1. (a) $\vec{a} \cdot \vec{b} = |\vec{a}|\,|\vec{b}| \cos\theta = 3\sqrt{3}$.
   (b) $|\vec{a} \times \vec{b}| = |\vec{a}|\,|\vec{b}| \sin\theta = 3$.

2. A normal to the plane is $\langle 1, -2, -2 \rangle$. A convenient point on the plane is $Q(1,0,0)$. The absolute value of the scalar projection of $\vec{QP}$ onto $\vec{n}$ is the distance. This is

$$\left| \frac{\vec{QP} \cdot \vec{n}}{|\vec{n}|} \right| = \left| \frac{-25}{3} \right| = 25/3.$$

3. (a) One such vector is $\vec{PQ} \times \vec{PR} = -\vec{i} + \vec{j}$.
   (b) $-x + y = 1$.

4. We have $\vec{r}\,'(t) = \langle 2t,\ 3t^2,\ \pi\cos(\pi t) \rangle$.
   (a) $\int_0^2 |\vec{r}\,'(t)|\,dt = \int_0^2 \sqrt{4t^2 + 9t^4 + \pi^2\cos^2(\pi t)}\,dt$.
   Since $\vec{r}(1) = \langle 2, 0, 0 \rangle$ and $\vec{r}\,'(1) = \langle 2, 3, -\pi \rangle$, a parametric equation for the line is

$$\vec{r}(t) = \langle 2, 0, 0 \rangle + t\langle 2, 3, -\pi \rangle.$$

5. $(\vec{v}(t) \times \vec{w}(t))'\Big|_{t=1} = \vec{v}\,'(1) \times \vec{w}(1) + \vec{v}(1) \times \vec{w}\,'(1)$. This equals $\vec{v}\,'(1) \times \vec{w}(1)$ since we are given that $\vec{v}(1)$ and $\vec{w}\,'(1)$ are parallel. The magnitude of $\vec{v}\,'(1) \times \vec{w}(1)$ is $|\vec{v}\,'(1)|$ times $|\vec{w}(1)|$ since these two vectors are perpendicular. Thus the answer is 3.