Province of the
EASTERN CAPE
EDUCATION

DIRECTORATE SENIOR CURRICULUM MANAGEMENT (SEN-FET)

HOME SCHOOLING SELF-STUDY WORKSHEET

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<tr><td>SUBJECT</td><td>WELDING & METALWORK</td><td>GRADE</td><td>12</td><td>DATE</td><td>APRIL 2020</td></tr>
<tr><td>TOPIC</td><td>FORCES</td><td>TERM 1
REVISION</td><td>(√)</td><td>TERM 2
CONTENT</td><td>( )</td></tr>
<tr><td>TIME
ALLOCATION</td><td>2 hrs.</td><td colspan="4" rowspan="2"><u>TIPS TO KEEP HEALTHY</u>

1. WASH YOUR HANDS thoroughly with soap and water for at least 20 seconds. Alternatively, use hand sanitizer with an alcohol content of at least 60%.
2. PRACTICE SOCIAL DISTANCING – keep a distance of 1m away from other people.
3. PRACTISE GOOD RESPIRATORY HYGIENE: cough or sneeze into your elbow or tissue and dispose of the tissue immediately after use.
4. TRY NOT TO TOUCH YOUR FACE. The virus can be transferred from your hands to your nose, mouth and eyes. It can then enter your body and make you sick.
5. STAY AT HOME.</td></tr>
<tr><td>INSTRUCTIONS</td><td>Self – study notes with worked examples.</td></tr>
</table>

Definition of a Force:
A force is an influence which changes or tends to change the state of rest or uniform motion of a body.

Forces are always measured in Newtons (N).

One Newton is the force required to accelerate a mass of 1 kg at 1 m/s^2.

Forces are **vector** quantities and to specify a force fully, it is necessary to state the following:

• **magnitude** (the strength of the force)

• line of action (which is the straight line along which the vector acts and indicates **direction**)

• direction along the line of action of the force. (Is the force pushing or pulling?)

System of Forces:

Resultant

If a system of forces acts on a body and a single force can be found that has the same effect as the system, that single force is known as the resultant of the system.

Equilibrium

When two or more forces act on a body and the body remains at rest, the forces are said to be in equilibrium.

Equilibrant

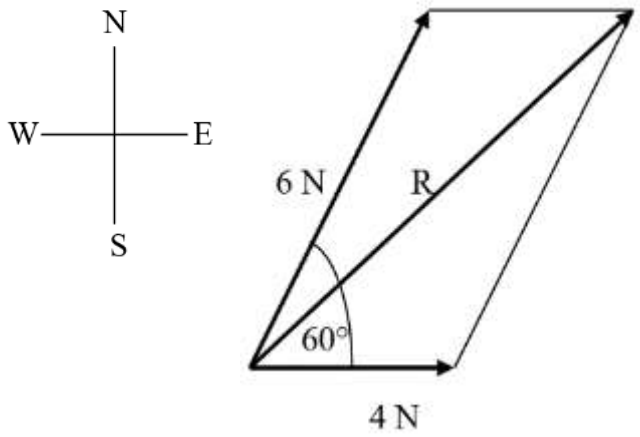
If a system of forces acts on a body but a single force keeps the body at rest, the single force is known as the equilibrant of the system of forces.

The equilibrant of a system of forces has the same magnitude and line of action as the resultant but is opposite in direction.

PARALLELOGRAM OF FORCES

Example: 1

Calculate the magnitude and the direction of the Resultant force (R)n the parallelogram of forces below



Pythagoras:

$R^2 = X^2 + Y^2$

$R = 7^2 + 5.2^2$

$R = \sqrt{49^2 + 27.04^2}$

$R = 76.04$

$R = 8.72$ N

FORCE	VETICAL COMPONENT		HORIZONTAL COMPONENT	
6 N	Y = 6 Sin 60°	5.2 N	X = 6 Cos 60°	3 N
4 N	Y = 4 Sin 0°	0 N	X = 4 Cos 0°	4 N
		5.2 N		7 N

