higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T240(E)(N25)
**NOVEMBER EXAMINATION**

**NATIONAL CERTIFICATE**

# BUILDING SCIENCE N1

(15070001)

**25 November 2013 (X-Paper)**
**09:00–12:00**

**Calculators may be used.**

**Candidates will require drawing instruments.**

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

# DEPARTMENT OF HIGHER EDUCATION AND TRAINING
# REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
BUILDING SCIENCE N1
TIME: 3 HOURS
MARKS: 100

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**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. Rule off on completion of each answer.
5. ALL sketches and/or diagrams must be done in pencil, neat, reasonably large and fully labelled.
6. Assume that a 1 kg mass exerts a force of 10 N.
7. Numerical answers are to be rounded off to two decimal places after the decimal comma.
8. Write the formula before starting with a calculation.
9. Write neatly and legibly.

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## QUESTION 1

1.1 Define the *law of Boyle.* (3)

1.2 Convert 300 K to °C (2)

1.3 The volume of a gas is 6 $m^3$ at a pressure of 250 kPa.

Calculate the volume of the gas if the pressure is increased to 400 kPa while the temperature remains constant. (5)
**[10]**

## QUESTION 2

2.1 Give THREE examples of materials suitable for the use as damp-proof course. (3)

2.2 Calculate the water : cement ratio of a concrete mixture that contains 40 g of cement and 16 litres of water. (4)

2.3 The mass of a wet wood sample is 85 g and the mass of a dried sample of wood is 60 g.

Calculate the percentage of moisture. (3)
**[10]**

## QUESTION 3

Calculate the following:

3.1 The area of a rectangle 70 cm by 25 cm. (3)

3.2 The volume of a timber beam that is 10 m long, 150 mm wide and 250 deep. (3)

3.3 Complete the following table of SI units and symbols.

| QUANTITY | UNIT | SYMBOL |
|---|---|---|
| Volumes (liquids) | ? | ? |
| ? | pascal | ? |
| force | ? | ? |

(4)
**[10]**

 

## QUESTION 4

4.1 Define *porosity.* (3)

4.2 Name THREE woodboring insects found in South Africa. (3)

4.3 State FOUR properties which concrete must possess to be workable. (4)
**[10]**

## QUESTION 5

5.1 Explain briefly what is meant by the density of a material. (3)

5.2 Name a formula to obtain the relative density of a material. (1)

5.3 A timber beam 6 m long, 80 mm wide and 110 mm deep has a mass of 30 kg.

Calculate the density of the timber in kg/m$^3$. (6)
**[10]**

## QUESTION 6

6.1 Explain what is meant by the triangle of forces. (3)

6.2 The THREE concurrent, coplanar forces in FIGURE 1, ADDENDUM A (attached) is in equilibrium.

Determine graphically the magnitude and direction of forces 'P' and Q.

Clearly show the direction on your space diagram. (7)
**[10]**

## QUESTION 7

7.1 Define:

7.1.1 A force

7.1.2 A Newton

(2 x 2) (4)

7.2 Determine graphically the magnitude and direction of the resultant of the two coplanar concurrent forces shown in FIGURE 2, ADDENDUM A (attached). (6)
**[10]**

## QUESTION 8

Three forces act upon a beam as shown in FIGURE 3, ADDENDUM A (attached).

Determine by means of the link polygon method:

8.1 The reactions at the supports.

8.2 The position and magnitude of the resultant of the three forces.

Clearly state the distance from the resultant to the left hand end (A) of the beam.

**[15]**

## QUESTION 9

9.1 Define the *polygon of forces.* (3)

9.2 FIGURE 4, ADDENDUM A (attached), shows four forces acting on a pin.

Determine graphically and clearly show the magnitude and direction of the equilibrant, also the magnitude of the horizontal and vertical components of the equilibrant. (12)

