higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T190(E)(J29)T
AUGUST EXAMINATION

NATIONAL CERTIFICATE

BUILDING SCIENCE N2

(15070012)

29 July 2014 (Y-Paper)
13:00–16:00

Calculators may be used.

Candidates need drawing instruments.

This question paper consists of 5 pages, 2 diagram sheets and 1 formula sheet.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
BUILDING SCIENCE N2
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. All the sketches and/or diagrams must be done in pencil.
5. The sketches and/or diagrams must be reasonably large and fully labelled.
6. Assume that 1 kg of mass exerts a force of 10 N.
7. Write neatly and legibly.

QUESTION 1

Define the following terms as found in Building Science:

1.1. Name THREE of the four common gases that you would find in air. (3)

1.2 Explain how atmospheric pressure would influence the siphon action of a centrifugal pump. (4)

1.3 At what temperature would water have its maximum density? (1)

1.4 What unique characteristic does water have when it is cooled below this temperature? (2)

1.5 Name the three states (phases) that matter can exist in. (3)

1.6 What type of energy is required to change the state of matter? (1)
[14]

QUESTION 2

2.1 Briefly describe the difference between *heat* and *temperature*. (2)

2.2 Name FOUR different types of thermometers. (4)

2.3 Give an example (use) for each thermometer. (4)
[10]

QUESTION 3

3.1 Calculate the amount of heat energy required to raise the temperature of 30 kg of copper from 285 K to 343 K.
Assume the SHC of copper to be 0.394 kJ/kg K. (4)

3.2 What mass of water at 85 °C must be added to 1 kg of water at 35 °C to reach a final temperature of 45 °C? (6)

3.3 Briefly explain the action of frost damage to brickwork. (2)

3.4 What is the damage that excessive frost will cause to brickwork? (1)
[13]

QUESTION 4

4.1 What is meant by the term *surface tension* in a liquid? (1)

4.2 Determine the saturation coefficient of a sample of material using the following data:

Volume of pores = 0,030 cm^3
Volume of water absorbed = 0,28 cm^3 (2)

4.3 Copy the TABLE below in the ANSWER BOOK. Complete it by writing YES; NO; or FAIR as answers in the spaces provided.

Roof covering	Rustproof	Hail-resistant	Economical
Corrugated iron			
Glass fibre sheets			
Cement fibre sheets			
Thatch			

(12 x ½) (6)
[9]

QUESTION 5

FIGURE 1 on DIAGRAM SHEET 1 (attached) shows FIVE co-planar, concurrent forces acting on a communal point. The forces are being held in equilibrium by the single force 'F' as shown in the sketch.

Draw a space diagram and a force/vector diagram to GRAPHICALLY determine the magnitude and true direction of this equilibrant.

Use a scale of 1 mm = 2 N

[8]

QUESTION 6

6.1 FIGURE 2 on DIAGRAM SHEET 1 (attached) shows a scissors roof truss.

Determine GRAPHICALLY the magnitude of the forces in all the members.

Use the following scales: Space diagram: 1 : 50
Force diagram: 1 mm = 100 N

Indicate on the space diagram the nature of the members. (15)

6.2 Neatly tabulate your answers in the ANSWER BOOK according to the following TABLE:

MEMBER	MAGNITUDE (N)	NATURE	
		TIE	STRUT
1. CH			
2. DJ			
3. EJ			
4. FL			
5. AL			
6. AH			
7. HK			
8. LK			
9. KJ			
10. GA			
11. AB			

(22 x ½) (11)
[26]

QUESTION 7

FIGURE 3 on DIAGRAM SHEET 2 (attached) shows a lever held in position by a force 'P'; it is hinged at 'O' and a 200 N load is suspended 2 m from 'O'.

