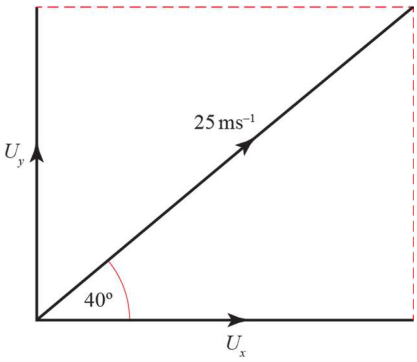
Exercise 1B

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

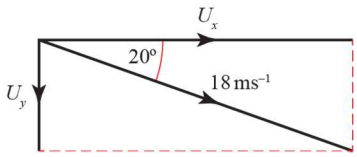
$$u_x = 25\cos 40^\circ$$
$$= 19.2 \text{ m s}^{-1}$$
$$u_y = 25\sin 40^\circ$$
$$= 16.1 \text{ m s}^{-1}$$



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

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

$$u_x = 18\cos 20^\circ$$
$$= 16.9 \text{ m s}^{-1}$$
$$u_y = -18\sin 20^\circ$$
$$= -6.15 \text{ m s}^{-1}$$

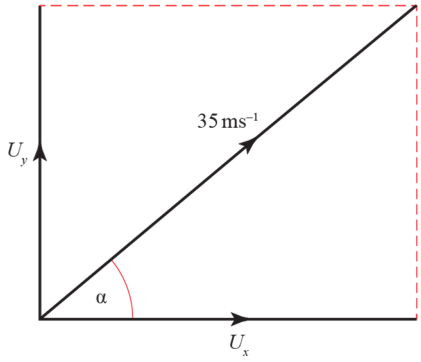


b $\mathbf{u} = (16.9\mathbf{i} - 6.15\mathbf{j})$ m s^{-1}

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

Components of velocity (3 s.f.):

$$u_x = 35\cos\alpha$$
$$= 35 \times \frac{12}{13}$$
$$= 32.3 \text{ m s}^{-1}$$
$$u_y = 35\sin\alpha$$
$$= 35 \times \frac{5}{13}$$
$$= 13.5 \text{ m s}^{-1}$$

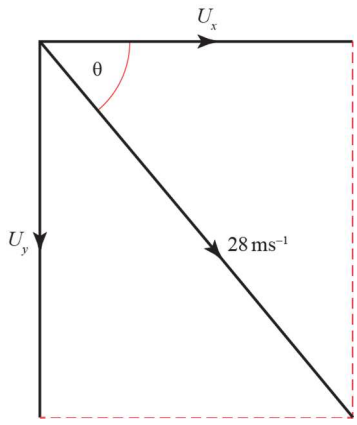


b $\mathbf{u} = (32.3\mathbf{i} + 13.5\mathbf{j})$ m s^{-1}

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

Components of velocity (3 s.f.):

$$u_x = 28\cos\theta$$
$$= 26.9 \text{ m s}^{-1}$$
$$u_y = -28\sin\theta$$
$$= -7.8 \text{ m s}^{-1}$$



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

5 Speed is magnitude of velocity:

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

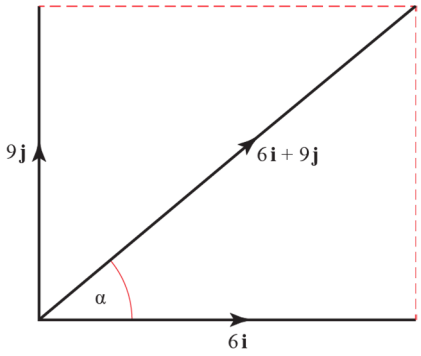
$= 10.816...$

The initial speed of the particle is 10.8 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:

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

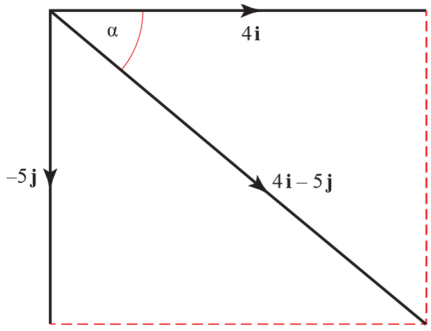
$= 6.4031...$

The initial speed of the particle is 6.40 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.).

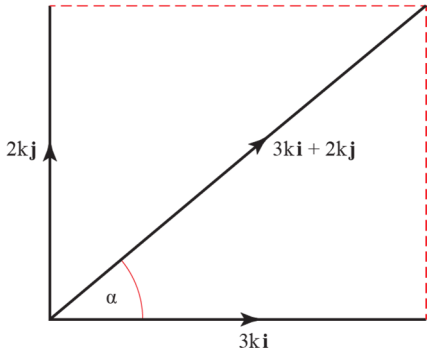


7 **a** Let the angle of projection be α

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

$\Rightarrow \alpha = 33.690...$

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



b Speed = magnitude of velocity, so:

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

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

$117 = 13k^2$

$k^2 = 9$

$k = \pm 3$