**[15]**

**TOTAL: 100**

**ADDENDUM A**

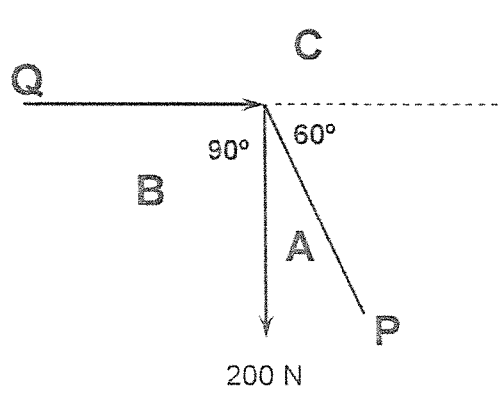


**FIGURE 1**

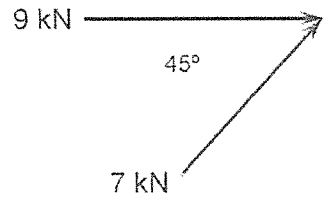


**FIGURE 2**

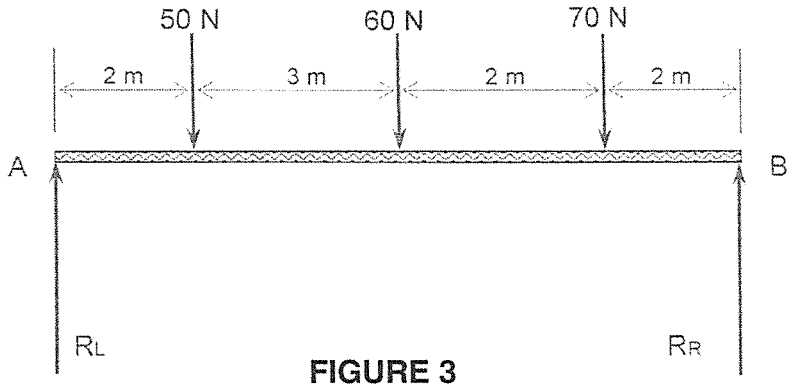


**FIGURE 3**

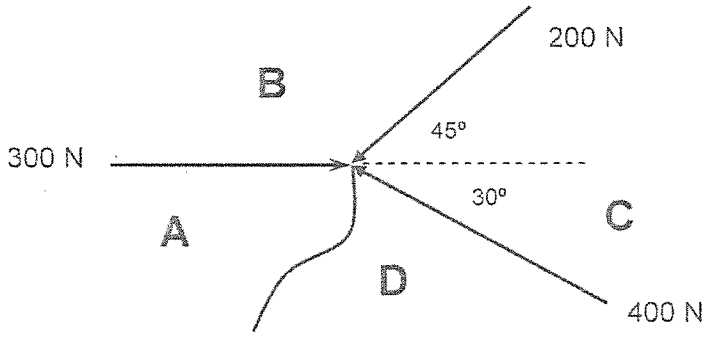


**FIGURE 4 / FIGUUR 4**

**BUILDING SCIENCE N1**

**FORMULA SHEET**

Any applicable formula may also be used.

1. $F = m \times g$

2. $\sin\theta = \frac{O}{H}$

   $\sin\theta = \frac{T}{S}$

3. $\cos\theta = \frac{A}{H}$

   $\cos\theta = \frac{A}{S}$

4. $\tan\theta = \frac{O}{A}$

   $\tan\theta = \frac{T}{A}$

5. $A = \frac{\pi D^2}{4} = \pi r^2$

6. $A = ½ (B \times h)$

7. $V = \frac{\pi D^2}{4} \times h$

8. $V = \frac{4}{3} \pi r^3$

9. $V = \frac{1}{3} \pi r^2 h$

10. $D = \frac{M}{V}$

11. $R.D. = \frac{M.S}{M.W}$

    $= \frac{D.S}{D.W}$

12. $K = C + 273$

13. $P_1V_1 = P_2V_2$

14. $VC/VK = F.\text{Sin}\square$

15. $HC/HK = \text{F.Cos}\square$

16. $V = \text{L} \times \square \times \text{H}$

17. $\%MC = \frac{IW - DW}{DW} \times 100$

    $\%VI = \frac{AG - DG}{DG} \times 100$

18. $P = h \times d \times g$

19. (Water-cement ratio)

