

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NATIONAL CERTIFICATE
BUILDING SCIENCE N1
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. 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. Untidy and/or illegible work will be penalized.
 7. Assume that 1 kg mass exerts a force of 10 N.
 8. Numerical answers are to be rounded off to two decimal places after the decimal comma.
 9. Write the formula before starting with a calculation.
 10. Write neatly and legibly.
-

QUESTION 1

- 1.1 Define *Boyle's Law*. (3)
- 1.2 Convert 200 K to °C. (2)
- 1.3 The volume of a gas is 4 m³ 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

Calculate the following:

- 2.1 The area of a rectangle 50 cm by 15 cm (3)
- 2.2 The volume of a timber beam 9 m long, 250 mm wide and 150 mm thick. (3)
- 2.3 Complete the following table of SI units and symbols.

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

(4)
[10]

QUESTION 3

- 3.1 Give THREE examples of materials suitable for using as damp-proof course. (3)
- 3.2 Calculate the water: cement ratio of a concrete mixture that contains 30 kg of cement and 15 litres of water. (4)
- 3.3 The mass of a wet wood sample is 75 g and the mass of the same dried wood sample is 50 g.

Calculate the percentage of moisture in the wood sample.

(3)
[10]

QUESTION 4

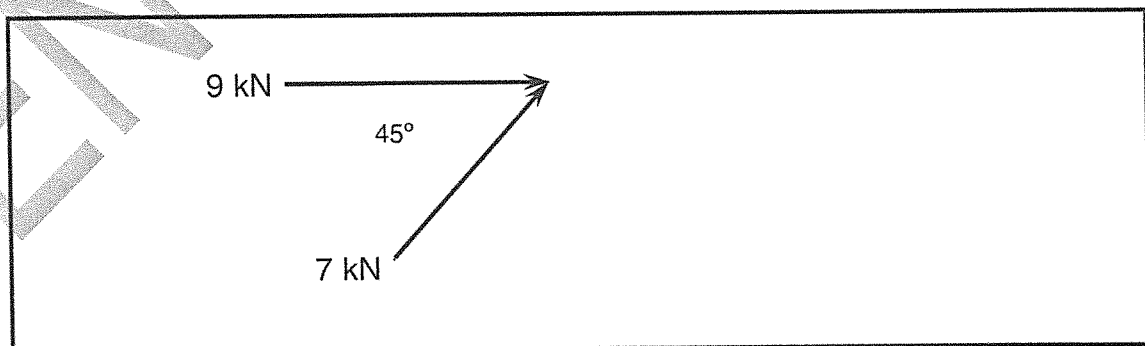
- 4.1 Explain briefly what is meant by the density of a material. (3)
- 4.2 Give a formula for determining the relative density of a material. (1)
- 4.3 A timber beam 5 m long, 120 mm wide and 70 mm thick has a mass of 40 kg.
Calculate the density of the timber beam in kg/m^3 . (6)

[10]**QUESTION 5**

- 5.1 Define *porosity*. (3)
- 5.2 Name THREE woodboring insects found in South Africa. (3)
- 5.3 State FOUR properties which concrete must possess to be workable. (4)