To determine the direction:

$$\text{Tan } Ø = \frac{\text{sum Y}}{\text{sum X}}$$

Tan Ø = $\frac{5.2}{7}$

Tan-1 = 0.742857142 and 36°North of East

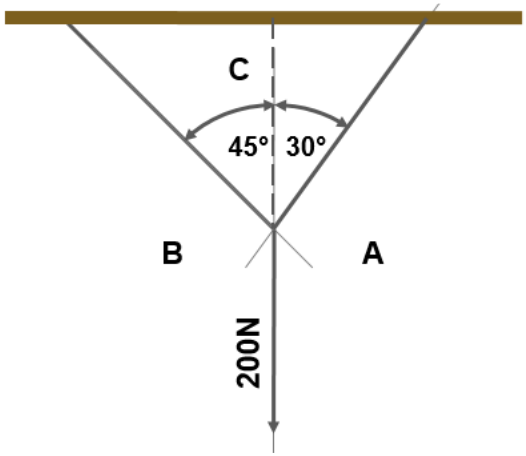
COMPONENTS OF FORCES

Space Diagram to Force Diagram:

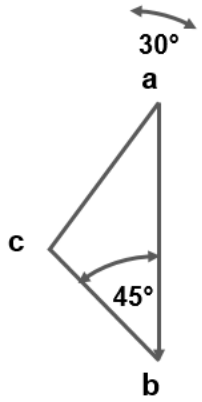
Two ropes, inclined at 30° and 45° to the vertical, support a load of 200 N.

Determine the tensions, that is pulls in both ropes.

Force diagram



Space diagram

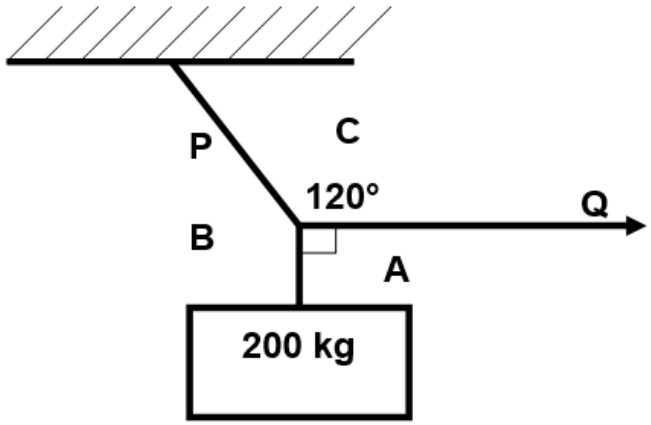


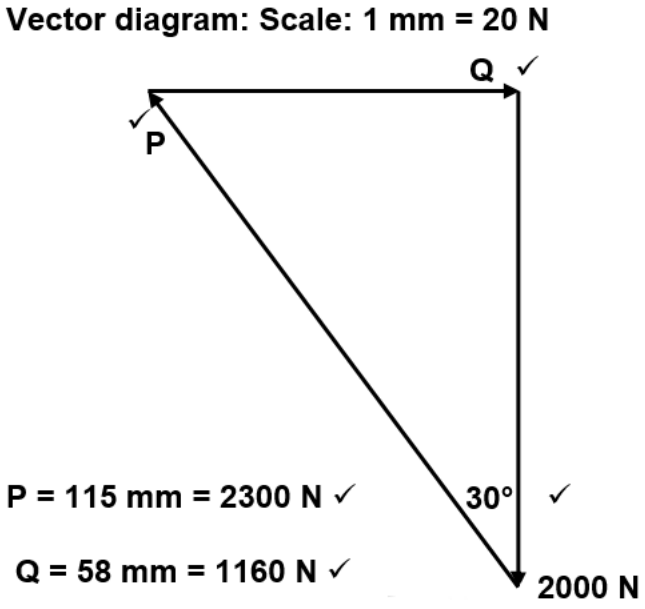
Scale 1cm = 50N

Example 2:

A system of forces indicated in the figure is in equilibrium. Make use of Bow's Notation and determine graphically the magnitude and directions of the

unknown forces P and Q. (Use Scale: 1 mm = 20 N)





Horizontal and vertical components of a force acting at an angle.