    $W.C.R. = \frac{M.W.}{M.C.}$

    $W.S.V. = \frac{M.W.}{M.S.}$

20. $R^2 = VC^2 + HC^2$

    $R^2 = VC^2 + HK^2$

21. $W = P \times V \times g$

    $G = P \times V \times g$

22. $\text{W} = \text{m} \times \text{g}$

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# MARKING GUIDELINE

## NATIONAL CERTIFICATE

## NOVEMBER EXAMINATION

## BUILDING SCIENCE N1

## 25 NOVEMBER 2013

**This marking guideline consists of 9 pages.**

## QUESTION 1

1.1 The volume√ of a given mass of gas is inversely proportional√ to the pressure exerted on it, providing the temperature remains the same.√ (3)

1.2 √ √
° C = K = - 273

= 300 =- 273√

= 27 ° C√ (2)

1.3 $P_1 V_1 = P_2 V_2$

$V_2 = \frac{P_1 V_1}{P_2}$ √

√ √
$= \frac{250 \text{ kPa} \times 6 \text{ m}^3}{400 \text{ kPa}}$ v v

$= 3{,}75 \text{ m}^3$ (5)
**[10]**

## QUESTION 2

2.1
- Malthoid√
- PVC√
- Bitumen-impregnated felt√
- Thin layers of slate
- Dense pressed bricks

(Any 3 × 1) (3)

2.2 √
16 litres of water = 16 kg of water (1 litre = 1 kg)

Water : cement ratio = $\frac{\text{mass of water v}}{\text{mass of cement v}}$

$= \frac{16 \text{ kg v}}{40 \text{ kg v}}$

= 0,4√ (4)

2.3 Moisture contant = $\frac{OM - DM}{DM} \times 100$ v

$= \frac{85 - 60}{60} \times 100$ v v

$= 41{,}667\%$ v v (3)

**[10]**

## QUESTION 3

3.1 Area = length x breath√

= 70 cm x 25 cm v v

= 1750 $cm^2$vv (3)

3.2 Volume = length x breath x height√

= 10 m x 0,15 m x 0,25 m v v v

= 0,375 $m^3$v

or

= 10 000 mm x 150 mm x 250 mm v v v

= 375 000 000 $m^3$v (3)

3.3

| QUANTITY | UNIT | SYMBOL |
|---|---|---|
| Volumes (liquids) | **Litre** √ | v**ℓ or litre** |
| **Pressure**√ | pascal | v**Pa** |
| force | **Newton** v | v**N** |

(4)

**[10]**

## QUESTION 4

4.1 A material is said to be porous when its mass is not solid throughout, √ but contains a certain amount of air space. √ This air space is usually divided up into a great number of very small spaces known as voids or pores√ which are distributed throughout the mass of the material. (3)

4.2
- Furniture beetle√
- Powder-post beetle√
- Longhorn beetle√
- Termites

(Any 3 × 1) (3)

4.3
- It must be composed of the correct proportions of fine to coarse aggregates. √
- It must have the correct cement/aggregate ratio. √
- It must have the correct water/cement ratio. √
- It must be well mixed. √
- Fully compacted.
- Be well cured.

(Any 4 × 1) (4)
**[10]**

## QUESTION 5

5.1 The mass√ per unit volume√ of a substance√ is called its density, and is expressed in g/cm³ or kg/m³. (3)

5.2 Relative density = $\frac{\text{density of substance}}{\text{Density of water}}$ √

or

= $\frac{\text{mass of substance}}{\text{mass of water}}$ √

Relative density = $\frac{\text{density of substance}}{\text{Density of water}}$ √

√or

= $\frac{\text{density of substance}}{\text{Density of water}}$ √

√ (1)

5.3 Volume = length x breath x width v

v v v

= 6 x 0,08 x 0,11 m (correct conversion to m)

v v

= 0, 053 m³ (correct conversion to m)