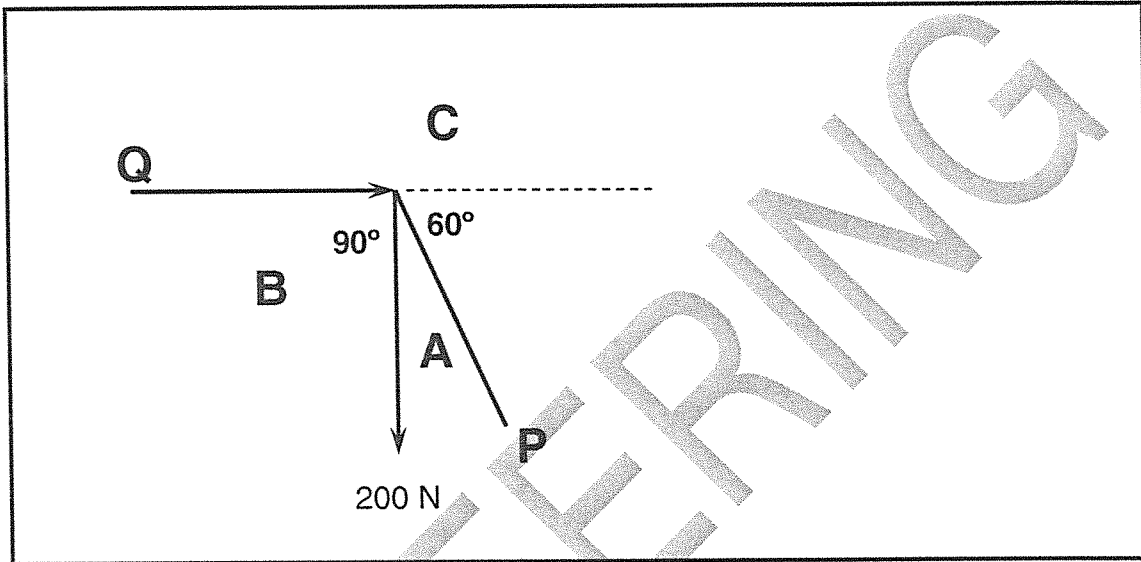
[10]**QUESTION 6**

- 6.1 Define:
- 6.1.1 A force
- 6.1.2 A Newton (2 × 2) (4)
- 6.2 Determine graphically the magnitude and direction of the resultant of the two coplanar concurrent forces shown in FIGURE 1 below. (6)

**FIGURE 1****[10]**

QUESTION 7

- 7.1 Explain what is meant by the *triangle of forces*. (3)
- 7.2 The THREE concurrent, coplanar forces in FIGURE 2 below are in equilibrium.

**FIGURE 2**

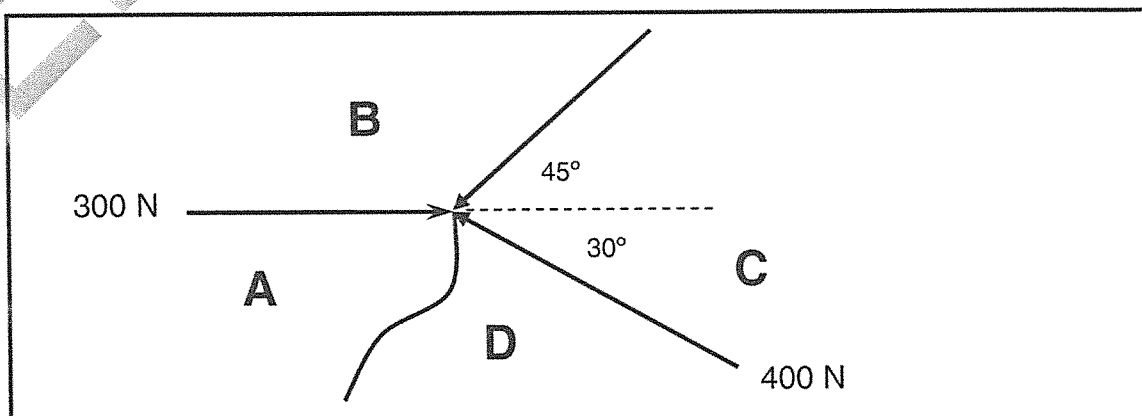
Determine graphically the magnitude and direction of forces **P** and **Q**.

Clearly indicate the directions on your space diagram.

(7)
[10]

QUESTION 8

- 8.1 Define the *polygon of forces*. (3)
- 8.2 FIGURE 3 below shows four forces acting on a pin.

**FIGURE 3**

Determine graphically and clearly show the magnitude and direction of the equilibrant as well as the magnitude of the horizontal and vertical components of this equilibrant.

