candidates could not tell the differences required in part (a) and (b) of this question.

Expected responses
There are distinct differences in colour, cylinder size, thread type and safety plugs between the oxygen set and the acetylene set which the candidates were required to point out. In part (b) the candidates should have indicated that in brazing the parent metal is not melted, the oxidizing flame is used, spelter and flux are required while in gas welding, the parent metals are melted to fuse, neutral flame is used and the filler rod of the same material as the parent metals is used.

Question 10
Figure 2 shows orthographic view of a component.

Sketch in good proportion the isometric views of the component.

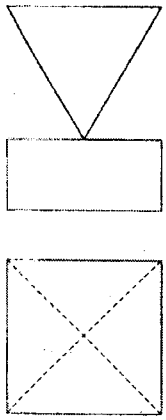
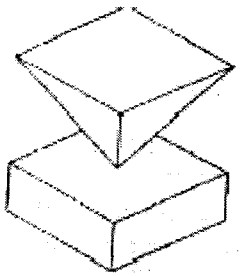


Figure 2

Candidates were required to convert the given orthographic views into an isometric drawing which most of the candidates fail to present accurately.

Expected response



Question 12
(a) Name three methods of testing the quality of gas-welded joints.
(b) Sketch the correct flame for welding brass and outline the procedure of setting the flame.

(c) Use labelled sketch to show an appropriate technique for gas welding thick plate and give three reasons for using the technique.

The question required the candidates to list various methods of testing welded joints, sketch the oxidizing flame and illustrate the rightward welding technique. Apparently, from the responses given, most of the candidates had very vague ideas about the flame and the welding techniques required.

Expected responses

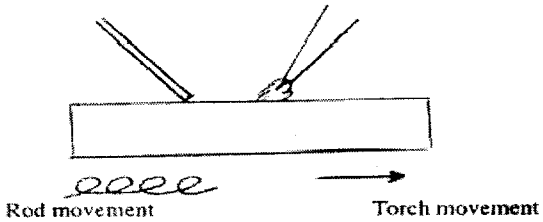
(a) TESTING METHODS
Inspection
Fluid or die penetration
X - ray
Magnetic
Subjecting to stress

(b) (i)

Oxidizing flame

(ii) Open the acetylene cylinder half turn.
Open the oxygen cylinder full turn.
Open acetylene needle valve and set to required pressure.
Open oxygen needle valve and set to required pressure.
Open acetylene valve slightly and light the torch.
Increase gas till flame is clear of soot.
Open oxygen valve and set flame to oxidizing.

(b)



REASONS FOR TECHNIQUE

Less gas used
Cooling rate is lower
Faster than leftward
Better view of molten pool
No bevel required

Question 13

(a) With the aid of a sketch, explain the term piping as applied to forging and state how it can be avoided.

(b) The end portion of a mild steel bar of cross-section 40 x 70mm is to be reduced to 20 x 70 by fullering. With the aid of sketches, outline the procedure of reducing the cross section naming the tools used in each step.

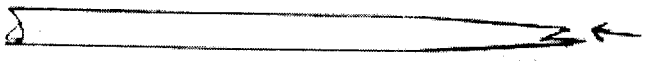
Candidates were required to explain what piping is and outline the procedure of fullering a mild steel bar to a smaller diameter. The answers given by most of the candidates portrayed lack of adequate knowledge on fullering and piping.

Expected response

(a) PIPING

(i) Hollow point developed at the tip of a bar when drawing down

(ii)



(iii) When drawing down:
- forge the cross-section to square
- forge the cross-section to octagon
- forge the cross section to round.

(b) FULLERING

Marking the portion to be forged.
Heat the portion to be forged to be right temperature.
Position the end between the fullers.
Hammer the top fuller to reduce the thickness.
Repeate steps 2, 3 and 4 until the required size is approached.
Use flatter to smmothen the surface and finish to size.

18.3 PAPER 2 (445/2)

This was a project paper where candidates were required to make a predesigned hand press under the supervision of their teachers. The skilled tested in this project included marking out, cutting, filing, forming, drilling, riveting, threading, chamfering, brazing and gas welding.

