1. Evaluate:

$$\int_{-\infty}^{2} \frac{2\,dx}{x^2+4} = \lim_{t\to-\infty} \int_t^2 \frac{2}{x^2+4}\,dt$$

$$= \lim_{t\to-\infty} \left[2\cdot\frac{1}{2}\tan^{-1}\left(\frac{x}{2}\right)\right]_t^2$$

$$= \lim_{t\to-\infty} \left[\tan^{-1}\left(\frac{2}{2}\right) - \tan^{-1}\left(\frac{t}{2}\right)\right]$$

$$= \lim_{t\to-\infty} \left[\frac{\pi}{4} - \tan^{-1}\left(\frac{t}{2}\right)\right]$$

$$= \frac{\pi}{4} - \left(-\frac{\pi}{2}\right)$$

$$= \boxed{\frac{3\pi}{4}}$$

2. Evaluate:

$$\int_0^4 \frac{dx}{\sqrt{4-x}} = \lim_{t\to4^-} \int_0^t (4-x)^{-1/2}\,dx$$

$$= \lim_{t\to4^-} \left[-2(4-x)^{1/2}\right]_0^t$$

$$= \lim_{t\to4^-} -2\left(\sqrt{4-t} - \sqrt{4-0}\right)$$

$$= \lim_{t\to4^-} -2\left(\sqrt{4-t} - 2\right)$$

$$= -2(0-2)$$

$$= \boxed{4}$$

3. Does the following integral converge or diverge? (Use the Comparison Test.)

$$\int_4^\infty \frac{dx}{\sqrt{x}-1}$$

$$\frac{1}{\sqrt{x}-1} \geq \frac{1}{\sqrt{x}}$$

Since $\int_4^\infty \frac{1}{\sqrt{x}}\,dx$ diverges, $(p=\frac{1}{2})$

$\int_4^\infty \frac{dx}{\sqrt{x}-1}$ also $\boxed{\text{diverges.}}$

Q: What is it that you will break even when you name it?