To calculate the resultant of a parallelogram of forces, the forces in the system must first be resolved into their horizontal and vertical components.

The horizontal component (x) of any force (F) can be obtained by using this simple formula: x = F cos θ

The vertical component (y) of any force (F) can be obtained by using this simple formula: y = F sin θ

Calculating the resultant of a parallelogram of forces the arithmetic sum of x and y components are then used to find the magnitude of the resultant

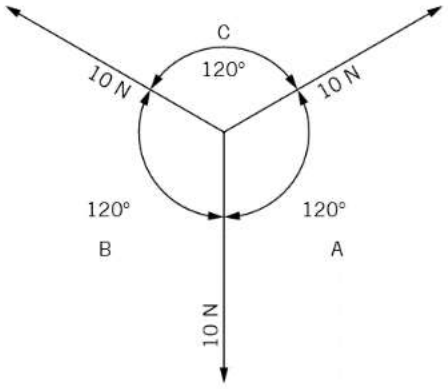
by Pythagoras, i.e. $R^2 = x^2 + y^2$

The direction of the resultant force is calculated by using the formula:

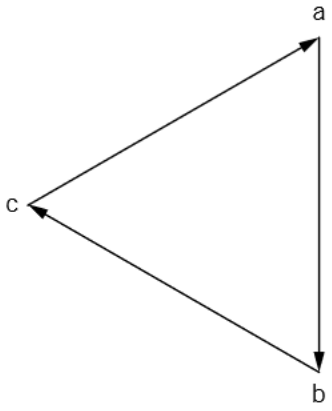
$$\tan \theta = \frac{\text{sum X}}{\text{sum Y}}$$

TRIANGLE OF FORCES

Space Diagram



Force Diagram

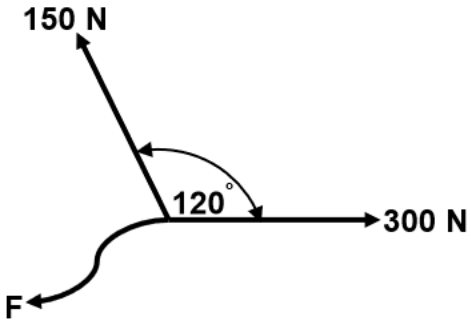


Scale 4 cm = 10 N

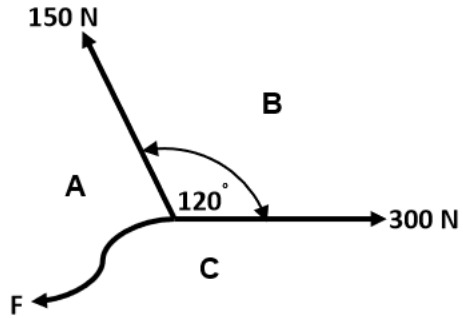
Example 3:

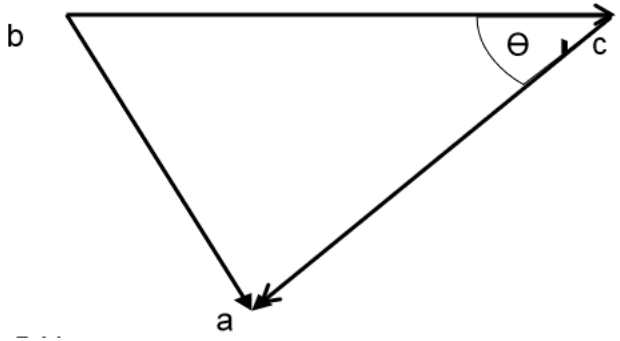
The Figure below shows a system of forces acting on the same point. Determine graphically the magnitude and direction of the equilibrant for this system.

Use the following scale with Bow's notation: 1 mm = 3 N.