The teachers used a marking scheme provided by the KNEC to mark the projects, recorded the scores in manual marksheets provided and sent the candidates' marks to the Council for processing.

29.16 METAL WORK (445)

29.16.1 Metal Work Paper 1 (445/1)

SECTION A (40 marks)

*Answer **all** the questions in this section.*

1 (a) Name the most suitable extinguishing agent for putting out each of the following types of fires:

(i) petrol;
(ii) gas;
(iii) wood;
(iv) electrical. (2 marks)

(b) Give **two** reasons for keeping an inventory in a workshop. (2 marks)

2 (a) Give **three** reasons for marking out a work piece. (3 marks)

(b) Illustrate the following sheet metal joints and state **one** application of each:
(i) folded seam;
(ii) knocked up joint. (3 marks)

3 (a) With reference to cutting external thread:
(i) name **two** types of dies used;
(ii) state **two** reasons for using cutting oil. (3 marks)

(b) An M10 internal thread is to be cut in a mild steel plate. Given that the thread pitch is 1.5mm, determine the size of the drill to be used (2 marks)

4 Differentiate between the following:
(a) a rule and a ruler;
(b) bilateral and unilateral tolerance;
(c) trysquare and sliding bevel. (3 marks)

5 (a) What is meant by the term heat treatment as applied to ferrous metals. (1 mark)

(b) Outline the procedure of heat treating a file ready for use. (4 marks)

6 Name each rivet shown in figure 1 and state one application of each. (3 marks)

7 State **four** methods of identifying metals in a workshop. (2 marks)

8 Outline the differences between:
(a) the oxygen set and the actylene set in oxy-acetylene equipment;
(b) brazing and gas welding. (6 marks)

9 Give **two** reasons for applying primer in painting process. (2 marks)

10 Figure 2 shows orthographic view of a component.

Sketch in good proportion the isometric views of the component. (4 marks)

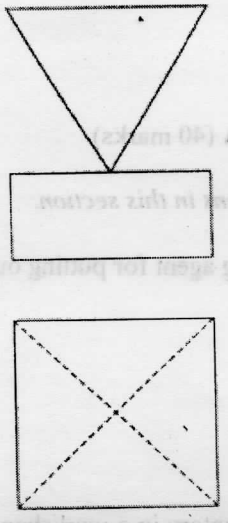


Figure 2

SECTION B (60 marks)

Answer question 11 and any other three questions from this section. Candidates are advised to spend not more than 25 minutes on question 11.