(12)
[15]

QUESTION 9

Three forces act upon a beam as shown in FIGURE 4 below.

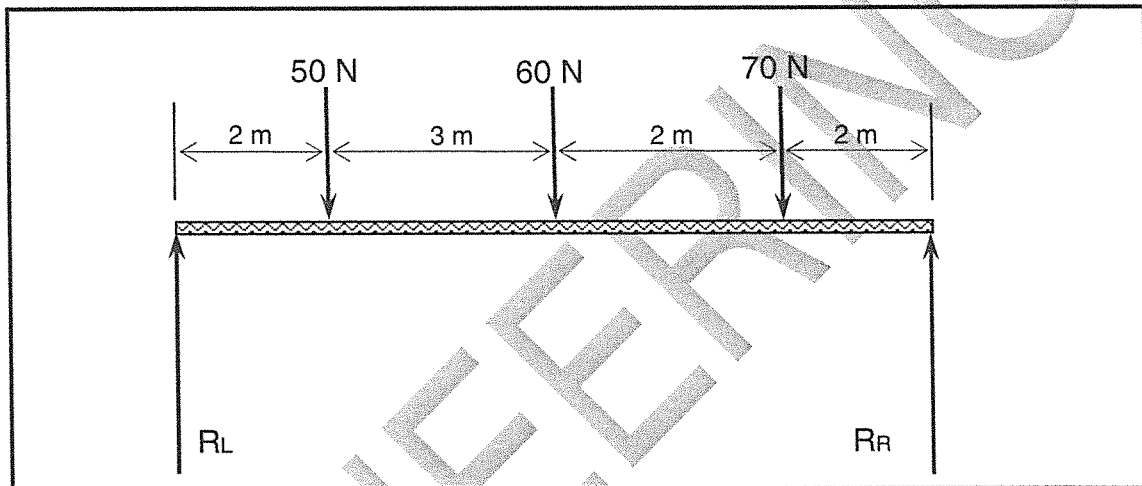


FIGURE 4

Determine by means of the link polygon method:

- 9.1 The reactions at the supports (6)
- 9.2 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.

(9)
[15]

