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
   \[
   \frac{|\vec{QP} \cdot \vec{n}|}{|\vec{n}|} = \frac{-25}{3} = 25/3.
   \]

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. \( (\vec{v}(t) \times \vec{w}(t))'_{t=1} = \vec{v}'(1) \times \vec{w}(1) + \vec{v}(1) \times \vec{w}'(1). \) 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 \( \vec{v}'(1) \times \vec{w}(1) \) times \( |\vec{w}(1)| \) since these two vectors are perpendicular. Thus the answer is 3.