11 Figure 3 shows two views of a machined component drawn in first angle projection.

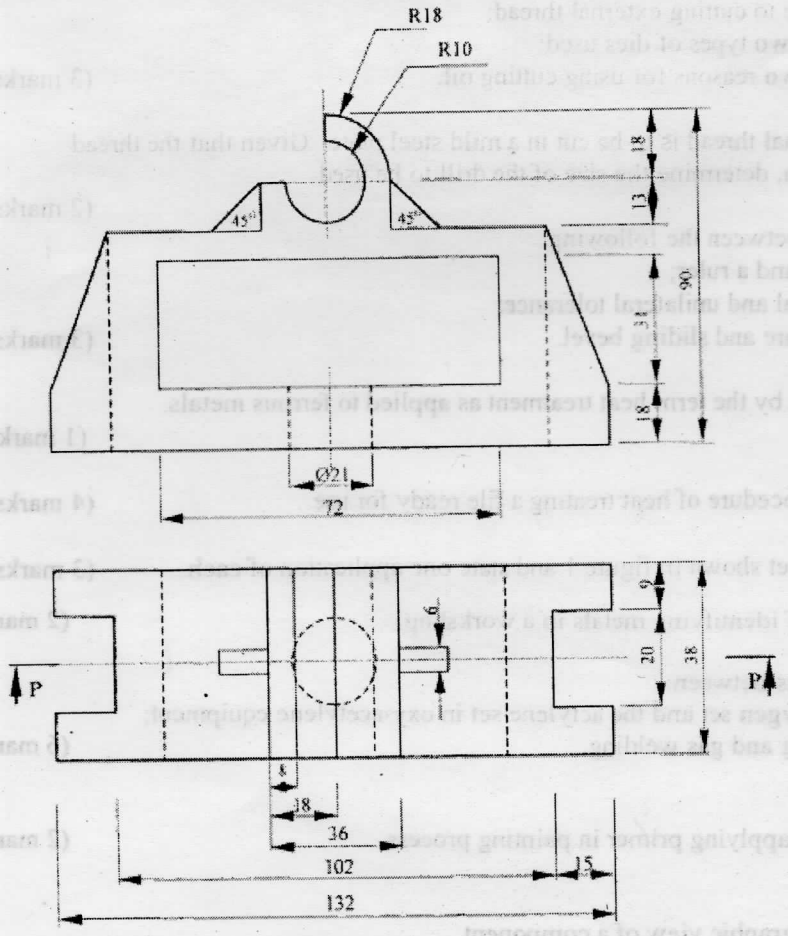


Figure 3

Draw full size, the following views:

(a) sectional front elevation through P-P. Do not show the hidden details;

(b) end elevation including hidden details. (15 marks)

12 (a) Name **three** methods of testing the quality of gas-welded joints. (1½ marks)

(b) Sketch the correct flame for welding brass and outline the procedure of setting the flame. (5½ marks)

(c) Use labelled sketch to show an appropriate technique for gas welding thick plates and give **three** reasons for using the technique. (8 marks)

13 (a) With the aid of a sketch, explain the term piping as applied to forging and state how it can be avoided. (3 marks)

(b) The end portion of a mild steel bar of cross-section 40 x 70mm is to be reduced to 20 x 70 by fullering. With the aid of sketches, outline the procedure of reducing the cross section naming the tools used in each step. (12 marks)

14 (a) Draw the following tables and show the components of each:

(i) cutting list;

(ii) bill of materials. (7 marks)

(b) Name and sketch **four** forms of metal supply and state one application of each. (8 marks)

15 (a) Outline the procedure of locating the centre of a round bar using the scribing block, surface plate and vee block. (3 marks)

(b) Figure 4 shows a micrometer screw gauge.
Name the parts labeled A to F and state the function of each. (6 marks)

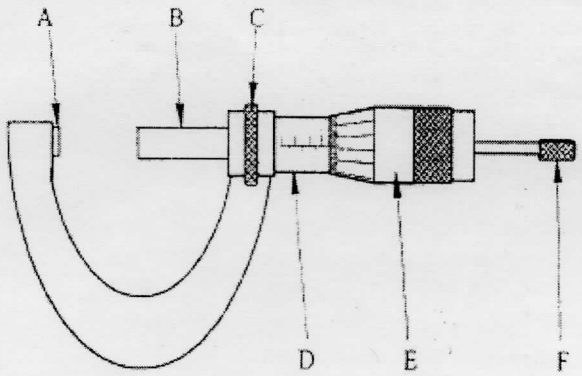


Figure 4

(c) Figure 5 shows different micrometer and vernier caliper readings.
Determine the readings and show how each is obtained. (6 marks)