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

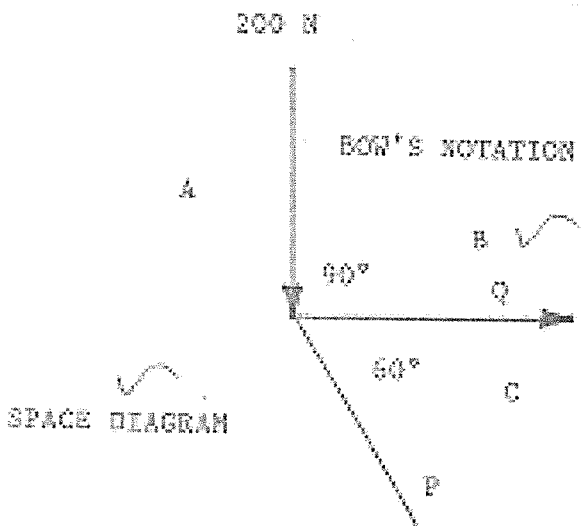
$$= \frac{30 \text{ kg}}{0{,}053 \text{ m}^3} = 566{,}038 \text{ kg/m}^3$$

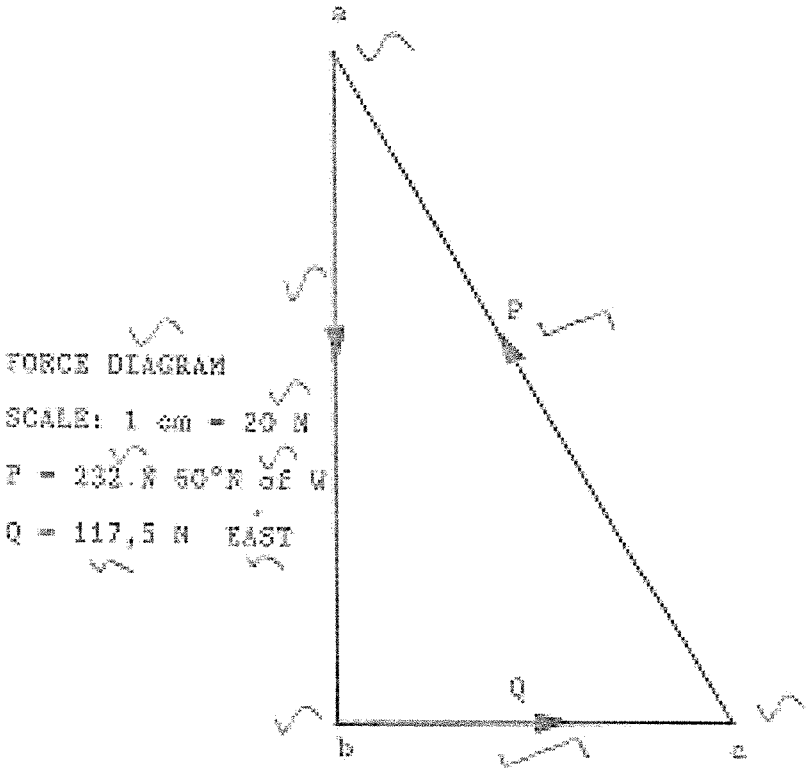
(6)
**[10]**

## QUESTION 6

6.1 If three forces acting at a point are in equilibrium, they can be represented in size or magnitude and direction by the sides of a triangle, taken in order. (Any 3 × 1) (3)

6.2






(7)
**[10]**

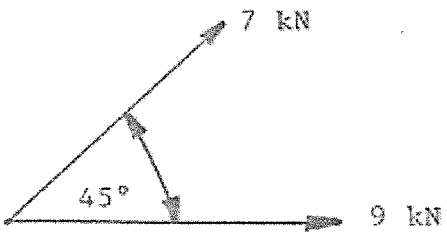
**QUESTION 7**

7.1 7.1.1 A force v is that which changes or tend to change v the state of rest or uniform motion v of a body in a straight line. v

