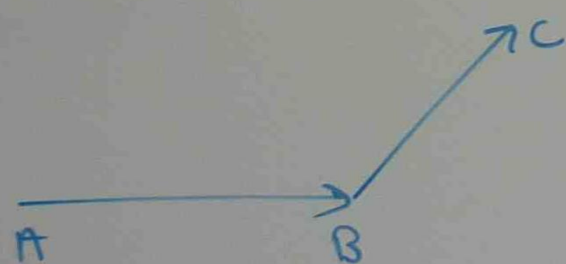
INTRODUCTION TO VECTORS

VECTOR → MAGNITUDE — LENGTH OF THE LINE

VECTOR → DIRECTION — ARROW HEAD OF THE LINE

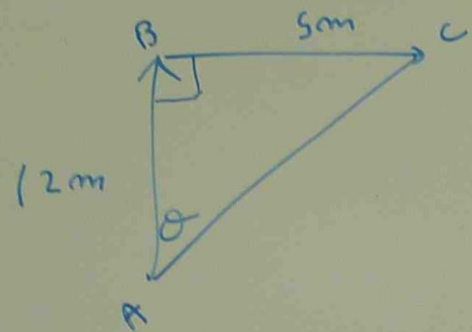
VECTOR $\overline{AB}$

ADDITION OF VECTORS



$$\overline{AB} + \overline{BC} = \overline{AC}$$

Ex IF A BODY UNDERGOES A DISPLACEMENT OF 12 m DUE NORTH FOLLOWED BY A DISPLACEMENT OF 5 m DUE EAST. FIND THE DISPLACEMENT AND DIRECTION.



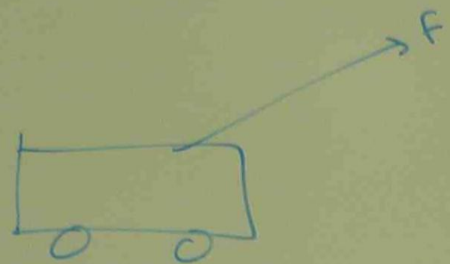
$$AC^2 = AB^2 + BC^2$$
$$= 12^2 + 5^2$$
$$= 169$$
$$AC = \sqrt{169} = 13\ m$$

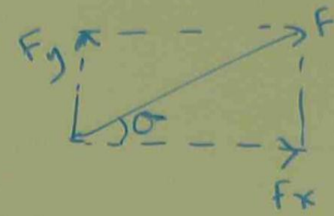
$$\tan\theta = \frac{BC}{AC}$$

$$\tan\theta = \frac{5}{12}.$$

$$\theta = \tan^{-1}\frac{5}{12} = 22.6$$

RESOLUTION OF A VECTOR IN TO TWO COMPONENTS AT RIGHT ANGLE

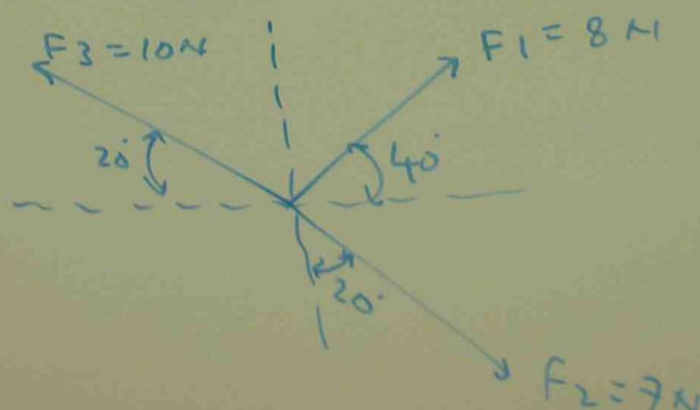


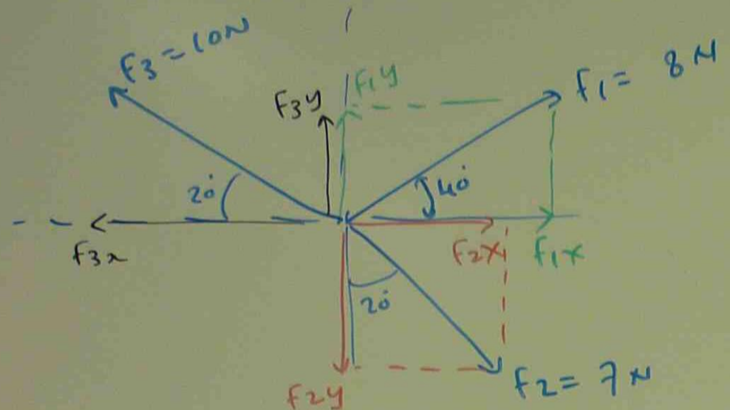


$$F_x = F\cos\theta$$
$$F_y = F\sin\theta$$

EX EACH OF THE FORCE SHOWN IN DIAGRAM HAS A HORIZONTAL COMPONENT & VERTICAL COMPONENT.

