Complete the problems listed below in your blue book.
There are **no graphing calculators** allowed for this portion of the test.
To receive full credit, show all of your work.
When you are finished, fold your test and put it into your blue book.

1. *12 points* For each of the following functions find all possible antiderivatives.

   (a) $f(x) = 3\sqrt{x}$

   (b) $f(x) = \sqrt{2}$

   (c) $f(x) = e^{5x}$

   (d) $f(x) = \dfrac{1}{x^2}$

   (e) $f(x) = \dfrac{1}{x}$

   (f) $f(x) = \sqrt[5]{e^x}$

2. *3 points* Sketch the graphs for two different antiderivatives for the function $f(x) = 2x$. Label the y-intercept in each of your graphs.

3. *4 points* For each of the following functions $f(x)$ find all possible antiderivatives $F(x)$ with the following property.

   (a) $f(x) = 2x + 6$ and $F(1) = 5$

   (b) $f(x) = e^{-x}$ and $F(0) = 4$

4. *4 points* Compute the following indefinite integrals.

   (a) $\displaystyle\int \pi \left(12x^3 + 4x\right) dx$

   (b) $\displaystyle\int \frac{x^7 + 18x^3}{3x^6} dx$

5. *12 points* Use substitution to compute the following indefinite integrals.

   (a) $\displaystyle\int \frac{5x^4 + 2x}{\sqrt{x^5 + x^2 + 1}} dx$

   (b) $\displaystyle\int (8 + 2x^3 - 3x^2)^{12}(3x^2 - 3x) dx$

   (c) $\displaystyle\int \frac{\sqrt[3]{\ln(x)}}{x} dx$

   (d) $\displaystyle\int \frac{1}{3x + 7} dx$

6. *5 points* The velocity at time t of a ball thrown straight up into the air is given by the function $v(t) = -32t + 160$ (measured in feet per second).

   (a) Let $s(t)$ denote the position of the ball, as a function of time (in seconds). What is the relationship between the functions $s(t)$ and $v(t)$?

   (b) Compute the displacement of the ball over the time interval $0 \leqslant t \leqslant 4$.

   (c) Given that the initial height of the ball is 10 feet, determine its position at $t = 1$.

7. *6 points* Consider the function $f(x) = 4 - x^2$ on the interval $[-2, 2]$.

   (a) Compute the Riemann Sum for $f(x)$ using $n = 4$ rectangles and right endpoints.

   (b) Compute the area of *only* the left-most rectangle in the Riemann Sum for $f(x)$ using $n = 17$ rectangles and left endpoints.

8. *4 points* Consider the following function $f(x) = x^2 - x - 6$. Set up the integral you would use to compute the area bounded between the graph of $f(x)$ and the x-axis on the interval $[-3, 4]$. You do not need to evaluate this integral.

9. *Extra Credit* Recall that $(\sin(x))' = \cos(x)$, $(\cos(x))' = -\sin(x)$, and $\tan(x) = \frac{\sin(x)}{\cos(x)}$. I computed the following indefinite integral:

$$\int 1 + \tan^2(x)dx = \tan(x) + C$$

   (a) Explain how you could check that my work is correct without computing this integral.

   (b) Check that my work is correct.