This activity is worth 10 points of course credit. See tentative calendar for due dates. Late activities are accepted at the discretion of your recitation instructor and a penalty may be imposed.

(1) Integrate! For each clearly specify any substitution made.

Note: The grader may just grade a random sampling of these...

(a) \[ \int x^2e^{x^3} \, dx \]

(b) \[ \int \frac{x}{1 + x^4} \, dx \]

(c) \[ \int \sin(x)\cos(x) \, dx \]

(d) \[ \int \frac{x}{\sqrt{1 + x^2}} \, dx \]

(e) \[ \int \frac{1}{5x + 7} \, dx \]
(f) \[ \int \frac{1}{x \ln(x)} \, dx \]

(g) \[ \int \frac{2x}{(1 - 2x)^2} \, dx \]

(h) \[ \int x(3 + x)^{3/2} \, dx \]

(i) \[ \int \frac{x^2 - 2x}{(x - 1)^2} \, dx \]

(j) \[ \int \frac{1}{\sqrt{x} \sqrt{1 - x}} \, dx \]

(2) The ending result of the calculation below is right, but there is something wrong in the intermediate steps. Please find it and explain how it could be fixed (using complete sentences). Then fix it.

\[ \int_4^9 \frac{\sin(\pi \sqrt{x})}{\sqrt{x}} \, dx = \int_4^9 \frac{2 \sin u}{\pi} \, du = -\frac{2 \cos u}{\pi} \bigg|_4^9 = -\frac{2 \cos (\pi \sqrt{x})}{\pi} \bigg|_4^9 = \frac{4}{\pi}. \]

\[ \left( u = \pi \sqrt{x} \text{ and } du = \frac{\pi}{2 \sqrt{x}} \, dx \right) \]
(3) A snowstorm hits the Willamette Valley. With snow on the ground and falling at a constant rate, a snow plow began plowing down a long straight road at noon. The plow traveled three times as far during the first hour as it did in the second hour. At what time did the snow start falling? Assume the plowing rate is inversely proportional to the depth of the snow squared.

Solve this problem by following these steps:

(a) Let \( b \) be the base of amount of snowfall (in inches) that has already fallen by noon, let \( r \) be the constant snowfall rate (in inches per hour) and let \( t \) be hours since noon.

Determine \( d(t) \) the total amount of snowfall fallen at time \( t \) in terms of \( b, r, t \).

\[
d(t) =
\]

(b) Up to a constant, determine \( v(t) \), the snow plow’s rate of plowing (in length units per hour – the particular length unit doesn’t matter).

Hint: If \( x \) is inversely proportional to \( y \) then \( x = \frac{k}{y} \) for some constant \( k > 0 \).

\[
v(t) =
\]

(c) Now setup an equation to reflect that “the plow traveled three times as far during the first hour as it did in the second hour.”
(d) Solve this equation for $r$ (in terms of $b$).

\[ r = \]

(e) So, when did the snow start falling?


(4) The velocity of a mass on a horizontal spring at time $t \geq 0$ is given by

$$v(t) = \frac{5\pi}{2} \sin (100\pi t) \text{ in cm/s.}$$

(a) Find the displacement of the mass during the first 20 milliseconds.

(b) Find the distance traveled by the mass during the first 20 milliseconds.