TOTAL: 100

ADDENDUM

BUILDING SCIENCE N1
BOUWETENSKAP N1

BYLAE A

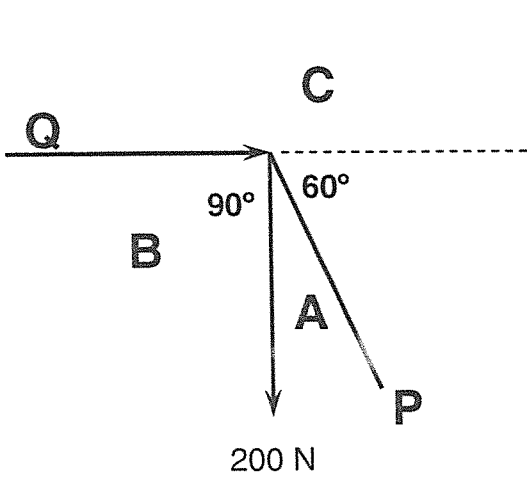


FIGURE 1

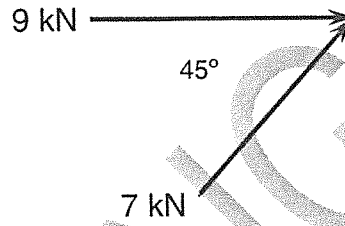


FIGURE 2

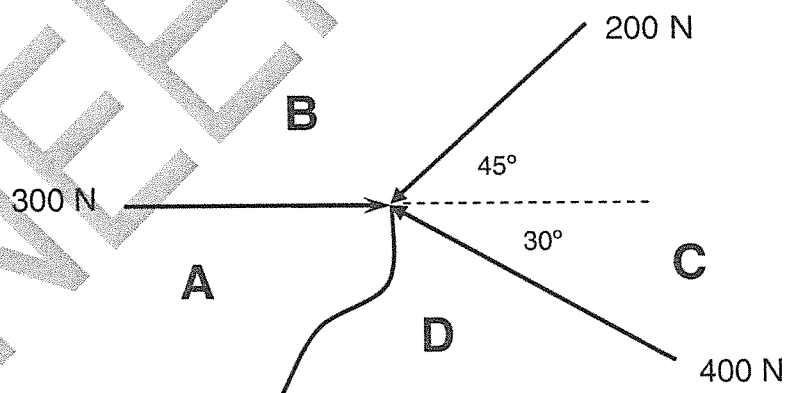


FIGURE 3

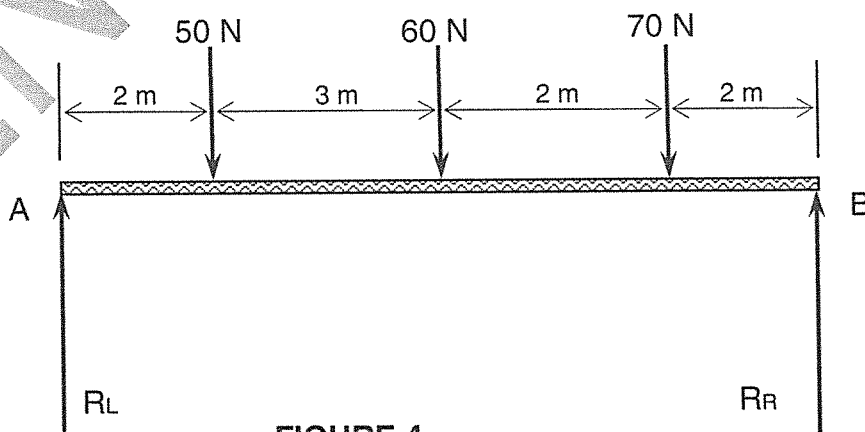


FIGURE 4

FORMULA SHEET**BUILDING SCIENCE N1**

Any applicable formula may also be used.

1. $F = m \times g$

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

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

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. $A = \frac{1}{2}(B \times h)$

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

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

12. $K = C + 273$

13. $VC / VK = F \cos \theta$

14. $HC / HK = F \cos \theta$

15. $V = L \times B \times H$

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

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

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

18. (Water : cement ratio)

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

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

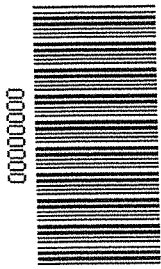
19. $R^2 = VC^2 + HC^2$

$$R^2 = VK^2 + HK^2$$

20. $W = P \times V \times g$
 $G = P \times V \times g$

21. $W = m \times g$

22. $P_1 V_1 = P_2 V_2$



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

NOVEMBER EXAMINATION

BUILDING SCIENCE N1

18 NOVEMBER 2014

This marking guideline consists of 8 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
$$\begin{aligned} ^\circ\text{C} &= \text{K} - 273 \\ &= 200 - 273 \quad \checkmark \\ &= -73 \text{ } ^\circ\text{C} \quad \checkmark \end{aligned}$$
 (2)

1.3
$$\begin{aligned} P_1 V_1 &= P_2 V_2 \\ V_2 &= \frac{P_1 V_1}{P_2} \quad \checkmark \\ &= \frac{250 \text{ kPa} \times 4 \text{ m}^3}{400 \text{ kPa}} \quad \checkmark \quad \checkmark \\ &= 2,5 \text{ m}^3 \quad \checkmark \end{aligned}$$
 (5)
[10]

QUESTION 2

2.1
$$\begin{aligned} \text{Area} &= \text{length} \times \text{breadth} \quad \checkmark \\ &= 50 \text{ cm} \times 15 \text{ cm} \\ &= 750 \text{ cm}^2 \end{aligned}$$
 (3)

