1. Answer: \( \sin 1 \)
   By Taylor Expansion, \( \sin x = x - \frac{x^3}{3!} + \frac{x^5}{5!} - \frac{x^7}{7!} + \ldots \). Let \( x = 1 \), and the desired value equals \( \sin 1 \).

2. Answer: \( \frac{\pi}{2} \)
   
   \[ d = \int_0^\infty \frac{1}{1+t^2}dt = \tan^{-1}(t)|_0^\infty = \lim_{t \to \infty} \tan^{-1}(t) - \tan^{-1}(0) = \frac{\pi}{2}. \]

3. Answer: \( \frac{10}{9} \)
   By l'Hôpital's rule,
   \[ \lim_{x \to 0} \frac{10}{x^2} \sin 2(3x) = \lim_{x \to 0} \frac{20}{6 \sin(3x) \cos(3x)} x = \lim_{x \to 0} \frac{20}{3 \sin(6x)} = \lim_{x \to 0} \frac{20}{18 \cos(6x)} = \frac{10}{9}. \]

4. Answer: \( \frac{\pi - 2 \ln(2)}{4} \) or equivalent expression
   We integrate by parts:
   \[ \int_0^1 1 \cdot \tan^{-1}(x)dx = [x \tan^{-1}(x)]_0^1 - \int_0^1 x \frac{dx}{x^2 + 1} \]
   \[ = \frac{\pi}{4} - 0 - \left[ \frac{1}{2} \ln(x^2 + 1) \right]_0^1 \]
   \[ = \frac{\pi}{4} - \frac{1}{2} \ln(2). \]

5. Answer: \( -\frac{\cos(8)}{32} + \frac{33}{32} \)

   \[ v(t) = \int a(t)dt = \int \cos^2(2t)dt = \int \frac{1 + \cos(4t)}{2}dt = \frac{\sin(4t)}{8} + \frac{t}{2} + c_1, \]
   where \( c_1 \) is a constant. Plug in \( t = 0 \) to find \( v(0) = c_1 = -2 \). So \( v(t) = \frac{\sin(4t)}{8} + \frac{t}{2} - 2. \)

   \[ x(t) = \int v(t)dt = \int \frac{\sin(4t)}{8} + \frac{t}{2} - 2 dt = -\frac{\cos(4t)}{32} + \frac{t^2}{4} - 2t + c_2. \]

   Plug in \( t = 0 \) to get \( x(0) = -\frac{1}{16} + c_2 = 1 \), so \( c_2 = \frac{33}{32} \). Thus,
   \[ x(2) = -\frac{\cos(8)}{16} + \frac{33}{32}. \]

6. Answer: \( \frac{a^2}{1+a} e^{-ax} \)
   Since \( \frac{d^n}{dx^n}(e^{-ax}) = (-a)^n e^{-ax} \),
   \[ \sum_{n=2}^{\infty} \frac{d^n}{dx^n}(e^{-ax}) = e^{-ax} \sum_{n=2}^{\infty} (-a)^n. \]

   This forms a geometric series with common ratio \( -a \) and first element \( a^2 \), which converges since \( |a| < 1 \). Thus the answer is \( \frac{a^2}{1+a} e^{-ax} \).
7. Answer: \( \frac{1 - \cos(4)}{16} \)

Define a partition on \([0, 1]\) with \(n\) elements by setting \(x_i = \frac{i}{n}\) for \(0 \leq i \leq n\). Then \(x_i - x_{i-1} = \frac{1}{n}\) for all \(i\). If we let \(f(y) = (1 - y)\cos(4y)\) and put \(y_k = \frac{k}{n}\) for \(1 \leq k \leq n\), then we have

\[
\sum_{k=1}^{n} \frac{n - k}{n^2}\cos\left(\frac{4k}{n}\right) = \sum_{k=1}^{n} f(y_k)(x_i - x_{i-1}).
\]

Thus, we may conclude that

\[
\lim_{n \to \infty} \sum_{k=1}^{n} f(y_k)(x_i - x_{i-1}) = \int_{0}^{1} f(y)dy = \int_{0}^{1} (1 - y)\cos(4y)dy = \left[ \left( \frac{1 - y}{4} \right)\sin(4y) - \frac{\cos(4y)}{16} \right]_{0}^{1} = \frac{-\cos(4)}{16} + \frac{1}{16}.
\]

8. Answer: \( \frac{14e^2 - 12}{e^2 - 1} \), or \( \frac{14 - 12e^{-2}}{1 - e^{-2}} \)

To evaluate the floor function, split the integral into unit intervals:

\[
\int_{0}^{\infty} 4[x + 7]e^{-2x}dx = \sum_{k=0}^{\infty} \int_{k}^{k+1} 4(k + 7)e^{-2x}dx = (14e^{-0} - 14e^{-2}) + (16e^{-2} - 16e^{-4}) + (18e^{-4} - 18e^{-6}) + \ldots = 12 + 2(e^{-0} + e^{-2} + e^{-4} + \ldots) = 12 + \frac{2}{1 - e^{-2}} = \frac{14 - 12e^{-2}}{1 - e^{-2}} = \frac{14e^2 - 12}{e^2 - 1}.
\]

9. Answer: \( \frac{5}{16} \)

Let \( S = \sum_{n=0}^{\infty} \frac{n}{5^n} \). Then

\[
\frac{1}{5}S = \sum_{n=0}^{\infty} n \cdot \frac{1}{5^{n+1}} = \sum_{n=0}^{\infty} \frac{n + 1 - 1}{5^{n+1}} = \sum_{n=0}^{\infty} \frac{n + 1}{5^{n+1}} - \sum_{n=0}^{\infty} \frac{1}{5^{n+1}} = \sum_{n=1}^{\infty} \frac{n}{5^n} - \frac{1}{1 - \frac{1}{5}} = S - \frac{1}{4},
\]

\[
\Rightarrow S = 5 - \frac{1}{4} \Rightarrow 4S = \frac{1}{4} \Rightarrow S = \frac{5}{16}.
\]

10. Answer: 62.8

This sum is difficult to evaluate exactly. However, it can be closely approximated by the improper integral of the same function, which is easily evaluated using \( u \)-substitution.
\[
\int_0^\infty \frac{dx}{50 + x^2/80000} = \frac{1}{50} \int_0^\infty \frac{dx}{1 + (x/20000)^2} = \frac{1}{50} \int_0^\infty \frac{2000du}{1 + u^2} = \frac{2000}{50} \left[ \tan^{-1} u \right]_0^\infty = \lim_{b \to \infty} \left( \tan^{-1}(b) - \tan^{-1}(0) \right) = \lim_{b \to \infty} \tan^{-1}(b) = \frac{\pi}{2} = 20\pi \\
\approx 62.83.
\]

To see that this integral is correct to the nearest tenth, we observe that since the integrand is a monotonic function, we can bound it above and below by Riemann sums. More precisely:

\[
\sum_{n=1}^\infty \frac{1}{50 + n^2/80,000} \leq 20\pi \leq \sum_{n=0}^\infty \frac{1}{50 + n^2/80,000}.
\]

By rearranging terms, this implies that:

\[
20\pi - \frac{1}{50} \leq \sum_{n=1}^\infty \frac{1}{50 + n^2/80,000} \leq 20\pi.
\]

From this it follows that 62.8 is indeed correct to the nearest tenth.