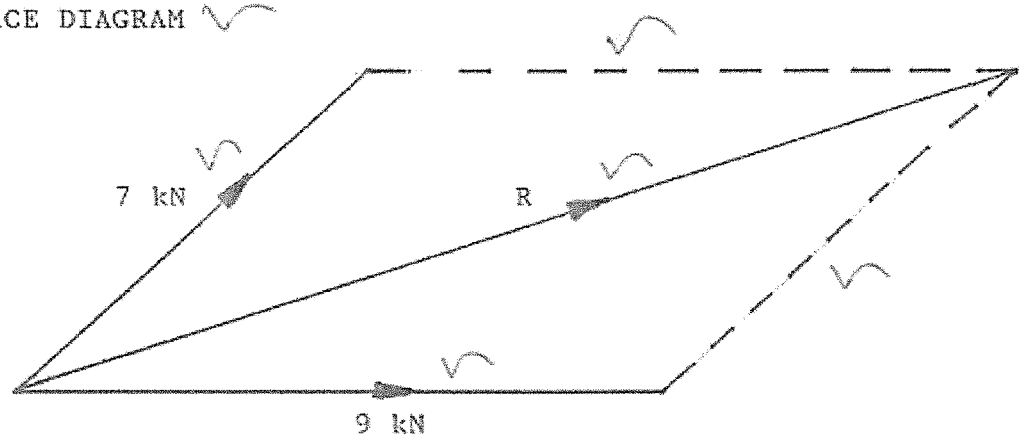
7.1.2 The unit v in which a force v is measured v, is called the newton and the symbol used for newton is N v.

(2 x 2) (4)