Solution:





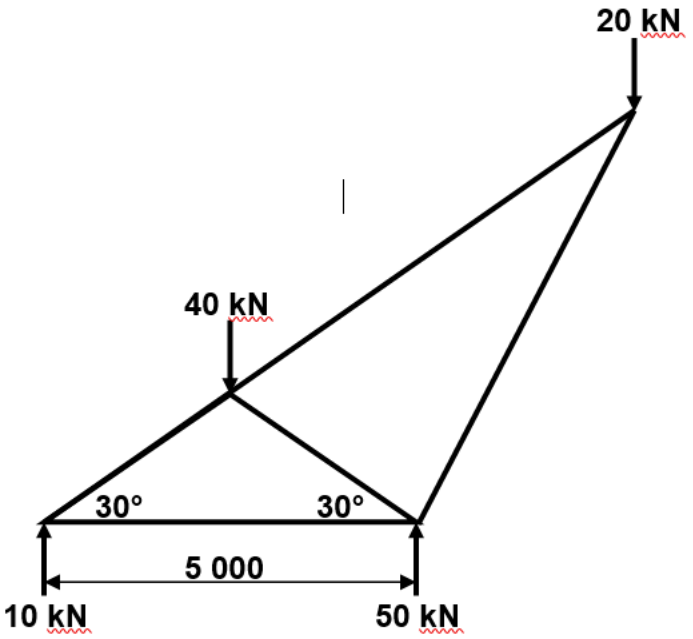
Scale 1 mm =5 N

ac = F = 265 N θ = 30° South from West

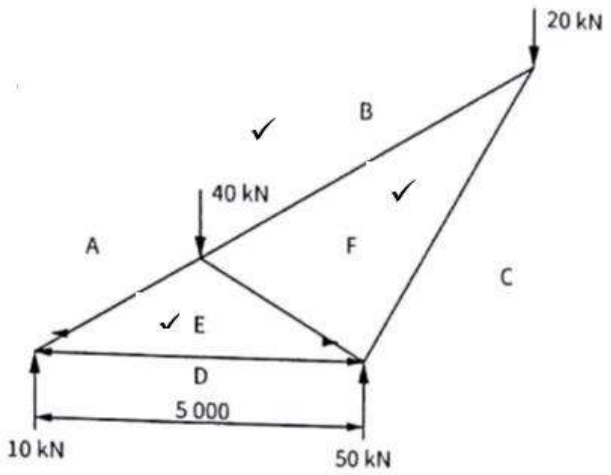
Example 4:

Determine graphically the magnitude and nature of the forces in ALL the members in the Figure below.

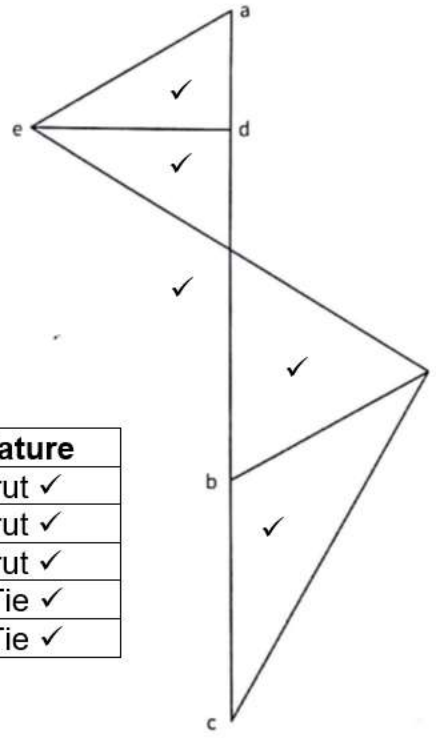
SCALE: Space diagram 1 : 100 and Vector/Force diagram 2 mm = 1 kN



SOLUTION:



