16. (i) Two non-zero vectors, **a** and **b**, are such that

$$|\mathbf{a} + \mathbf{b}| = |\mathbf{a}| + |\mathbf{b}|$$

Explain, geometrically, the significance of this statement.

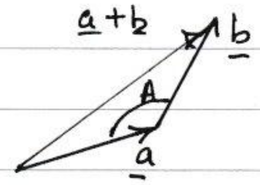
(1)

(ii) Two different vectors, **m** and **n**, are such that $|\mathbf{m}| = 3$ and $|\mathbf{m} - \mathbf{n}| = 6$
The angle between vector **m** and vector **n** is 30°

Find the angle between vector **m** and vector **m** − **n**, giving your answer, in degrees, to one decimal place. 2019

(4)

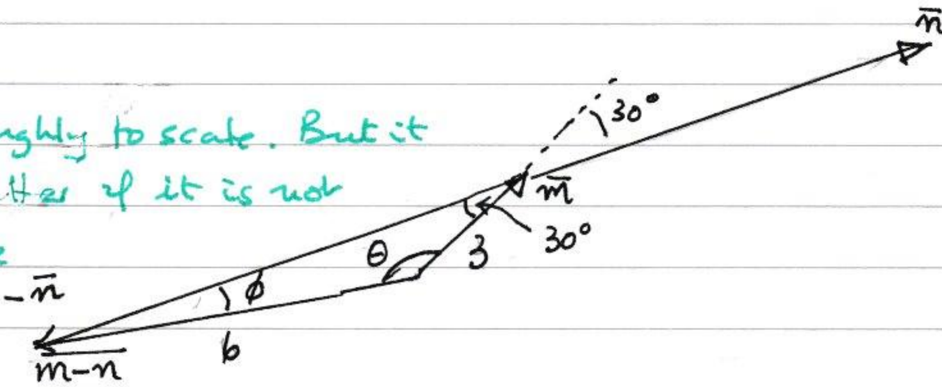
(i)



if the "length" of |a+b| is equal to the sum of the "lengths" of a and b ie |a|+|b|, the diagram shows that this is only possible if a and b are parallel.
ie angle A = 180°

(ii)

The figure is roughly to scale. But it does not matter if it is not drawn so – the answer will come out ok.



It is clear |n| must be quite large if |m−n| = 6 and so the required angle θ is also large (obtuse).

We cannot use sine rule directly to get θ as we do not know |n|. So use the sine rule to get φ and then θ = 180 − 30 − φ.

$$\frac{3}{\sin\phi} = \frac{6}{\sin 30} \quad \text{so } \sin\phi = \tfrac{1}{2}\sin 30 = \tfrac{1}{4}$$

This gives φ = 14·5°

So required angle θ = 180 − 30 − 14·5

= 135·5°