

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

(a) (10 points) Evaluate the definite integral  $\int_{-2}^0 \cos(x) \sqrt{1 + 2 \sin(x)} dx$ .

(b) (10 points) Evaluate the definite integral  $\int_2^0 1 - x^2 dx$ .

(c) (8 points) Suppose that  $f(x) = \int_3^x \frac{t^2 + 2}{t - 1} dt$ . 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  $[-2; 3 - 2]$  by using four approximating rectangles; take the sample points to be the right endpoints.

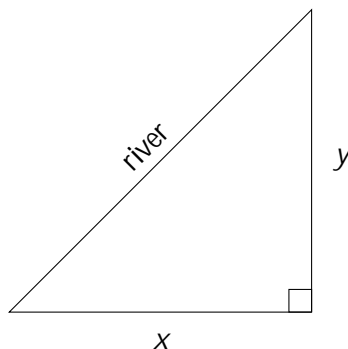
(b) (14 points) Evaluate the limit  $\lim_{n \rightarrow \infty} \sum_{i=1}^n \frac{1}{n} \left( \frac{i^3}{n^3} + \frac{2i}{n} \right)$  using summation formulas, or by evaluating an appropriate definite integral.

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  $m=s^2$ ) 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  $v(1) = 2 m=s$ .

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  $50 m^2$ , 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  $\int_a^b f(x) dx + \int_1^2 f(x) dx + \int_1^3 f(x) dx$  as a single integral of the form  $\int_a^b f(x) dx$ .

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