7.1 Calculate the reactions at 'O' by taking moments about any suitable point. (6)

7.2 Calculate the reactions at 'O' if the point load on this beam is replaced by an evenly distributed load of 10 kN per metre length over the whole length of the beam. (4)
[10]

QUESTION 8

FIGURE 4 on DIAGRAM SHEET 2 (attached) shows the dimensions on a timber block of uniform thickness that is cut in such a manner that it will hold a mason's line when used to lay bricks. (The measurements in FIGURE 4 are in millimetres)

Determine the position of the centroid from side XX by calculation only.

NOTE: NO MARKS will be allocated for a graphical solution. **[10]**

TOTAL: 100

DIAGRAM SHEET 1

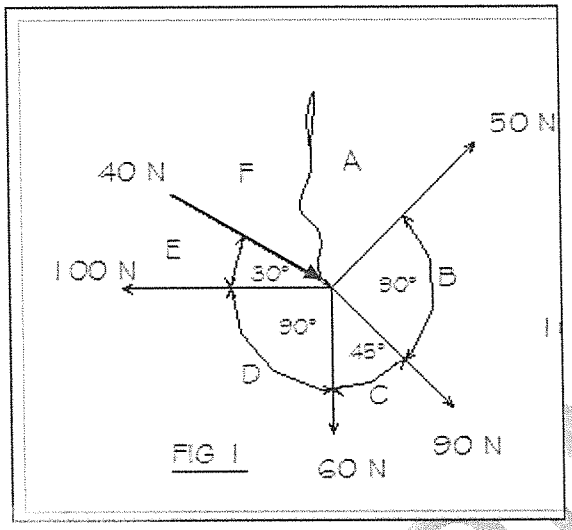

FIG 1

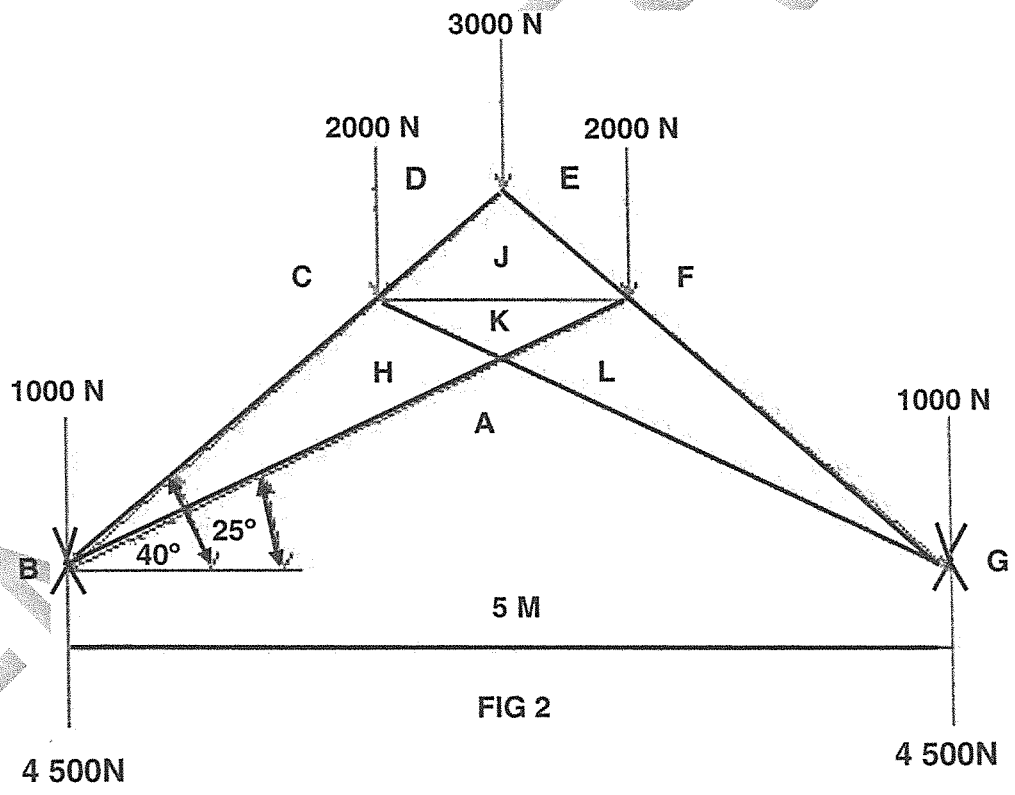

FIG 2

DIAGRAM SHEET 2

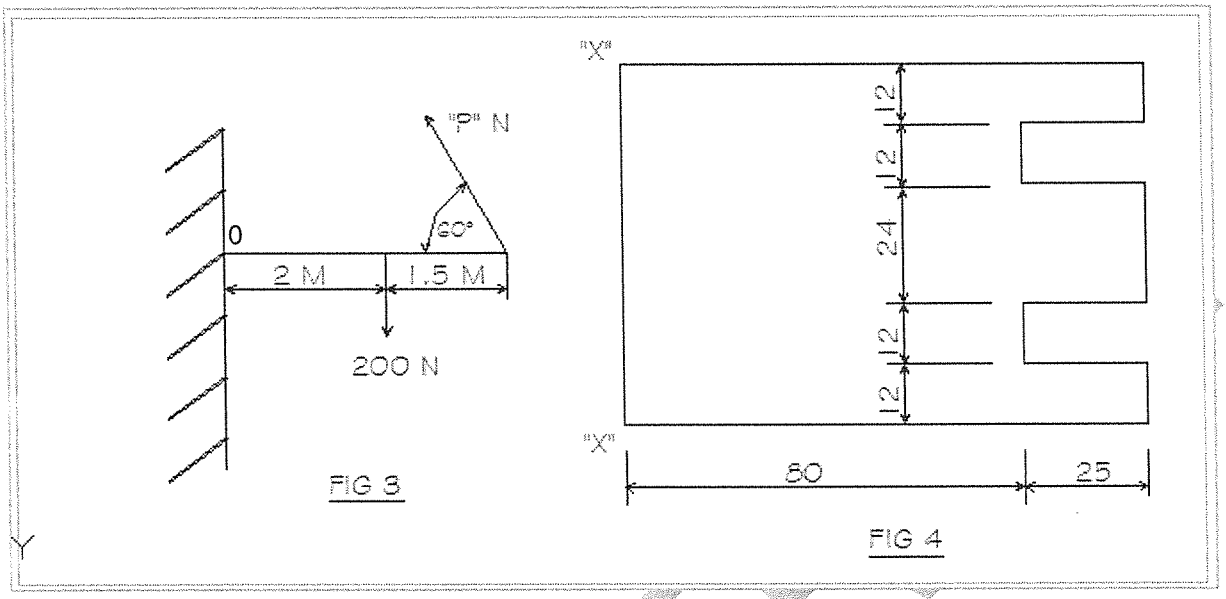

FIG 3

FIG 4

FORMULA SHEET

Any applicable formula may be used.

1. F =m x g
2. Sinø = O/H Sinø = T/S
