4.3   The velocity field of a flow is given by
$\mathbf{V} = 2x^2t\hat{\mathbf{i}} + [4y(t - 1) + 2x^2t]\hat{\mathbf{j}}$ m/s, where x
and y are in meters and t is in seconds. For fluid
particles on the x axis, determine the speed and
direction of flow.

$u = 2x^2t$, $v = 4y(t-1) + 2x^2t$, $w = 0$

For particles on the x-axis $y = z = 0$ so that

$u = 2x^2t$ and $v = 2x^2t$

Thus, on the x-axis the velocity
is in the x-y plane with

$V = \sqrt{u^2 + v^2 + w^2} = \sqrt{(2x^2t)^2 + (2x^2t)^2}$

or

$V = 2\sqrt{2}\, x^2t \;\dfrac{m}{s}$

and

$\tan\theta = \dfrac{v}{u} = \dfrac{2x^2t}{2x^2t} = 1$ or $\theta = 45°$