1. (28 points) The following problems are not related.

   (a) (10 points) Evaluate the definite integral $\displaystyle\int_0^{\pi/2} \cos(x)\sqrt{1+2\sin(x)}\,dx$.

   (b) (10 points) Evaluate the definite integral $\displaystyle\int_{-1}^{2} \left|1-x^2\right|\,dx$.

   (c) (8 points) Suppose that $f(x) = \displaystyle\int_3^{\sqrt{x}} \frac{t^2+2}{t-1}\,dt$. Find $f'(4)$.

2. (24 points) The following problems are not related.

   (a) (10 points) Approximate the area of the region bounded by the function $f(x) = 2\cos(x) + 2$ and the x-axis on the interval $[-\pi/2, 3\pi/2]$ by using four approximating rectangles; take the sample points to be the right endpoints.

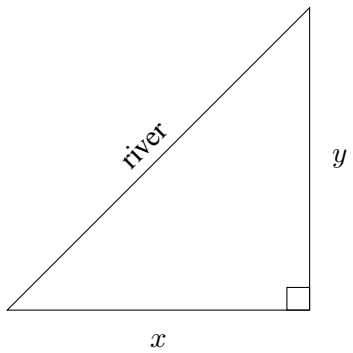
   (b) (14 points) Evaluate the limit $\displaystyle\lim_{n\to\infty} \sum_{i=1}^{n} \frac{1}{n}\left(\frac{i^3}{n^3} + \frac{2i}{n}\right)$ using summation formulas, or by evaluating an appropriate definite integral.

3. (16 points) The following problems are not related.

   (a) (6 points) Suppose we want to approximate a solution to the equation $3x + 2 - \cos(x) = 0$ using Newton's Method. What would the formula for x_{n+1} be? *(To get full points for this question, you must provide the explicit formula for x_{n+1} in terms of x_n; the generic formula for Newton's Method is not sufficient.)*

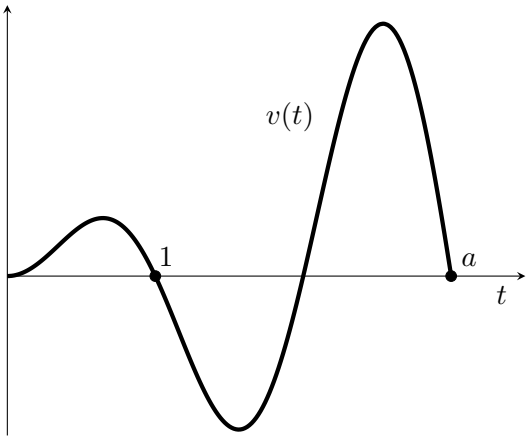
   (b) (10 points) Suppose the acceleration of an object (in $\mathrm{m/s^2}$) at any time t is given by $a(t) = 6t^2 - 4$. Find the velocity $v(t)$ of the object at any time t, if $v(1) = 2\,\mathrm{m/s}$.

4. (18 points) A farmer wants to fence off a small field in the shape of a right triangle. The hypotenuse of the triangle is along a riverbank, and the farmer will not need fencing there. If the farmer wants the area of the field to be $50\,\mathrm{m}^2$, what is the minimum amount of fencing they will need? *Justify your answer with calculus techniques, and include appropriate units with your answer.*



5. (8 points) Write the expression $\displaystyle\int_{-1}^{2} f(x)\,dx + \int_{1}^{-1} f(x)\,dx + \int_{-3}^{1} f(x)\,dx$ as a single integral of the form $\displaystyle\int_a^b f(x)\,dx$.

6. (6 points) Suppose the velocity $v(t)$ of a particle is given in the graph below:



Arrange the following quantities in order from smallest to largest:

(i) the total distance the particle travels from $t = 0$ to $t = a$

(ii) the displacement of the particle from $t = 0$ to $t = a$

(iii) the instantaneous acceleration of the particle at $t = 1$.

Note: no justification is required on this problem, but give your answer as a list of the numerals above. For example, $(i), (ii), (iii)$ *would indicate that you believe item* (i) *is the smallest value, and item* (iii) *is the largest.*