7.2




SPACE DIAGRAM ✓

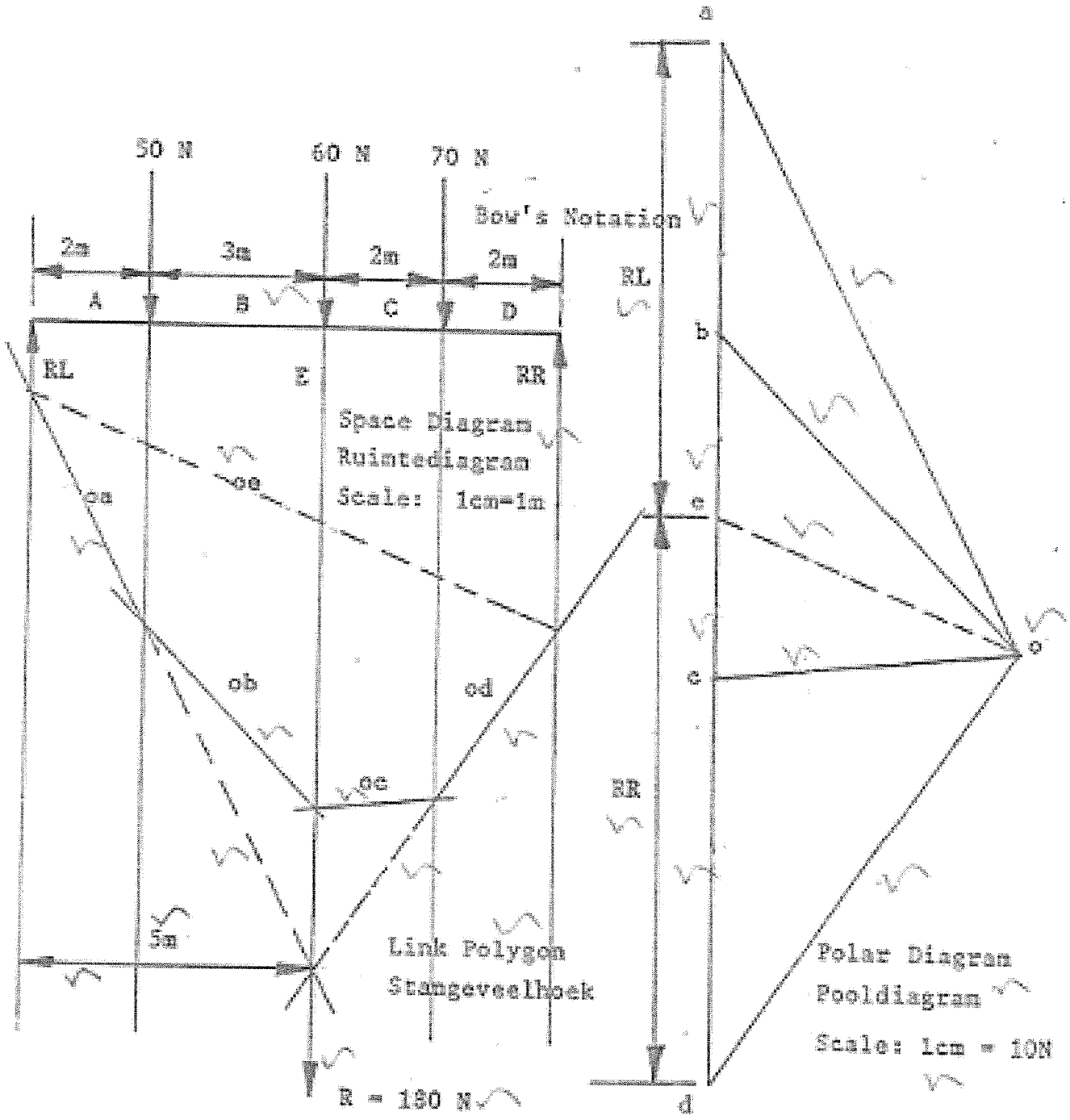



FORCE DIAGRAM ✓

Scale: 1 cm = 1 kN ✓ RESULTANT = 14,8 kN / 19,5° N of E ✓✓✓✓

(6)
**[10]**

## QUESTION 8




RL = 82 N

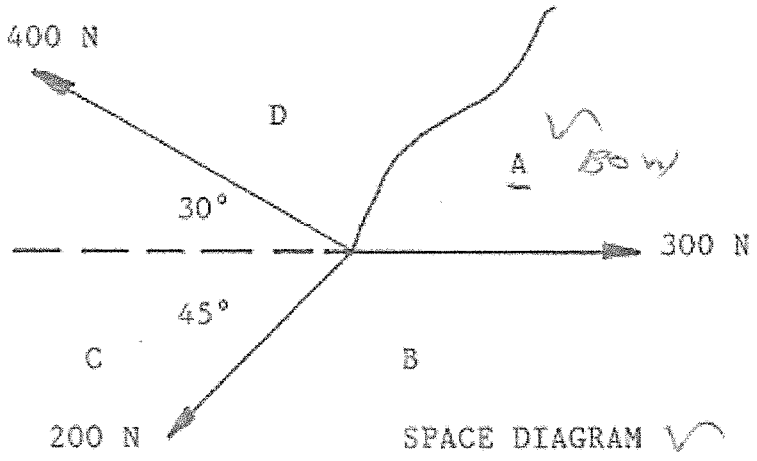
RR = 98 N

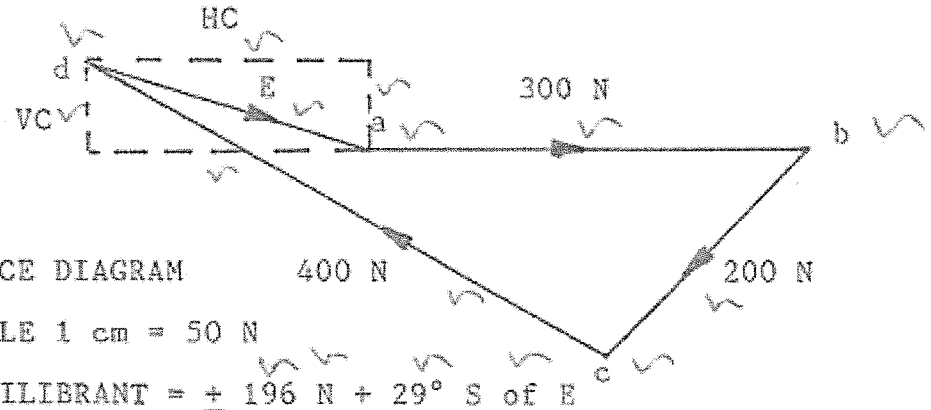
**[15]**

## QUESTION 9

9.1 If more than three v coplanar forces acting on a point v are in equilibrium v, they can be represented v in magnitude and direction v by the sides of a closed polygon v, taken in order. (3)

9.2




FORCE DIAGRAM

SCALE 1 cm = 50 N

EQUILIBRANT = ± 196 N ± 29° S of E

VC = ± 95 N

HC = ± 171 N

(12)
**[15]**

**TOTAL: 100**