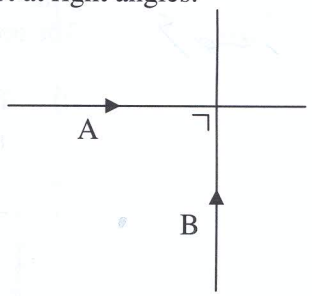
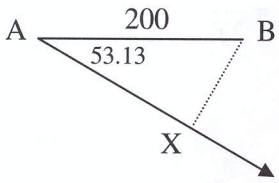
2. **(a)** Two cars, A and B, travel along two straight roads which intersect at right angles.
A is travelling east at 15 m/s.
B is travelling north at 20 m/s.
At a certain instant both cars are 800 m from the intersection and approaching the intersection.
Find **(i)** the shortest distance between the cars
(ii) the distance each car is from the intersection when they are nearest to each other.



(i)
$$\vec{V}_A = 15\vec{i} + 0\vec{j}$$
$$\vec{V}_B = 0\vec{i} + 20\vec{j}$$
$$\vec{V}_{AB} = \vec{V}_A - \vec{V}_B$$
$$= 15\vec{i} - 20\vec{j}$$
slope $= -\frac{4}{3}$ or magnitude $= 25$ m/s
or direction: East 53.13° South

B reaches intersection in $\frac{800}{20} = 40$ s
In this time A travels $15 \times 40 = 600$ m and is now 200 m from the intersection



shortest distance $= 200\sin\alpha$
$= 200\sin(53.13°) = 160$ m

(ii)
$$\text{time} = 40 + \frac{|AX|}{|\vec{V}_{AB}|}$$
$$= 40 + \frac{200\cos 53.13°}{25}$$
$$= 44.8 \text{ s}$$
In this time A travels $15 \times 44.8 = 672$ m
and B travels $20 \times 44.8 = 896$ m
distance of A from the intersection $= 800 - 672 = 128$ m
distance of B from the intersection $= 800 - 896 = -96$ m
$= 96$ m past intersection

5	
5	
5	
5	
5	
5	30