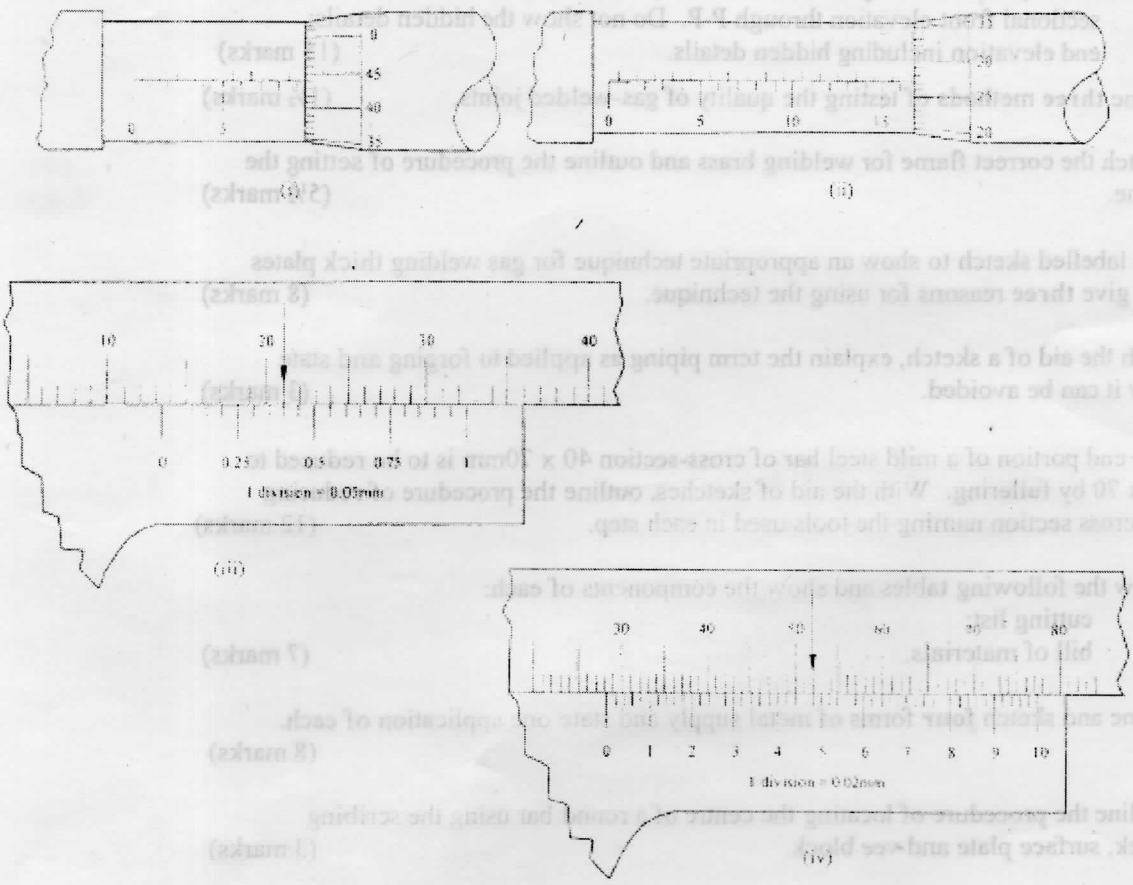


Figure 5

30.16 METAL WORK (445)

30.16.1 Metal Work Paper 1 (445/1)

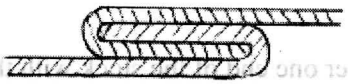
1. (a) EXTINGUISHING AGENTS
   (i) foam
   (ii) carbon dioxide
   (iii) powder
   (iv) dry powder — 2 x ½

   (b) REASONS FOR INVENTORY
   (i) provides a record of what is available
   (ii) monitors any movement to avoid losses
   (iii) guides in determining additional equipment — any 1 x 1

2. (a) REASONS FOR MARKING OUT
   (i) defines the shape of an article
   (ii) locates position of features like holes
   (iii) minimises wastage
   (iv) provides cutting guide
   (v) aids in clamping — any 3 x 1

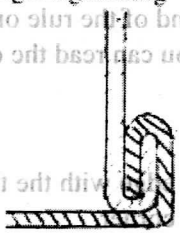
   (b) SHEETMETAL JOINTS

   (i)



   for widening/lengthening — 1 ½ x 2

   (ii)



   for closing up a box or cylinder — 2 x ½

3. (a) (i) DIES - circular
   - split/adjustable — 2 x ½

   (ii) CUTTING OIL - cools the tap or die
   - lubricates the thread — 2 x 1

   (b) T = D - P where T = tapping Ø
   D = root Ø
   P = pitch
   T = 10 - 1.5 = 8.5m — 2 marks

4. (a) Ruler has clearance between its end and zero mark while calibration in a rule starts right at the end..

