Projectiles 6B

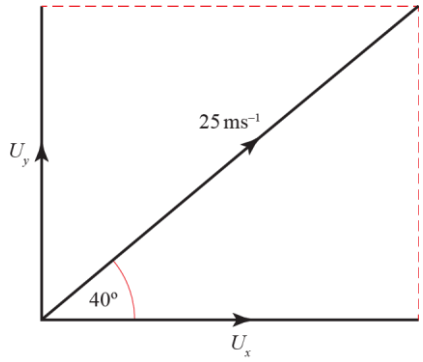
1 a Components of velocity (3s.f.):

$u_x = 25\cos 40^\circ$

$= 19.2 \text{ ms}^{-1}$

$u_y = 25\sin 40^\circ$

$= 16.1 \text{ ms}^{-1}$



b $\mathbf{u} = (19.2\mathbf{i} + 16.1\mathbf{j}) \text{ ms}^{-1}$

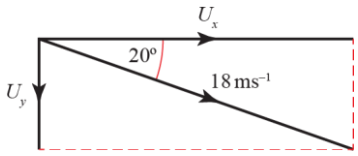
2 a Components of velocity (3s.f.):

$u_x = 18\cos 20^\circ$

$= 16.9 \text{ ms}^{-1}$

$u_y = -18\sin 20^\circ$

$= -6.15 \text{ ms}^{-1}$



b $\mathbf{u} = (16.9\mathbf{i} - 6.15\mathbf{j}) \text{ ms}^{-1}$

3 a $\tan\alpha = \frac{5}{12}$ so $\sin\alpha = \frac{5}{13}$ and $\cos\alpha = \frac{12}{13}$

Components of velocity (3s.f.):

$u_x = 35\cos\alpha$

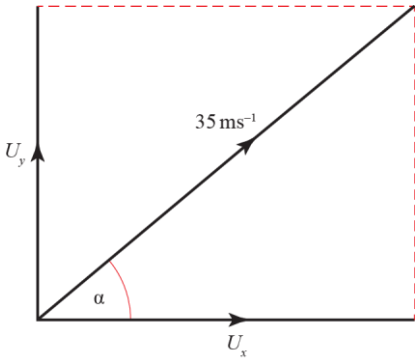
$= 35 \times \frac{12}{13}$

$= 32.3 \text{ ms}^{-1}$

$u_y = 35\sin\alpha$

$= 35 \times \frac{5}{13}$

$= 13.5 \text{ ms}^{-1}$



b $\mathbf{u} = (32.3\mathbf{i} + 13.5\mathbf{j}) \text{ ms}^{-1}$

4 a $\tan\alpha = \frac{7}{24}$ so $\sin\alpha = \frac{7}{25}$ and $\cos\alpha = \frac{24}{25}$

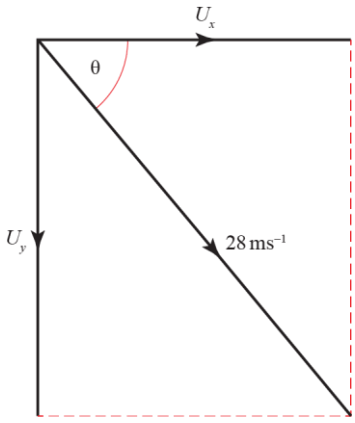
Components of velocity (3s.f.):

$u_x = 28\cos\theta$

$= 26.9 \text{ ms}^{-1}$

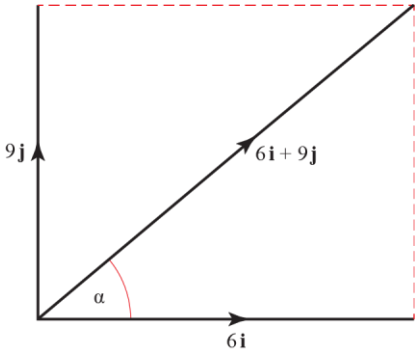
$u_y = -28\sin\theta$

$= -7.8 \text{ ms}^{-1}$



b $\mathbf{u} = (26.9\mathbf{i} - 7.8\mathbf{j}) \text{ ms}^{-1}$

5 Speed is magnitude of velocity:



$|\mathbf{u}| = \sqrt{6^2 + 9^2}$

$= 10.816...$

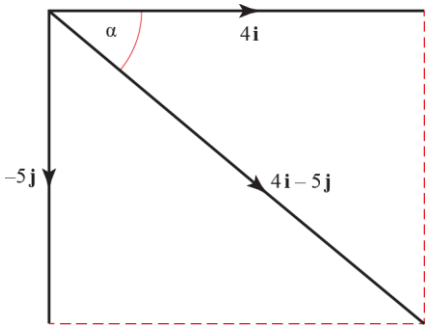
The initial speed of the particle is $10.8\ \text{ms}^{-1}$ (3 s.f.).

$\tan\alpha = \frac{9}{6}$

$\alpha = 56.309...$

Particle is projected at an angle of 56.3° above the horizontal (3 s.f.).

6 Speed is magnitude of velocity:



$|\mathbf{u}| = \sqrt{4^2 + 5^2}$

$= 6.4031...$

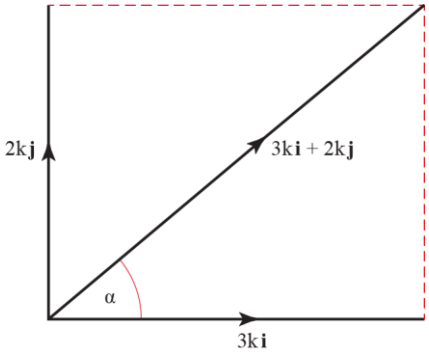
The initial speed of the particle is $6.40\ \text{ms}^{-1}$ (3 s.f.).

$\tan\alpha = \frac{5}{4}$

$\alpha = 51.340...$

Particle is projected at an angle of 51.3° below the horizontal (3 s.f.).

7 **a** Let the angle of projection be α



$\tan\alpha = \frac{2k}{3k} = \frac{2}{3}$

$\Rightarrow \alpha = 33.690...$

The angle of projection is 33.7° (3s.f.).

b Speed = magnitude of velocity, so:

$\left(3\sqrt{13}\right)^2 = (3k)^2 + (2k)^2$

$9 \times 13 = 9k^2 + 4k^2$

$117 = 13k^2$

$k^2 = 9$

$k = \pm 3$