FIND TOTAL HORIZONTAL & VERTICAL COMPENTS AND RESULTANT FORCE.





$F_{1x} = F_1 \cos 40° = 8 \cos 40$

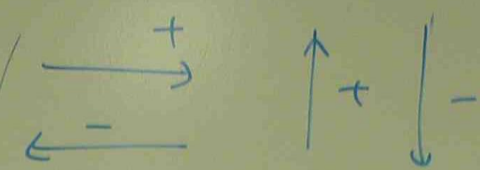
$F_{1y} = F_1 \sin 40° = 8 \sin 40$

$F_{2x} = F_2 \sin 20° = 7 \sin 20$

$F_{2y} = F_2 \cos 20° = 7 \cos 20$

$F_{3x} = F_3 \cos 20° = 10 \cos 20$

$F_{3y} = F_3 \sin 20° = 10 \sin 20$



$F_x = (+F_{1x}) + (+F_{2x}) + (-F_{3x})$

$= 8\cos 40 + 7\sin 20 + (-10\cos 20)$

$= 8\cos 40 + 7\sin 20 - 10\cos 20$

$= 6.128 + 2.394 - 9.396$

$= -0.874$

$F_x = 0.874$

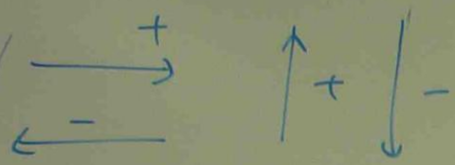
$\leftarrow$

$F_y = (+F_{1y}) + (-F_{2y}) + (+F_{3y})$

$= 8\sin 40 - 7\cos 20 + 10\sin 20$

$= 5.142 - 6.577 + 3.42$

$= 1.985 \uparrow$



$$F_x = (+F_1x) + (+F_2x) + (-F_3x)$$

$$= 8\cos 40 + 7\sin 20 + (-10\cos 20)$$

$$= 8\cos 40 + 7\sin 20 - 10\cos 20$$

$$= 6.128 + 2.394 - 9.396$$

$$= -0.874$$

$$F_x = 0.874$$

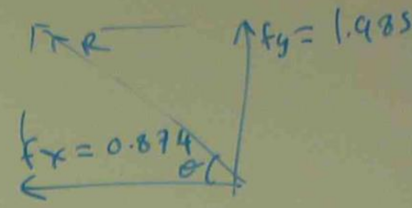
$$\longleftarrow$$

$$F_y = (+F_1y) + (-F_2y) + (+F_3y)$$

$$= 8\sin 40 - 7\cos 20 + 10\sin 20$$

$$= 5.142 - 6.577 + 3.42$$

$$= 1.985 \uparrow$$



$$R = \sqrt{F_x^2 + F_y^2}$$

$$= \sqrt{0.874^2 + 1.985^2}$$

$$= 2.168$$

$$\theta = \tan^{-1} \frac{F_y}{F_x}$$

$$= \tan^{-1} \frac{1.985}{0.874}$$

$$= \tan^{-1} 2.271$$

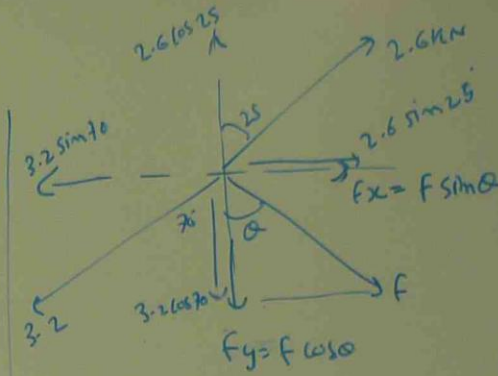
$$= 66.2^\circ$$

EQUILIBRIUM

IF A NUMBER OF FORCES HAVE A RESULTANT ZERO, WE CAN SAY THAT THE FORCES ARE IN EQUILIBRIUM.

