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**Problem 1** (10 Points) State and prove the second Borel-Cantelli lemma.

**Problem 2** (10 Points) Given two independent random variables  $\xi_1$  and  $\xi_2$  with probability densities  $p_{\xi_1}(x_1)$  and  $p_{\xi_2}(x_2)$ , find the probability density of the variable  $\eta = \xi_1 + \xi_2$ .

**Problem 3** (10 Points) *Chebyshev's Inequality*: Prove that for any random variable  $\xi$  for which  $\mathbf{E}\xi^2$  exists that  $\mathbf{P}\{|\xi| > \epsilon\} \leq \frac{1}{\epsilon^2}\mathbf{E}\xi^2$ .