10.3, #11. We multiple the two series:

$$\begin{aligned} e^t \cos t &= \big(1 + t + \frac{1}{2}t^2 + \frac{1}{6}t^3 + \cdots\big)\big(1 - \frac{1}{2}t^2 + \frac{1}{24}t^4 + \cdots\big) \\ &= 1 + t + (\frac{1}{2}t^2 - \frac{1}{2}t^2) + (\frac{1}{6}t^3 - \frac{1}{2}t^3) + (\frac{1}{24}t^4 - \frac{1}{4}t^4 + \frac{1}{24}t^4) + \cdots \\ &= 1 + t - \frac{1}{3}t^3 - \frac{1}{6}t^4 + \cdots. \end{aligned}$$

10.3, #15. We expand the three functions in series about $y = 0$:

$$\begin{aligned} \ln(1 + y^2) &= y^2 - \frac{1}{2}y^4 + \cdots \\ \sin(y^2) &= y^2 - \frac{1}{6}y^6 + \cdots \\ 1 - \cos y &= \frac{1}{2}y^2 - \frac{1}{24}y^4 + \cdots. \end{aligned}$$

So for y near 0, but $y \neq 0$, we have

$$\sin(y^2) > \ln(1 + y^2) > 1 - \cos y > 0.$$

10.3, #16. We expand the three functions in series about $\theta = 0$:

$$\begin{aligned} 1 + \sin\theta &= 1 + \theta - \frac{1}{6}\theta^3 + \cdots \\ \cos\theta &= 1 - \frac{1}{2}\theta^2 + \cdots \\ \frac{1}{1 - \theta^2} &= 1 + \theta^2 + \cdots. \end{aligned}$$

So for $\theta > 0$, we have

$$\cos\theta < \frac{1}{1 - \theta^2} < 1 + \sin\theta.$$

10.3, #21.

$$\begin{aligned}
E &= \frac{kQ}{(R-1)^2} - \frac{kQ}{(R+1)^2} = \frac{kQ}{R^2}\Big(\frac{1}{(1-1/R)^2} - \frac{1}{(1+1/R)^2}\Big) \\
&= \frac{kQ}{R^2}\Big(1 + 2\frac{1}{R} + 3\frac{1}{R^3} + \cdots - 1 + 2\frac{1}{R} - 3\frac{1}{R^3} + \cdots\Big) \\
&= \frac{4kQ}{R^3}\big(1 + \frac{2}{R^2} + \frac{3}{R^4} + \cdots\big)
\end{aligned}$$

10.3, #23.

$$\begin{aligned}
V &= 2\pi\sigma(\sqrt{R^2 + a^2} - R) \\
&= 2\pi\sigma R(\sqrt{1 + (a/R)^2} - 1) \\
&= 2\pi\sigma R(1 + \frac{1}{2}(a/R)^2 + \cdots - 1) \\
&= \frac{\pi\sigma a^2}{R} + \text{higher order terms.}
\end{aligned}$$

10.3, #26.

$$\begin{aligned}
F &= \frac{mgR^2}{(r+h)^2} = mg\frac{1}{(1+h/R)^2} \\
&= mg\big(1 - 2(h/r) + 3(h/R)^2 - + \cdots\big) \\
&= mg
\end{aligned}$$