$$\sum F_x = 0 \quad , \quad \sum F_y = 0 \quad , \quad R = 0$$

$$\overrightarrow{F_x} = \overleftarrow{F_x} \quad , \quad F_y\uparrow = F_y\downarrow$$



$$\sum F_x = 0 \qquad \longrightarrow + \qquad \longleftarrow -$$

$$F\sin\theta + 2.6\sin 25 - 3.2\sin 70 = 0$$

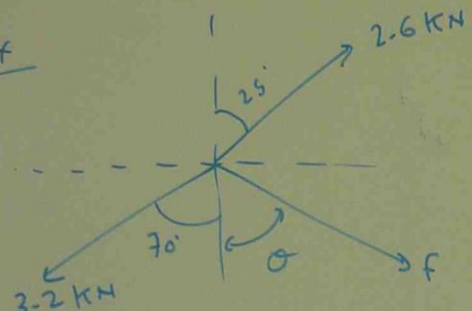
$$F\sin\theta = 3.2\sin 70 - 2.6\sin 25 = 1.908 \text{ N}$$

$$\sum F_y = 0 \qquad \uparrow + \qquad \downarrow -$$

$$2.6\cos 25 - 3.2\cos 70 - F_y\cos\theta = 0$$

$$F_y\cos\theta = 2.6\cos 25 - 3.2\cos 70 = 1.2619$$

Ex



GIVEN THAT THESE FORCES ARE IN EQUILIBRIUM, FIND "F".

$$\sin^2\theta + \cos^2\theta = 1$$

$$F^2\sin^2\theta = (1.908)^2$$

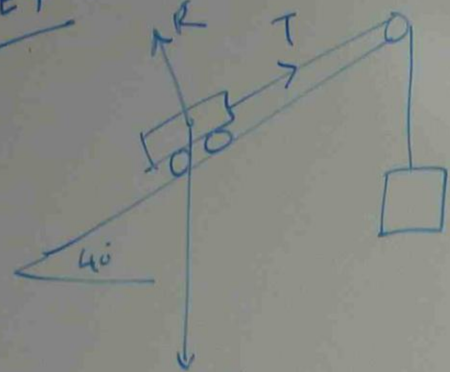
$$F^2\cos^2\theta = (1.2619)^2$$

$$F^2\sin^2\theta + F^2\cos^2\theta = 1.908^2 + 1.2619^2$$

$$F^2(\sin^2\theta + \cos^2\theta) = 5.233$$

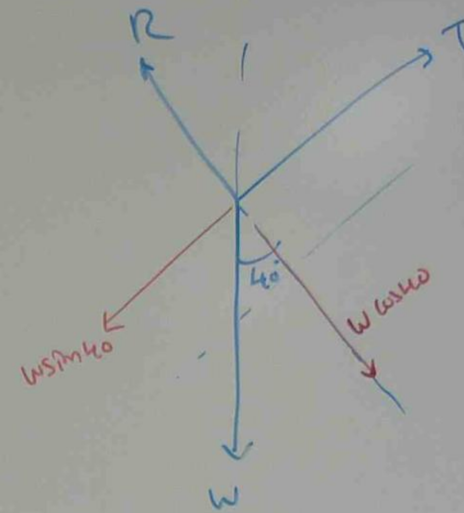
$$F^2 = 5.233 \rightarrow F = \sqrt{5.233} = 2.3 \text{ kN}$$

Ex



A BODY RESTS UPON A SMOTH INCLINED PLANE.

GIVEN THAT THE THREE FORCES SHOWN ARE IN EQUILIBRIUM, FIND THE MAGNITUDE OF THE FORCES T AND R.



