

## Distances to planes and lines

**1.** Using vector methods, find the distance from the point  $(1,0,0)$  to the plane  $2x + y - 2z = 0$ . Include a 'cartoon' sketch illustrating your solution.

**Answer:** The sketch shows the plane and the point  $P = (1,0,0)$ .  $Q = (0,0,0)$  is a point on the plane.  $R$  is the point on the plane closest to  $P$ .

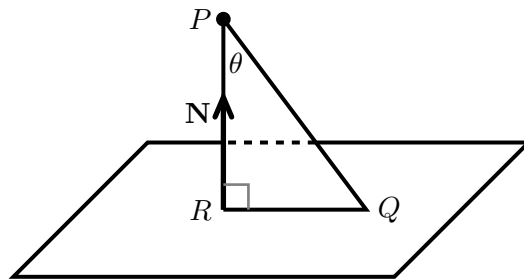
As usual, our sketches are merely suggestive and we do not actually find the point  $R$ .

The figure shows that

$$\text{distance} = |PR| = |\overrightarrow{PQ}| \cos \theta = \left| \overrightarrow{PQ} \cdot \frac{\mathbf{N}}{|\mathbf{N}|} \right|.$$

Computing  $\overrightarrow{PQ} = \langle 1, 0, 0 \rangle$  gives

$$\text{distance} = \left| \overrightarrow{PQ} \cdot \frac{\mathbf{N}}{|\mathbf{N}|} \right| = \left| \langle 1, 0, 0 \rangle \cdot \frac{\langle 2, 1, -2 \rangle}{3} \right| = \frac{2}{3}.$$

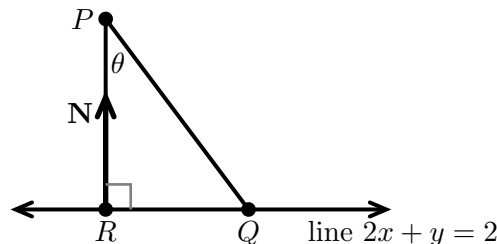


**2.** Using vector methods, find the distance from the point  $(0,0)$  to the line  $2x + y = 2$ . Include a sketch.

**Answer:** Finding the distance from a point to a line in the plane is just like finding the distance from a point to a plane in space.

The normal to the line is  $\mathbf{N} = \langle 2, 1 \rangle$  and a point on the line is  $Q = (1, 0)$ . We have

$$\text{distance} = \left| \overrightarrow{PQ} \cdot \frac{\mathbf{N}}{|\mathbf{N}|} \right| = \left| \langle -1, 0 \rangle \cdot \frac{\langle 2, 1 \rangle}{\sqrt{5}} \right| = \frac{2}{\sqrt{5}}.$$



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