2.2
$$\begin{aligned} \text{Volume} &= \text{length} \times \text{breadth} \times \text{height} \quad \checkmark \\ &= 9 \text{ m} \times 0,15 \text{ m} \times 0,25 \text{ m} \\ &= 0,338 \text{ m}^3 \quad \checkmark \end{aligned}$$

OR

$$\begin{aligned} &= 9\,000 \text{ mm} \times 150 \text{ mm} \times 250 \text{ mm} \\ &= 337\,500\,000 \text{ mm}^3 \quad \checkmark \end{aligned}$$
 (3)

2.3

QUANTITY	UNIT	SYMBOL
Volumes (liquids)	Litre \checkmark	\checkmark <i>l</i> or litre
Pressure \checkmark	pascal	\checkmark Pa
force	Newton \checkmark	\checkmark N

(4)
[10]

QUESTION 3

- 3.1
- Malthoid ✓
 - PVC ✓
 - Bitumen-impregnated felt ✓
 - Thin layers of slate ✓
 - Dense pressed bricks ✓
- (Any 3 × 1) (3)

3.2 15 litres of water = 15 kg of water (1 litre = 1 kg)

$$\begin{aligned} \text{Water : cement ratio} &= \frac{\text{Mass of water}}{\text{Mass of cement}} \quad \checkmark \\ &= \frac{15 \text{ kg}}{30 \text{ kg}} \quad \checkmark \\ &= 0,5 \quad \checkmark \end{aligned} \quad (4)$$

3.3 Moisture content = $\frac{\text{OM} - \text{DM}}{\text{DM}} \times 100 \quad \checkmark$

$$\begin{aligned} &= \frac{75 - 50}{50} \times 100 \quad \checkmark \\ &= 50\% \quad \checkmark \end{aligned} \quad (3)$$

[10]

QUESTION 4

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

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

or

= $\frac{\text{Mass of substance}}{\text{Mass of water}}$ ✓

(1)

$$\begin{aligned}
 4.3 \quad \text{Volume} &= \text{length} \times \text{breadth} \times \text{width} \quad \checkmark \\
 &= 5 \times 0,07 \times 0,12 \text{ m} \quad (\text{correct conversion to m}) \\
 &= 0,042 \text{ m}^3
 \end{aligned}$$

$$\begin{aligned}
 \text{Density} &= \frac{\text{Mass}}{\text{Volume}} \quad \checkmark \\
 &= \frac{40 \text{ kg}}{0,042 \text{ m}^3} \quad \checkmark = 952,381 \text{ kg/m}^3
 \end{aligned}$$

(6)
[10]**QUESTION 5**

5.1 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)

- 5.2
- Furniture beetle ✓
 - Powder-post beetle ✓
 - Longhorn beetle ✓
 - Termites ✓
- (Any 3 × 1) (3)

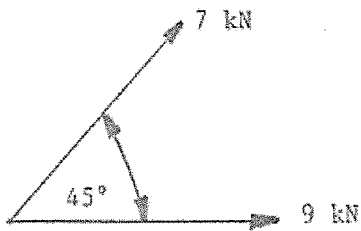
- 5.3
- It must be composed of the correct proportions of fine to coarse aggregates. ✓
 - It must have the correct cement : aggregate ratio. ✓
 - It must have the correct water : cement ratio. ✓
 - It must be well-mixed. ✓
 - It must be fully compacted. ✓
 - It must be well cured. ✓
- (Any 4 × 1) (4)
[10]

