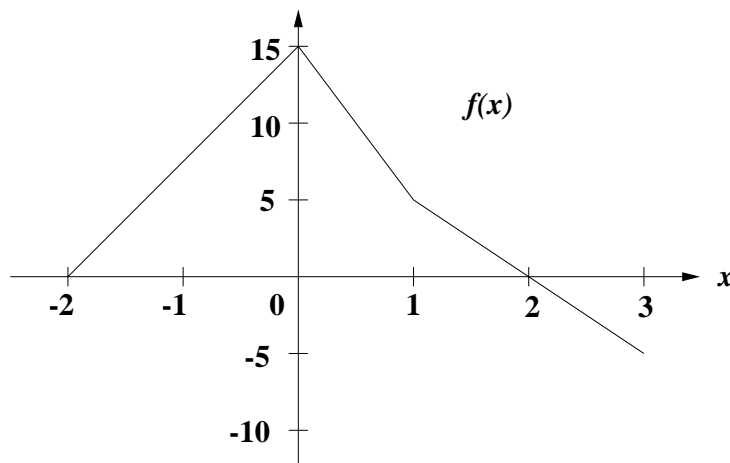


- Doug's bicycle has a speedometer attached. During yesterday's ride, he checked the speedometer at noon and every 15 minutes thereafter until 1:00 PM. At noon, his speed was 18.3 MPH; at 12:15 PM it was 22.4 MPH; at 12:30 PM it was 27.3 MPH; at 12:45 PM it was 33.4 MPH; and at 1:00 PM it was 40.8 MPH. Assume that Doug's speed was always increasing between noon and 1:00 PM.
  - Use the data given above in order to find the best possible underestimate for the total distance that Doug traveled between noon and 1:00 PM.
  - Use the data given above in order to find the best possible overestimate for the total distance that Doug traveled between noon and 1:00 PM.
  - Try to obtain a better estimate using your answers from parts (a) and (b).
- A car is traveling at 60 feet per second when the driver sees a deer in the road 300 feet ahead and immediately steps on the brakes. The deer freezes and does not move from his spot in the road. I've recorded the driver's speed (in ft/sec) every two seconds starting at the time that he first stepped on the brakes and going until the time that the car finally came to a stop. **Does the car hit the deer? Explain.**

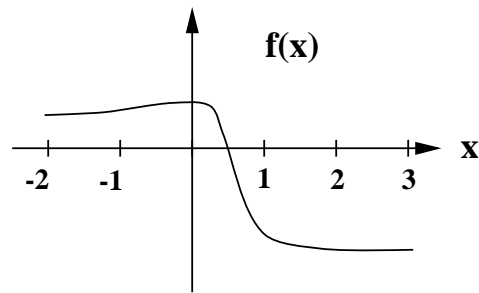
time	0	2	4	6	8
car's speed	60	46	28	12	0

*Hint:* It will help to know whether or not your estimate of the total distance that the car travels is an overestimate or an underestimate for the true distance traveled. You may assume that the car is always slowing down until it comes to a stop.

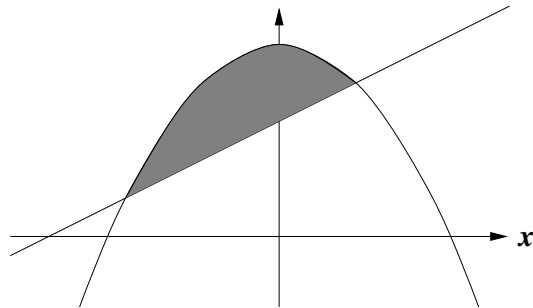
- By using a left-hand sum with four rectangles, approximate the value of  $\int_6^{14} \frac{7}{1.1^t} dt$ . Sketch a graph of the integrand along with the four rectangles that you used.
- Use the built-in integrator on your calculator to approximate  $\int_1^3 2^{1.1x} dx$ .
- Using the graph of  $f(x)$  shown below, compute the exact value of  $\int_{-2}^3 f(x) dx$ .



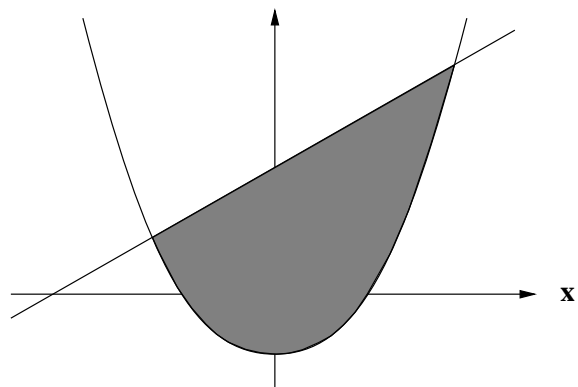
6. Using the graph of  $f(x)$  shown below, determine which one of the following choices could possibly be the value of the definite integral  $\int_{-2}^3 f(x) dx$ .



- (a) 15                      (b) 10                      (c) 5                      (d) 0                      (e) -5
7. The graphs of  $f(x) = x + 3$  and  $g(x) = 5 - x^2$  are sketched below and the area between the two curves is shaded in.



- (a) Find the points of intersection of these two graphs.  
 (b) Set up, but do not evaluate, the definite integral (or integrals) which represent the exact area between these two graphs.  
 (c) Use the built-in features of your calculator to get a very good approximation of this area.
8. The graphs of  $f(x) = x + 4$  and  $g(x) = x^2 - 2$  are sketched below and the area between the two curves is shaded in. Find the exact area of this shaded region. Your final answer must be a number.



9. Deep in a Hundred Acre Wood where Christopher Robin plays, it has been raining at the rate of  $r(t)$  inches per hour since 8:00 AM. I've recorded these rates every 1.5 hours in the table below. The rain has continued to fall down harder and harder until my last recorded entry.

time ( $t$ )	rate ( $r(t)$ )
8:00 AM	0.5
9:30 AM	1.2
11:00 AM	1.7
12:30 AM	2.5

- (a) Use the information in the table to give the best possible underestimate for the total number of inches of rain which have fallen between 8:00 AM and 12:30 PM.
- (b) Use the information in the table to give the best possible overestimate for the total number of inches of rain which have fallen between 8:00 AM and 12:30 PM.
- (c) Piglet would really like a better estimate. Show how you can combine your answers above in an attempt to find a closer estimate to the total number of inches of rain which have fallen between 8:00 AM and 12:30 PM.
10. At noon, the number of bacteria in Gordon's sink was 500 and was growing very rapidly. In fact, the number of bacteria was growing at a rate of  $r(t) = 200(1.6)^t$  bacteria per hour, where  $t$  represents the number of hours since noon.
- (a) Set up, but do not evaluate, the definite integral needed to compute the total change in the bacteria population between noon and 3:00 PM.
- (b) Use the built-in integrator on your calculator to get a good approximation to the value of the definite integral used in part (a).
- (c) How many bacteria were there in Gordon's sink at 3:00 PM?
11. Sharon had a lot of quizzes to grade but didn't begin until midnight. She was grading at a rate of  $100e^{-2t}$  quizzes per hour where  $t$  denotes the number of hours since midnight. Compute the exact number of quizzes that she graded between 1:00 AM and 2:00 AM. Give your answer to two decimal places.
12. State the **Fundamental Theorem of Calculus** in the following two ways:
- (a) Using an English sentence.
- (b) Using the definite integral symbol along with other correct mathematical notation.