3. Cosø = A/H Cosø = A/S
4. Tanø = O/A Tanø = T/A
5. $A = \pi \frac{D^2}{4}$ = π r²
6. A = ½(B x H) A = ½(L x B)
7. $V = \pi \frac{D^2}{4} x\, H$
8. ∑ CM = ∑ ACM
9. ∑ ↑F = ∑ ↓F
10. V = L x B x H
11. M = F x s
12. K = C + 273
13. Moment of area = area x distance from axis
14. VC = W. Sinø VK = W. Sinø
15. HC = W. Cosø HK = W. Cosø
16. $y = \frac{\sum My}{\sum A}$
17. $D = \frac{M}{V}$
18. $RD = \frac{DxS}{DxW} = RD = \frac{MxS}{MxW}$
19. $\Delta L = Lo\ x\ \Delta T\ x\ \alpha$
20. Heat required = $m\ x\ \Delta t\ x\ SHC$
21. $\%\ porosity = \frac{Bulk\ volume - Solid\ volume}{Bulk\ volume}\ x\ 100\%$
22. $saturation\ coefficiant = \frac{volume\ of\ water\ absorbed}{bulk\ volume - solid\ volume}$
23. *Heat lost = heat gained*

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MARKING GUIDELINE

NATIONAL CERTIFICATE

AUGUST EXAMINATION

BUILDING SCIENCE N2

29 JULY 2014

This marking guideline consists of 7 pages.