QUESTION 6

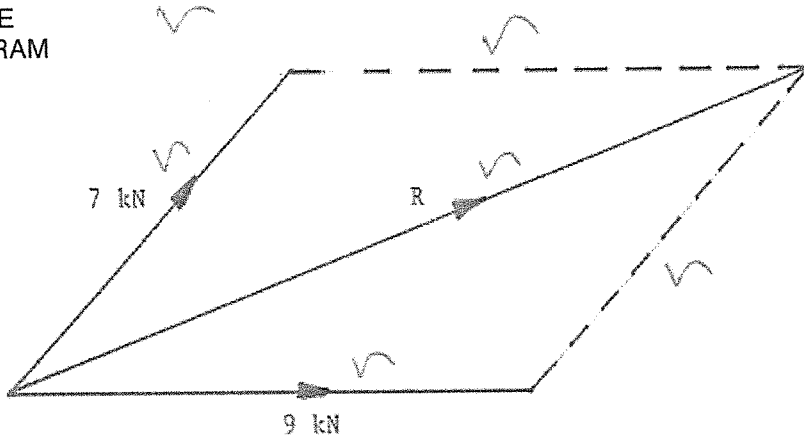
6.1 6.1.1 A force is that which changes or tend to change the state of rest or uniform motion of a body in a straight line. (2)

6.1.2 The unit in which a force is measured, is called a newton and the symbol used for newton is N. (2)

6.2



SPACE DIAGRAM



FORCE DIAGRAM

SCALE: 1 cm = 1 kN

RESULTANT = 14,8 kN/19,5 °N of E

(6)
[10]

