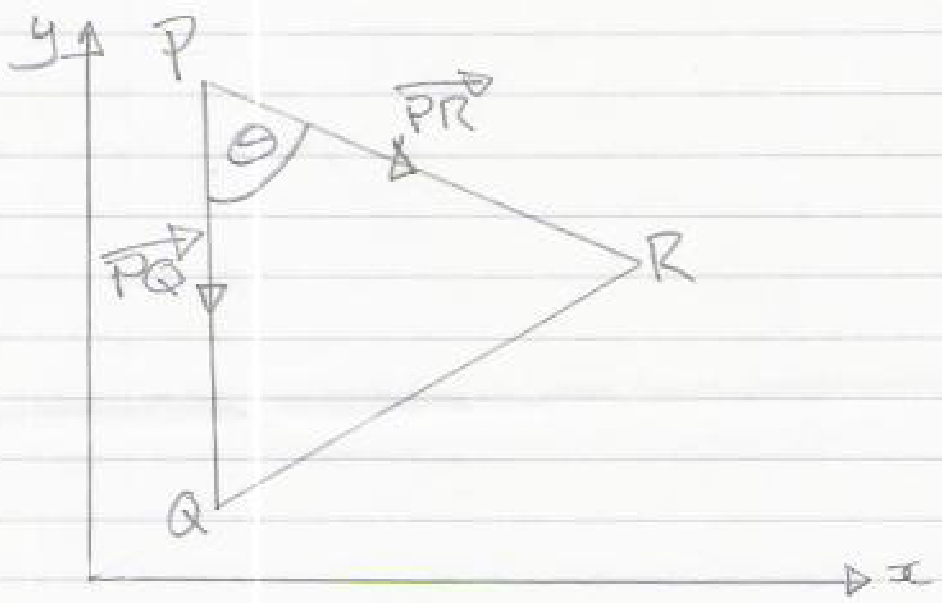
3)



Generally

$$|\vec{PQ}\times\vec{PR}|^2 = |\vec{PQ}|^2|\vec{PR}|^2 - (\vec{PQ}\cdot\vec{PR})^2$$
$$= |\vec{PQ}|^2|\vec{PR}|^2 - |\vec{PQ}|^2|\vec{PR}|^2\cos^2\theta$$
$$= |\vec{PQ}|^2|\vec{PR}|^2(1-\cos^2\theta)$$
$$= |\vec{PQ}|^2|\vec{PR}|^2\sin^2\theta$$

I must admit that I cannot remember seeing this relationship before ie $(\underline{a}\times\underline{b})^2 = \underline{a}^2\underline{b}^2 - (\underline{a}\cdot\underline{b})^2$

so $|\vec{PQ}\times\vec{PR}| = |\vec{PQ}||\vec{PR}|\sin\theta$ ✓ This is found by taking the modulus of both sides of the defn. of the cross product and is all you needed!

but the area of a triangle PQR is given by $\frac{1}{2}|\vec{PQ}||\vec{PR}|\sin\theta$

hence $\Delta PQR = \frac{1}{2}|\vec{PQ}||\vec{PR}|\sin\theta$

$$= \frac{1}{2}|\vec{PQ}\times\vec{PR}|$$ ✓

3/3

ii) $\dot{\underline{r}}(t) = \underline{v}$

$$\int_{r_0}^{r(t)} \dot{\underline{r}}(t)\,dt = \int_0^t \underline{v}\,dt$$

$$[\underline{r}(t)]_{r_0}^{r(t)} = [\underline{v}t]_0^t$$ NOTATION { The book uses bold type – you must underline all the vectors!

$$\underline{r}(t) - \underline{r}_0 = \underline{v}t$$ ✓

$$\underline{r}(t) = \underline{r}_0 + \underline{v}t$$ ✓ t is a scalar! 2/2

From the question, $\dot{\underline{r}}(t) = \underline{v}$ (a constant vector)

hence $\ddot{\underline{r}}(t) = \underline{0}$

The acceleration of the particle is zero, hence it continues to moves in a straight line. ✓ 1/1

iii) Initially, $\vec{PQ} = \underline{r}_{Q0} - \underline{r}_{P0}$

$$= (\underline{i}+3\underline{k}) - (-\underline{i}+4\underline{j}-3\underline{k})$$ NOTATION