QUESTION 1

1.1 Nitrogen ✓
Oxygen ✓
Argon ✓
Carbon dioxide ✓ (Any 3 x 1) (3)

1.2 Centrifugal pumps need a vacuum to operate; ✓✓
positive air pressure✓ will destroy the vacuum and render the pump useless for lifting liquids. ✓ (4)

1.3 4 °C ✓ (1)

1.4 Water will expand when it changes phase ✓ freezing or boiling.✓ (2)

1.5 Solid ✓
Liquid ✓
Gas ✓ (3)

1.6 Heat energy ✓ (1)
[14]

QUESTION 2

2.1 Temperature is the 'degree of hotness' of a body. ✓
Heat is an amount of energy present in a body. ✓ (2)

2.2
- Clinical thermometer ✓
- Alcohol thermometer ✓
- Mercury thermometer ✓
- Maximum/minimum limit thermometer ✓ (4)

2.3
- Clinical thermometer: medical use to measure body temperatures ✓
- Alcohol thermometer: to measure very low temperatures (at the poles) ✓
- Mercury thermometer: general industrial and domestic (weather) uses ✓
- Maximum/minimum limit thermometer: to record highest and lowest temperatures over a set period ✓ (4)
[10]

QUESTION 3

3.1 *Heat required* = $m \times \Delta t \times SHC$
X kJ = $30\ kg \times (343 - 285) \times 0.394\ kJ/kg°C$ ✓
= 30 x 58 x 0.394 ✓
Heat energy required = 685 kJ or 685.56 kJ ✓

Reward once for use of SI units. ✓ (4)

3.2 Heat lost = heat gained ✓
$m \times \Delta t \times SHC = m \times \Delta t \times SHC$

Hot water	cold water
Mass = ?	mass = 1 kg
T2 = 45 ✓	T2 = 45 ✓
T1 = 85	T1 = 35
SHC = 4,2	SHC = 4,2

Mass x 40 x 4,2 = 1 x 10 x 4,2 ✓
M = 4,2/16,76 ✓
M = 0,25 kg
Mass of hot water required = 250 g ✓ (6)

3.3 Bricks are porous and will absorb water. ✓
Water that freezes will expand. ✓ (2)

3.4 Excessive frost will expand to crack waterlogged bricks – weakening your structure. ✓ (1)
[13]

QUESTION 4

4.1 The cohesion force of a liquid that pulls all the molecules together is referred to as surface tension when the top surface of the liquid is exposed to another substance like air or oils ✓ (1)

4.2 $saturation\ coefficiant = \frac{volume\ of\ water\ absorbed}{bulk\ volume - solid\ volume}$.