(b) In unilateral tolerance only one limit is given from nominal size while in bilateral tolerance both limits are given.

(c) Trysquare marks and tests only right angles while sliding level can mark and test any angle.

3 x 1

5. (a) HEAT TREATMENT is a process of heating steel to a certain temperature and cooling it at a controlled rate in order to give it a desired property.

(b) HEAT TREATMENT OF FILE
Heat file to hardening temperature.
Quench in water or brine.
Heat again to tempering temperature
Cool in atmosphere

4 x 1

6. RIVETS

(a)	Pan head	- where maximum strength is required.
(b)	Flat head	-general rivet work for normal strength.
(c)	Bifurcated	-joins leather or plastic to metal.

name = 3 x ½
application = 3 x ½

7. METHODS
Appearance
Cold hammering
Chips from drilling
Spark test by grinding

any 4 x 1

8. DIFFERENCES
Oxygen and acetylene cylinders — colour, size, thread, safety plugs

any 3 x 1

BRAZING
-Parent metal not melted
-Uses flux
-Uses spelter as filler metal
-Uses oxidizing flame (lower temperature)

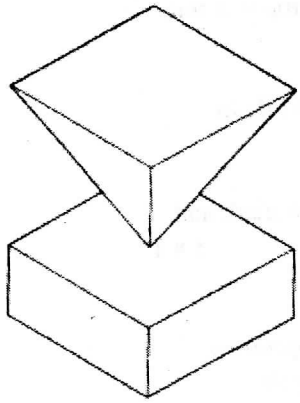
GAS WELDING
-Parent metal melted to fuse
-No flux used
-Uses same metal as parent metal
-Uses neutral flame (higher temperature)

any 3 x 1

9. REASONS FOR APPLYING PRIMER
- Prevents corrosion on the surface
- Enables paint to adhere to the surface
- acts as filler for uneven surface

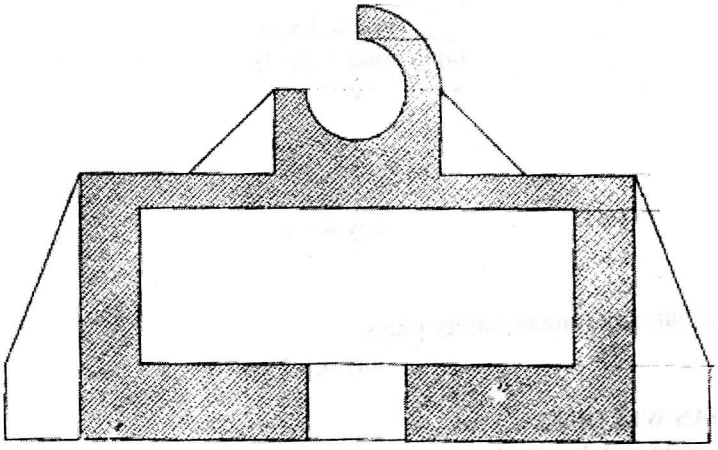
any 2 x 1

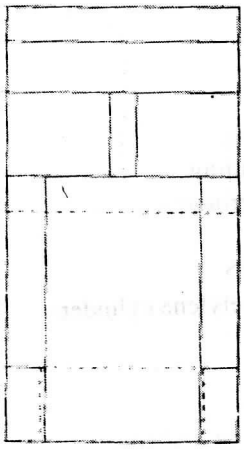
10.



6 faces x ½ = 3
Isometric = 1
Total 4

11.