Vector diagram
2 mm = 1 kN

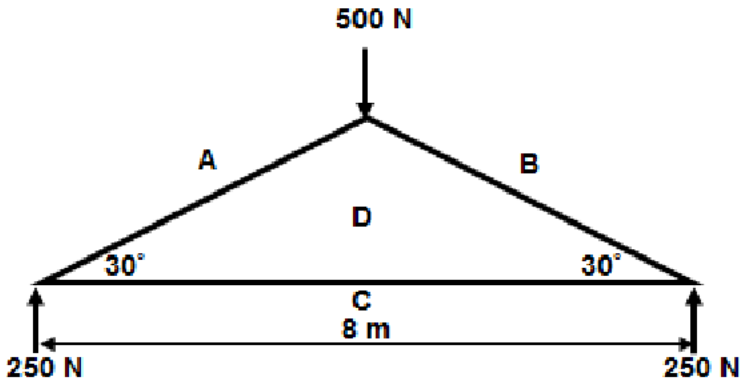


Member	Force	Nature
AE	20 kN ✓	Strut ✓
EF	40 kN ✓	Strut ✓
FC	34 kN ✓	Strut ✓
BF	20 kN ✓	Tie ✓
DE	17 kN ✓	Tie ✓

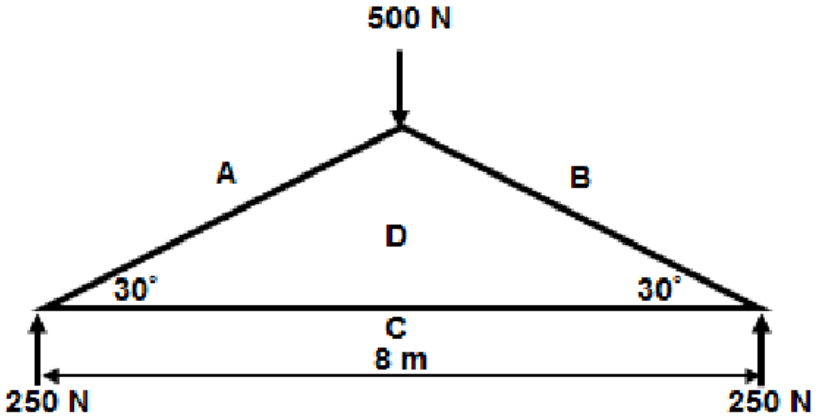
Example 5:

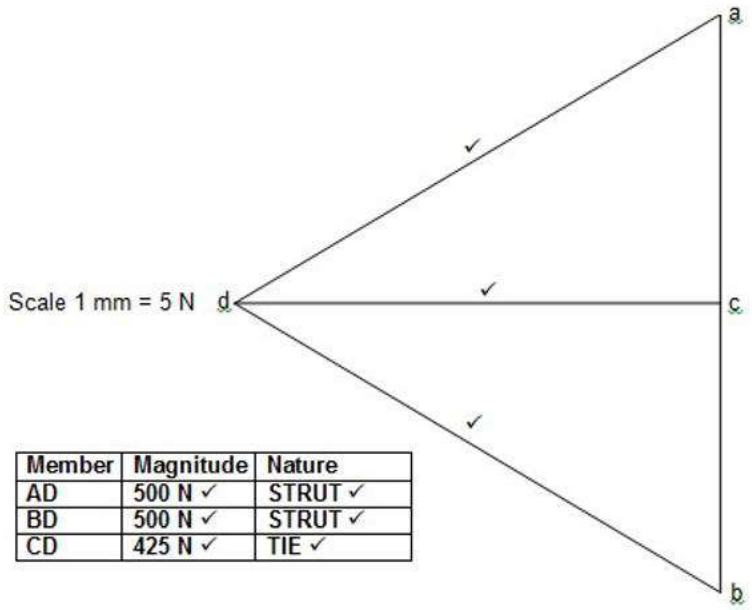
The Figure below shows a steel framework. Determine graphically the magnitude and nature of the forces in the following members: AD, BD and CD.

SCALE: Space diagram: 1 : 100 Force diagram: 1 mm = 5 N



Solution:





Member	Magnitude	Nature
AD	500 N ✓	STRUT ✓
BD	500 N ✓	STRUT ✓
CD	425 N ✓	TIE ✓

ACTIVITIES: Do the activities in the textbook on Forces.

RESOURCES: Make use of the textbook to answer the questions in the activities.