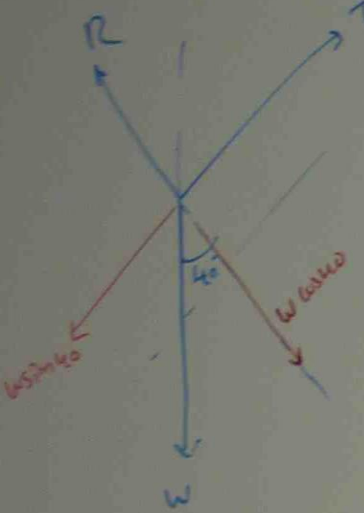
EQUILIBRIUM

$R = W\cos 40$

$R = 56\cos 40 = 42.9\ N$

$T = W\sin 40$

$= 56\sin 40 = 36\ N$



EQUILIBRIUM

$R = W\cos 40$

$R = 56\cos 40 = 42.9\ N$

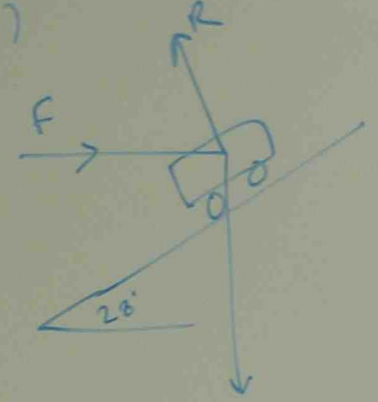
$T = W\sin 40$

$= 56\sin 40 = 36\ N$

EXERCISE

THE FOLLOWING SYSTEMS ARE IN STABILITY

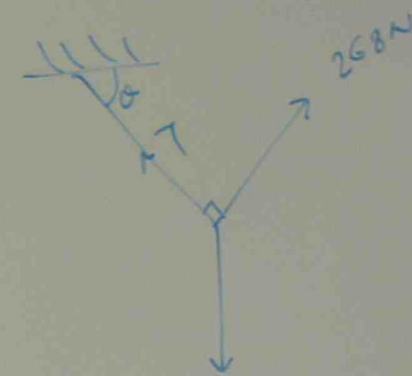
(a)



$W = 38.4\ N$

FIND F

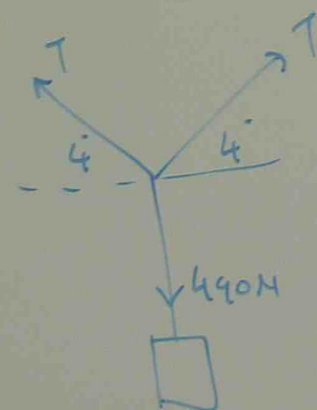
(b)



IF $\theta = 30°$

FIND T

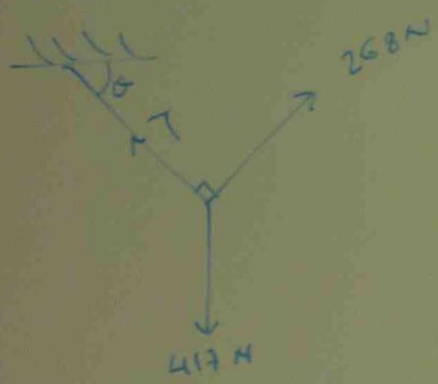
(c)



FIND T

...G SYSTEMS ARE IN STABILITY

(b)