SECTION:
6 faces x 1 = 6
Hatching 1
Centre lines (3 x ½) = 1½

END ELEVATION:
10 faces x ½ = 5
Hidden details = 1
Neatness = ½

Total 15

12. (a) TESTING METHODS
Inspection
Fluid or die penetration
X - ray
Magnetic
Subjecting to stress

any 3 x ½

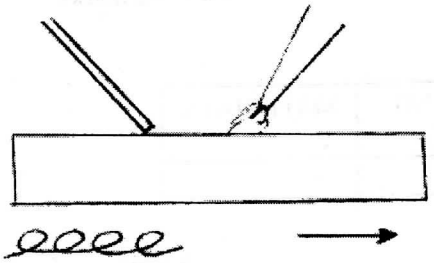
(b) (i)

Oxidizing flame

2 marks

(ii) Open the acetylene cylinder half turn.
Open the oxygen cylinder full turn
Open acetylene needle valve and set to required pressure.
Open oxygen needle valve and set to required pressure.
Open acetylene valve slightly and light the torch.
Increase gas till flame is clear of soot.
Open oxygen valve and set flame to oxidizing. 7 x ½=3 ½

(c)



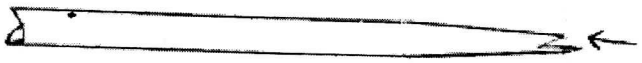
sketch = 2
labelling = 3

REASONS FOR TECHNIQUE
Less gas used
cooling rate is lower
Faster than leftward
Better view of motten pool
No bevel required.

any 3 x 1

13. (a) PIPING

(i) Hollow point developed at the tip of a bar when drawing down



(1 mark)

(ii)

½ mark

(iii) When drawing down:
- forgé the cross section to square
-forge the cross section to octagon
-forge the cross section to round

1 ½ marks

(b) FULLERING

Marking the portion to be forged.
Heat the portion to be forged to be right temperature.
Position the end between the fullers.
Hammer the top fuller to reduce the thickness.
Repeat steps 2, 3 and 4 until the required size is approached.
Use flatter to smoothen the surface and finish to size.

CORRECT PROCEDURE — 5 x 1 =5 marks
ANY CORRECT TOOLS NAMED — 10 x ½ = 5 marks
ANY APPROPRIATE SKETCHES — 4 x ½ =2 marks

14. (a) (i) CUTTING LIST

PART NO.	NO. OF PARTS	DESCRIPTION	CUTTING SIZE	MATERIALS

Used when preparing work pieces

6 x ½

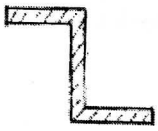
(ii) BILL OF MATERIALS

PART NO.	NO. OF PARTS	DESCRIPTION	CUTTING SIZE	MATERIAL	UNIT COST	TOTAL COST

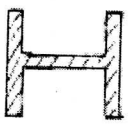
Used when ordering material

8 x ½

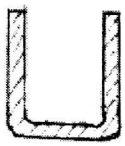
(b) FORMS OF METAL

(i)  Z - bar for window frames and casing

(ii)  Angle iron for door frames.



(iii) H - bar for roofing trasses

(iv)  U bar for channels 4 x 2 = 8 marks

15 (a) LOCATING CENTRE OF ROUND BAR
Place bar on a vee-block
Set the scriber to a point below/above centre
Scribe a line.
Rotate the bar about ⅛ turn and scribe a line.
Rotate the bar again ¼ turn and scribe a third line.
Rotate the bar again ¼ turn and scribe a fourth line.
Joint the diagonals of the quadrilateral to intersect at the centre.
6 x ½ =3 marks

(b)
A Anvil - supports one end of the work being measured.
B Spindle - moves in and out to determine actual reading.
C Locking nut to lock spindle in position.
D Sleeve or Barrel gives the main scale.
E Thimble moves spindle to give micrometer scale.
F Ratchet provides correct feel/even pressure. 6 x 1 = 6 marks

(c) (i) - Sleeve/barrel reading 09.00mm
-Thimble reading 00.44mm
9.44mm

(ii) - Sleeve/barrel reading 16.50mm
-Thimble reading 00.27mm
16.77mm

(iii) - Main scale reading 13.00mm
-Various scale reading (8 x 0.05) 0.40mm
13.40mm

(iv) - Main scale reading 28.00mm
-Various scale reading (8 x 0.05) 0.48mm
28.48mm

4 x 1½ =6 marks