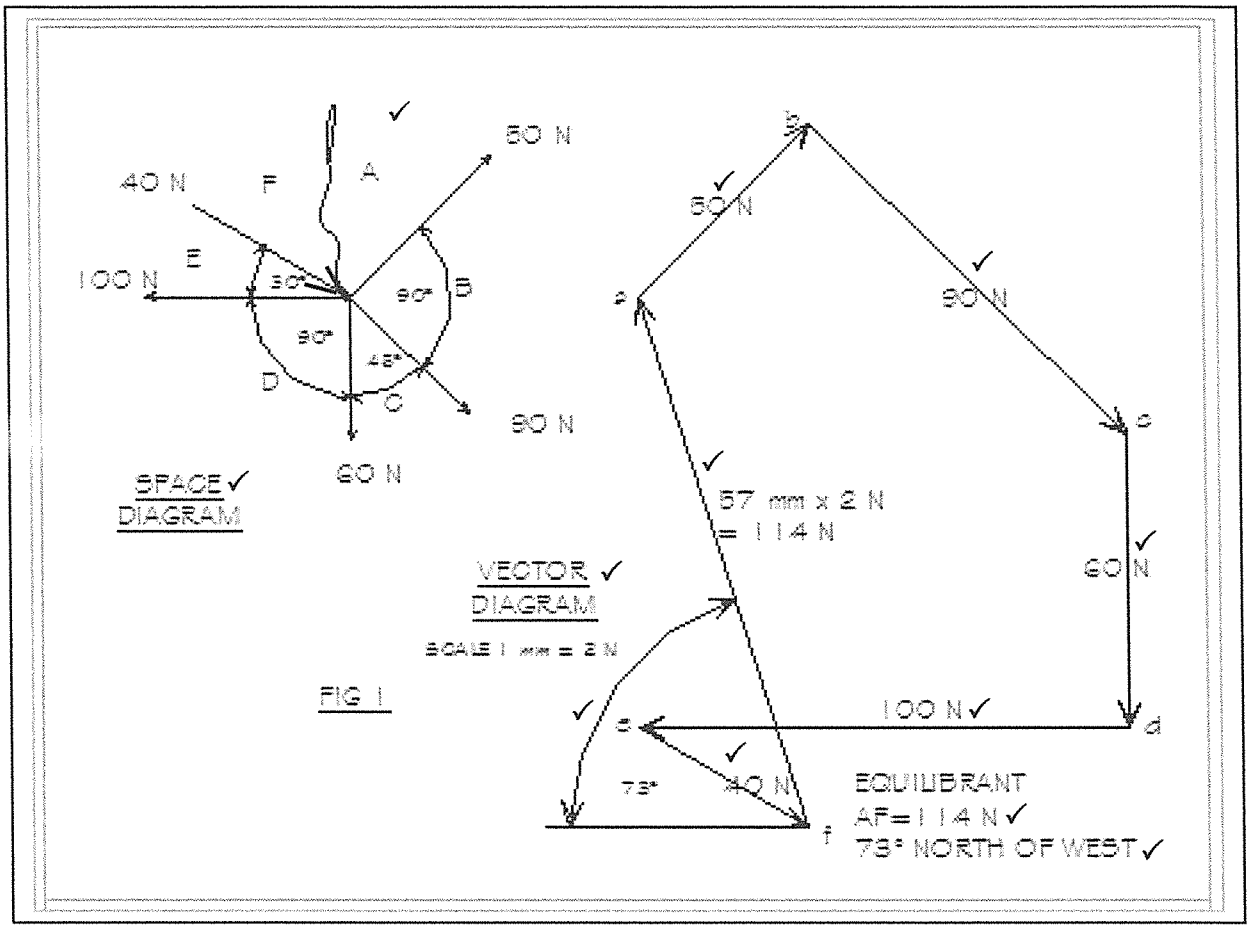
Sat co = $\frac{0.028}{0.030}$ ✓
= 0.93 ✓ (2)

4.3

Roof covering	Rustproof	Hail-resistant	Economical
Corrugated iron	Fair ✓	Yes ✓	Yes ✓
Glass fibre sheets	Yes ✓	Fair ✓	No ✓
Cement fibre sheets	Yes ✓	Fair ✓	Fair ✓
Thatch	Yes ✓	Yes ✓	No ✓

(12 x ½) (6)
[9]

QUESTION 5



Space diagram = 2

Vector diagram correctness = 8 x ½
Magnitude = 1
Direction = 1

[8]

