#9

First note that $\sum_{k=1}^{\infty} \cos(k\pi)\, k e^{-k} = \sum_{k=1}^{\infty} (-1)^k\, k e^{-k}$

Now $\sum_{k=1}^{\infty} \left| (-1)^k\, k e^{-k} \right| = \sum_{k=1}^{\infty} k e^{-k}$

Ratio Test: $\lim_{k \to +\infty} \frac{k+1}{e^{k+1}} \cdot \frac{e^k}{k} = \lim_{k \to +\infty} \left[\left(\frac{k+1}{k} \right) \cdot \frac{1}{e} \right] = 1 \cdot \frac{1}{e} < 1$

So $\sum_{k=1}^{\infty} k e^{-k}$ converges by the Ratio Test.

[Alternatively, use the Integral Test:

see Convergence Tests homework #11.]

So $\sum_{k=1}^{\infty} \cos(k\pi)\, k e^{-k}$ converges absolutely.