10.4, #15.

$$
\begin{aligned}
&3+\frac{3}{2}+\frac{3}{4}+\frac{3}{8}+\cdots+\frac{3}{2^{10}}\\
&\quad=3\Big(1+\frac{1}{2}+\frac{1}{4}+\frac{1}{8}+\cdots+\frac{1}{2^{10}}\Big)\\
&\quad=\frac{3(1-1/2^{11})}{1-1/2}\\
&\quad=\frac{3(2^{11}-1)}{2^{10}}.
\end{aligned}
$$

10.4, #23. (a) The height to which the ball rises after it hits the floor for the n-th time is $10(3/4)^n$ feet.
(b) The ball has traveled a total vertical distance of 10 feet when it hits the floor the first time, $10+2(10)(3/4)=25$ feet the second time, $10+2(10)(3/4)+2(10)(3/4)^2=36.25$ feet the third time, and $10+2(10)(3/4)+2(10)(3/4)^2+2(10)(3/4)^3=44.69$ feet the fourth time.
(c) When the ball hits the floor the n-th time, it has traveled a total vertical distance

$$
\begin{aligned}
&10+2(10)(3/4)+2(10)(3/4)^2+2(10)(3/4)^3+\cdots+2(10)(3/4)^{n-1}\\
&\quad=10+15[1+(3/4)+(3/4)^2+\cdots+(3/4)^{n-2}]\\
&\quad=10+15\left(\frac{1-(3/4)^{n-1}}{1-(3/4)}\right)\\
&\quad=10+60(1-(3/4)^{n-1})\text{ feet.}
\end{aligned}
$$

10.4, #30. The present value of a \$1000 bond is

$$1000(1.06)^{-10} + 50[(1.06)^{-1} + (1.06)^{-2} + + \cdots + (1.06)^{-10}]$$

The term $1000(1.06)^{-10}$ appears since the principal will have been held by the issuer of the bond for 10 years. The term $50(1.06)^{-j}$ is the present value of the coupon paid at the end of the j-th year. Thus present value of the bond is

$$1000(1.06)^{-10} + \frac{50}{1.06}\left(\frac{1-(1.06)^{-10}}{1-(1.06)^{-1}}\right) = 926.40 \text{ dollars.}$$

10.5, #1–2. The derivatives of $f(t) = e^t$ are e^t. Thus $|f^n(t)| \leq e^{0.5}$ on $[0, 0.5]$. In particular, $E_0 = f(t) - P_0(t)$ and $E_2 = f(t) - P_2(t)$ satisfy the inequalities

$$|E_0| \leq e^{0.5}(0.5) = 0.8243, \qquad |E_2| \leq e^{0.5}(0.5)^3/3! = 0.0343$$

by the second boxed remark on page 631. $P_0(t)$ and $P_2(2)$ are underestimates for e^t since they are truncations of the series $1+t+t^2/2!+t^3/3!+\cdots$, which contains only non-negative numbers when t is in $[0, .05]$.

10.5, #9. The $(n+1)$-st derivative of $f(x) = \cos x$ is $-\sin x$, $-\cos x$, $\sin x$, or $\cos x$ according as $n = 4t$, $4t+1$, $4t+2$, or $4t+3$ for some non-negative integer t In particular,

$$|f^{(n+1)}(x)| = \begin{cases} |\sin x| & \text{if } n \text{ is even} \\ |\cos x| & \text{if } n \text{ is odd} \end{cases}$$

If $0 \leq x \leq 1$, then $|f^{(n+1)}(x)| \leq \sin 1 = 0.841$ for even n, and $|f^{(n+1)}(x)| \leq \cos 0 = 1$ for odd n. The error term is thus bounded above by $(0.841/(n+1)!)1^{n+1} = 0.841/(n+1)!$ for even n and by $1/(n+1)!)1^{n+1} = 1/(n+1)!$ for odd n. A similar analysis works for $\sin x$ if the words "even" and "odd" are interchanged.