QUESTION 6

6.1

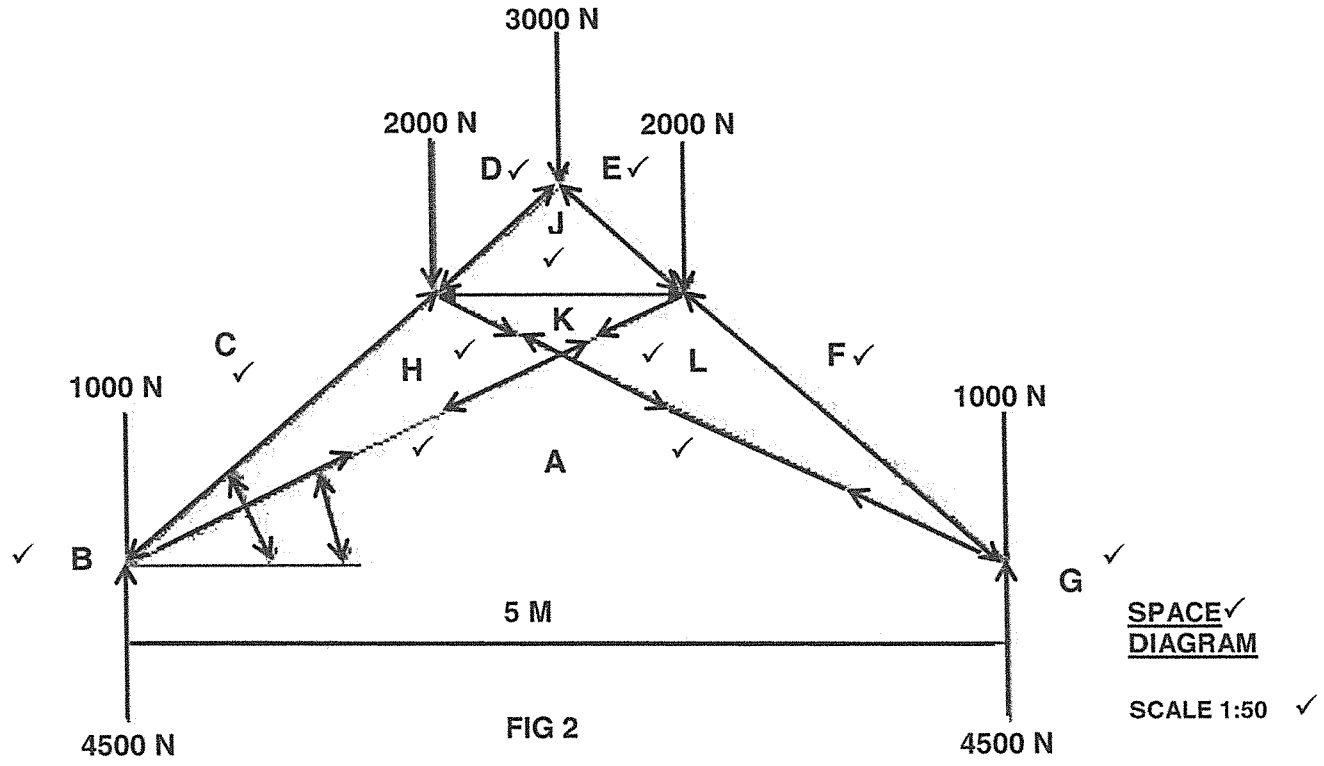
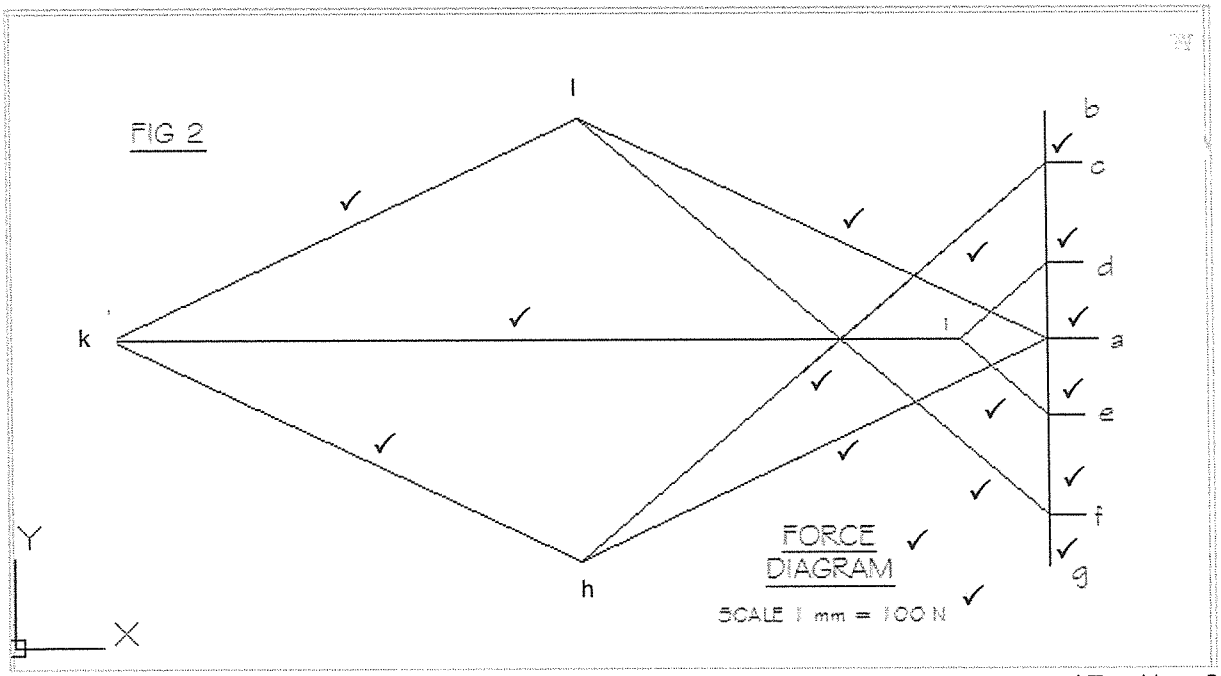