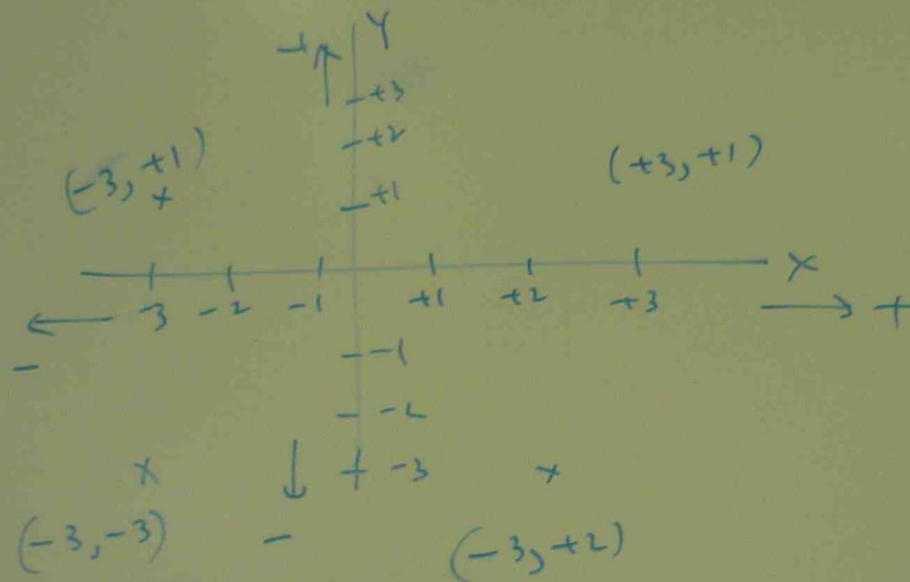


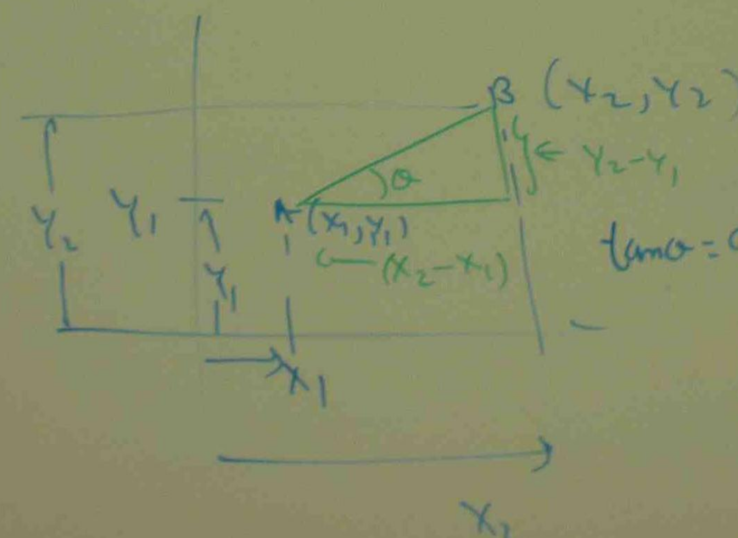
IF $\theta = 30°$

FIND T

...D T

STRAIGHT LINE, CO-ORDINATE GEOMETRY



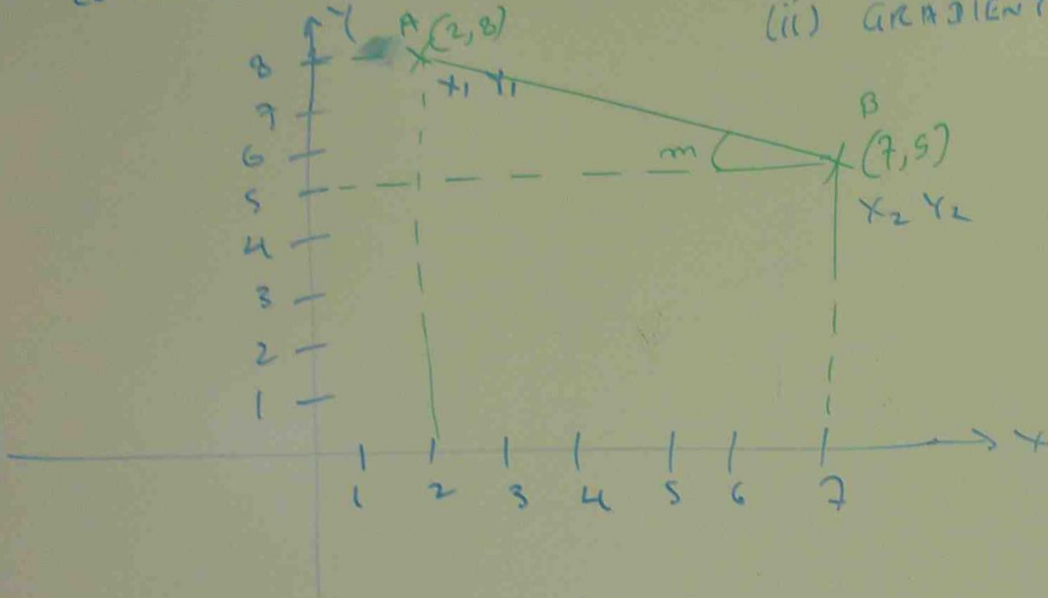


$$\tan\theta = \text{GRADIENT} = \frac{Y_2 - Y_1}{X_2 - X_1}$$

EX

LOCATE THE POINTS (2, 8) AND (7, 5) ON THE CO-ORDINATE PLANE AND FIND (i) DISTANCE BETWEEN TWO POINTS

(ii) GRADIENT



$$\text{DISTANCE} = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$= \sqrt{(7-2)^2 + (5-8)^2}$$

$$= \sqrt{5^2 + (-3)^2}$$

$$= \sqrt{25 + 9} = \sqrt{34} = 5.38$$

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$= \frac{5-8}{7-2} = \frac{-3}{5} = -0.6$$

MATHEMATICAL EQUATION FOR
A STRAIGHT LINE WITH GRADIENT "m"

$$\boxed{y = mx + b}$$

m = GRADIENT
b = Y INTERCEPT (THE VALUE OF Y WHEN X = 0)

EX $2y = 4 + 8x$ FIND GRADIENT & Y INTERCEPT.

$2y = 4 + 8x$

$2y = 8x + 4$

$y = 4x + 2$

$y = mx + b$

GRADIENT (m) = 4

Y INTERCEPT b = 2

EX DOES THE POINT (8,2) LIE ON THE

LINE $2y - \frac{x-2}{3} = x-5$?

SUBSTITUTE $x = 8$

$$2y - \frac{8-2}{3} = 8-5$$

$$2y - \frac{6}{3} = 3$$

$$2y - 2 = 3$$

$$2y = 2+3 = 5$$

$$y = \frac{5}{2} = 2.5 \neq 2$$

(8,2) DOES NOT LINE ON THE LINE.