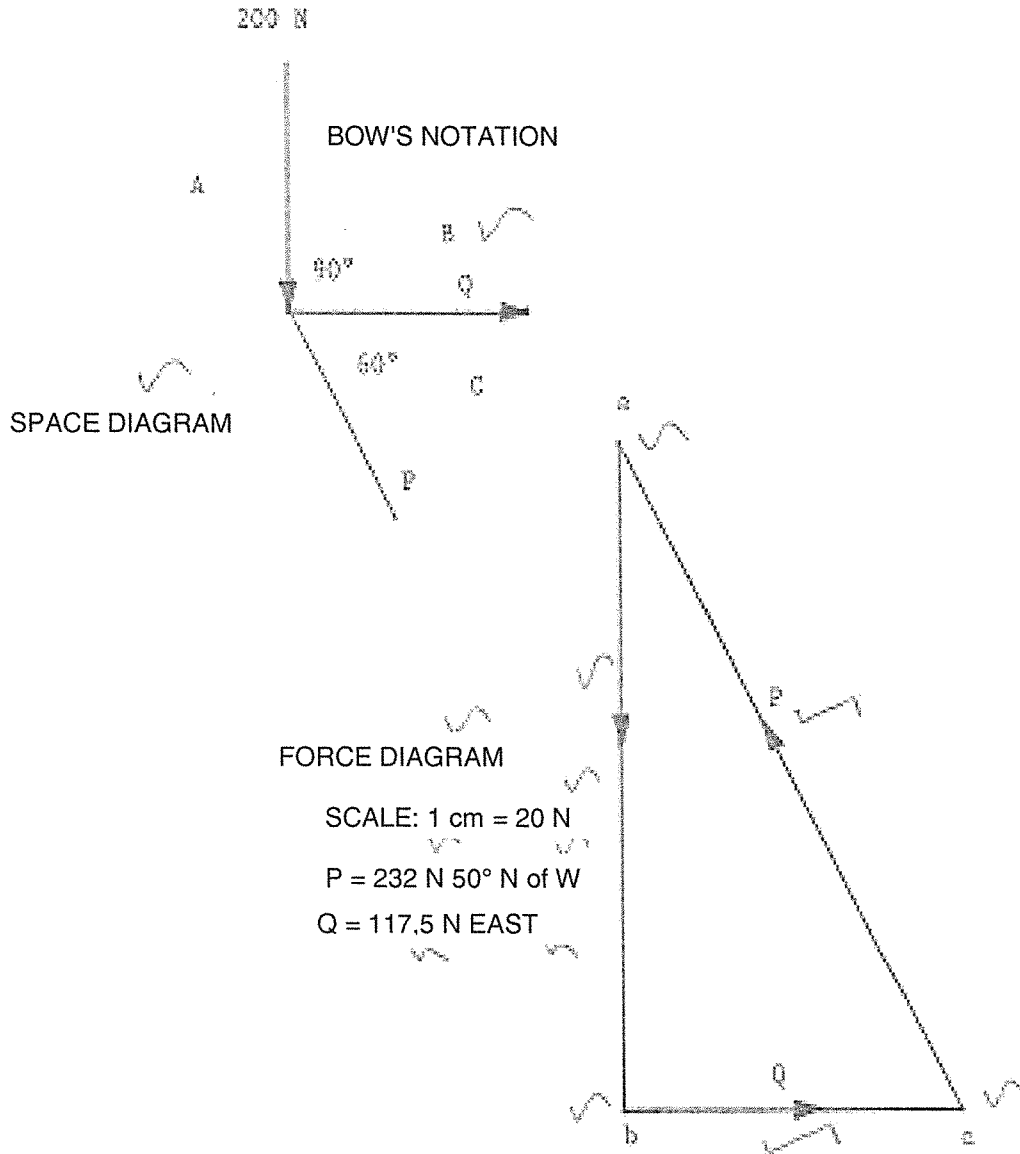
QUESTION 7

7.1 **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.

(3)

7.2



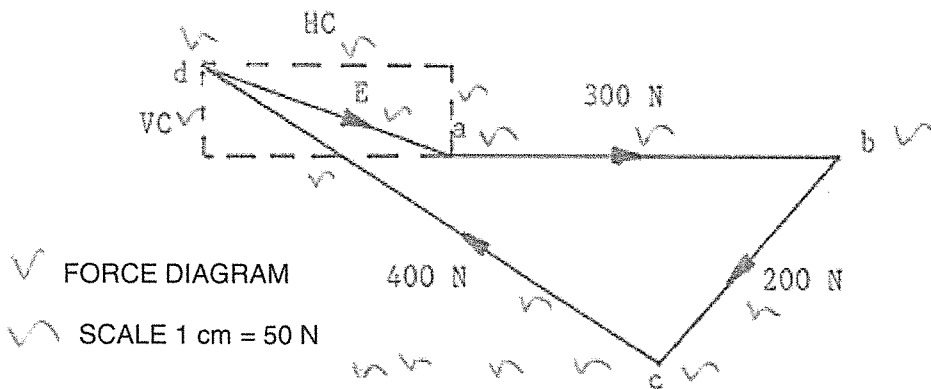
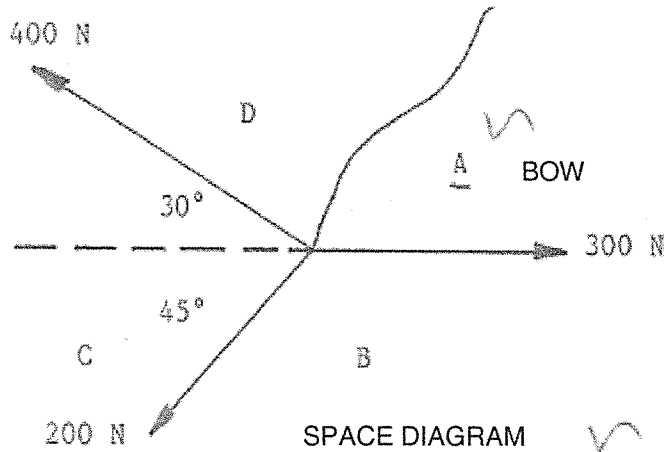
(7)
[10]

QUESTION 8

8.1 If more than three coplanar forces acting on a point are in equilibrium, they

can be represented in magnitude and direction by the sides of a closed polygon, taken in order. (3)