FIG 2

13 x ½ = 6½



17 x ½ = 8½

Use a scale of 1 mm = 100 N.
Draw and measure – graphical drawing accurate to 5% of memo values will be acceptable. (15)

MEMBER	MAGNITUDE (N)	NATURE	
		TIE	STRUT
1. CH	12 200 N ✓		X ✓
2. DJ	240 N ✓		X ✓
3. EJ	240 N ✓		X ✓
4. FL	12 200 N ✓		X ✓
5. AL	10 280 N ✓	X ✓	
6. AH	10 280 N ✓	X ✓	
7. HK	10 280 N ✓	X ✓	
8. LK	10 280 N ✓	X ✓	
9. KJ	16 820 N✓		X ✓
10. GA	4 500 N✓		X ✓
11. AB	4 500 N ✓		X ✓

(FIG 2)

6.2 Copy table and populate – point loads net required in table. 22 x ½ (11)

[26]

QUESTION 7

7.1 *Take moments about 'O'*
∑ CM = ∑ ACM ✓
(200 x 2)= P sin 60° x 3,5 ✓✓✓✓
P = 131,97 N ✓ (6)

7.2 *Take moments about 'O'✓*
∑ CM = ∑ ACM ✓
(10 x 3,5 x1,75) =P sin 60° x 3,5✓
P = 20,21 N✓ (4)
[10]

QUESTION 8

	AREA L x B mm²	DISTANCE TO XX (LEVER ARM)	AREA x DISTANCE	$Y = \frac{\Sigma MY}{\Sigma A}$ ✓
A	80 x 72 = 5760 mm²	36 mm	207360 mm³ ✓	
B	12 x 25 = 300 mm²	(12 x ½) + 60 = 66 mm	19800 mm³ ✓	
C	25 x 24 = 600 mm²	(24 x ½) + 24 = 36 mm	21600 mm³✓	
D	25 x 12 = 300 mm²	6 mm	1800 mm³✓	$= \frac{250560}{6960}$ ✓ y = 36 m ✓✓
	ΣA = 6960 m² ✓		250560 mm³✓	

[10]

TOTAL: 100