1. (10pts) Consider the curve $y = (2x+1)^{3/2}$ on $0 \le x \le 4$. Set up, but do NOT evaluate, an integral for the area of the surface generated by rotating this curve about the y-axis. **Fully simplify** ds.

2. Let $c > 0$ be a constant, and let R be the region in the first quadrant bounded above by the line $y = cx$ and below by the curve $y = x^2$. The following questions are both about this region R, but can be done independently.

   (a) (15pts) Assuming a uniform density, find the value of c for which the x-coordinate of the centroid of R is $\bar{x} = \dfrac{3}{2}$.

   (b) (10pts) Using the value of c from part (a) (or $c = 2$ if you did not find one), set up – but do NOT evaluate – an integral using the **method of cylindrical shells** for the volume of the solid generated by rotating R about the line $x = -1$.

3. (20pts) Solve the initial value problem

$$\frac{dy}{dx} = \frac{1}{y\,(9+x^2)^{3/2}}, \qquad y(0) = 2,$$

   and express your answer in the form $y = f(x)$.

4. Determine whether each of the following converges or diverges. Justify your answers and name any test or theorem you use. If a quantity converges, state what it converges to.

   (a) (9pts) the sequence $a_n = \dfrac{2+\cos n}{n^2}$, for $n = 1, 2, 3, \ldots$

   (b) (9pts) the sequence $b_n = \dfrac{3n+2}{n+4}$, for $n = 1, 2, 3, \ldots$ You may assume the sequence is bounded. Using the Monotonic Sequence Theorem, determine whether the sequence converges.

   (c) (9pts) the series $\displaystyle\sum_{n=1}^{\infty} \frac{5n^2+1}{2n^2+3}$

   (d) (9pts) the series $\displaystyle\sum_{n=1}^{\infty} b_n$, whose nth partial sum is $s_n = \dfrac{4n}{n+1}$

   (e) (9pts) the series $\displaystyle\sum_{n=1}^{\infty} \frac{2^{\,n+1}}{3^{\,2n}}$