8.2



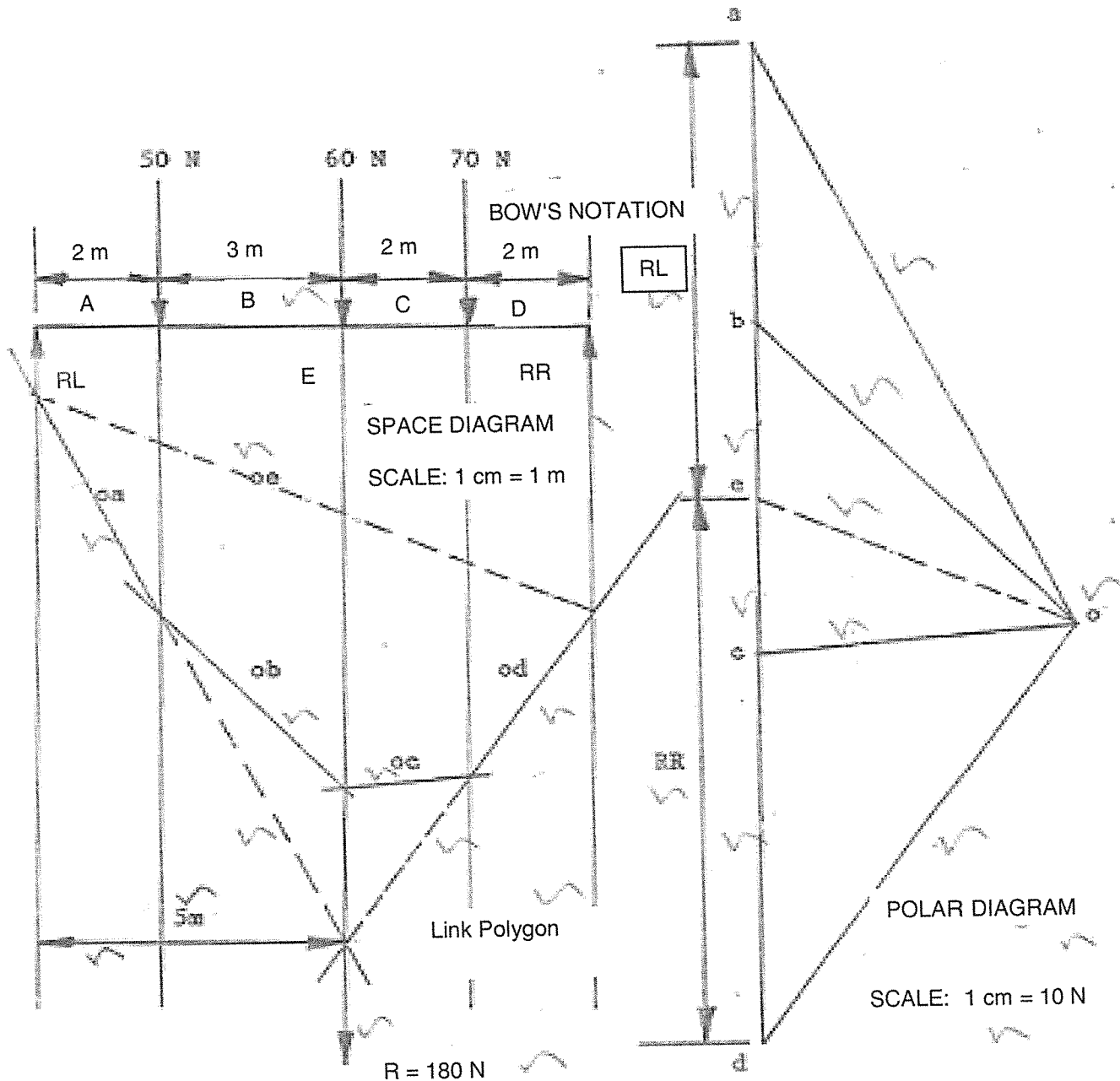
EQUILIBRANT = $\pm 196 \text{ N } \pm 29^\circ \text{ S of E}$

VC = $\pm 95 \text{ N}$

HC = $\pm 171 \text{ N}$

(12)
[15]

QUESTION 9



R = 180 N

RL = 82

RR = 98 N

[15]

TOTAL: 100