$= 2i - 4j + 6k$

I have stopped putting in the vector notati
Perhaps you might complete for practice

$\vec{PQ}$ increases at rate $v_Q - v_P = (-i+4j-2k)-(i+j+2k)$
$= -2i+3j-4k$

ie $\dot{\vec{PQ}} = -2i+3j-4k$

$$\int_{2i-4j+6k}^{\vec{PQ}} \dot{\vec{PQ}} = \int_0^t (-2i+3j-4k)\,dt$$

$$\left[\vec{PQ}\right]_{2i-4j+6k}^{\vec{PQ}} = \left[-2ti+3tj-4tk\right]_0^t$$

$$\vec{PQ} - (2i-4j+6k) = -2ti+3tj-4tk$$

$$\vec{PQ} = (2-2t)i+(-4+3t)j+(6-4t)k$$

2/2

you could have obtained this by using $r = r_0 + vt$ for r_Q, and r_P and then subtract them.

Initially $\vec{PR} = r_{R0} - r_{P0}$
$= (i+j+k)-(-i+4j-3k) = 2i-3j+4k$

$\vec{PR}$ increases at rate $\vec{v}_R - \vec{v}_P = (2j+k)-(i+j+2k)$
$= -i+j-k$

ie $\dot{\vec{PR}} = -i+j-k$

$$\int_{2i-3j+4k}^{\vec{PR}} \dot{\vec{PR}} = \int_0^t (-i+j-k)\,dt$$

$$\left[\vec{PR}\right]_{2i-3j+4k}^{\vec{PR}} = \left[-i+j+k\right]_0^t$$

$$\vec{PR} - (2i-3j+4k) = -ti+tj-tk$$

$$\vec{PR} = (2-t)i+(-3+t)j+(4-t)k$$

2/2

b) A vector perpendicular to the triangle PQR can be found by taking the crossproduct of $\vec{PQ}$ and $\vec{PR}$. 1/1

$$\vec{PQ}\times\vec{PR} = ((2-2t)i+(-4+3t)j+(6-4t)k)\times((2-t)i+(-3+t)j+(4-t)k)$$

$$= ((-4+3t)(4-t)-(6-4t)(-3+t))i + ((6-4t)(2-t)-(2-2t)(4-t))j$$
$$+((2-2t)(-3+t)-(-4+3t)(2-t))k$$

$$= (-16+16t-3t^2+18-18t+4t^2)i + (12-14t+4t^2-8+10t-2t^2)j$$
$$+(-6+8t-2t^2+8-10t+3t^2)k$$

$$= (2-2t+t^2)i + (4-4t+2t^2)j + (2-2t+t^2)k$$

$$= (2-2t+t^2)(i+2j+k)$$

2/2

$2-2t+t^2$ is a number, hence the normal to the triangle is always parallel to $i+2j+k$. 1/1