Question 1: Acceleration due to gravity on the moon is a constant with a value of approximately $-8/5$ m/s^2 . During the 1971 Apollo 15 moon mission, an astronaut standing on the moon's surface dropped a hammer and a feather (from rest) from the same height above the surface, and after $\sqrt{3/2}$ seconds both objects reached the surface at exactly the same time. From what height were the objects dropped?

[5]

Question 2: Find the most general antiderivative of each of the following:

(a) $f(x) = 2x(1 - x^{-3})$

[2]

(b) $g(x) = \dfrac{5x - 3x^2 \csc^2(x) + 1}{x^2}$

[3]

Question 3: Use the definition of the definite integral in the form

$$\int_a^b f(x)\,dx = \lim_{n\to\infty} \sum_{i=1}^{n} f(x_i)\Delta x$$

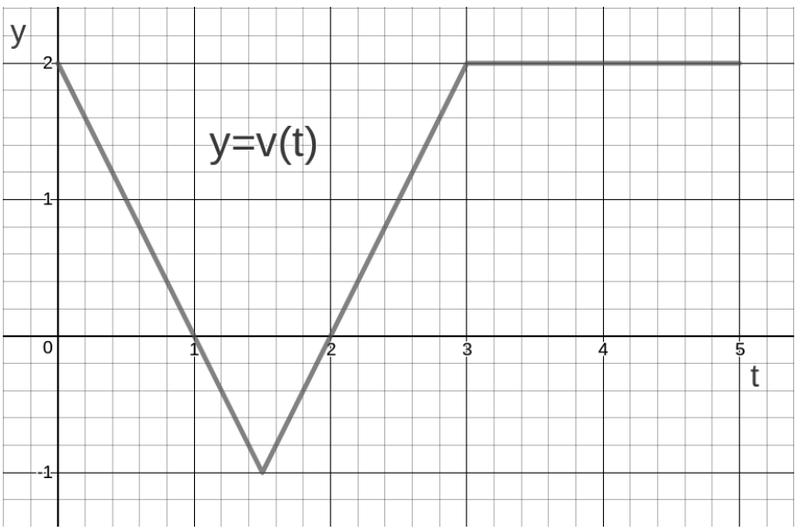
to evaluate

$$\int_{-1}^{1} (4x - x^2)\,dx$$

Carefully set up the Riemann sum and clearly show the steps of your simplification.

[10]

Question 4: The following is the graph of the velocity function for a particle moving along a straight line over the time interval $0 \leq t \leq 5$:



(a) Write a definite integral representing the total displacement of the particle and determine its value.

[3]

(b) Write a definite integral representing the total distance travelled by the particle and determine its value.

[4]

(c) Determine the average velocity of the object over the five second time interval.

[3]

Question 5: Determine the following integrals:

(a) $\int_{-2}^{0} 2x + 5\,dx$

[3]

(b) $\int \frac{1 + x + x^2}{\sqrt{x}}\,dt$

[2]

(c) $\int_{-\pi/4}^{\pi/4} \sec(x)\tan(x)\,dx$

[3]

(d) $\int \frac{te^t - 1 - t}{t}\,dt$

[3]

Question 6: Compute $\int_{-2}^{2} |1 - x^2|\, dx$

[5]

Question 7: Let $f(x) = \int_{0}^{x^2} \frac{t}{1+t^2}\, dt$. Here the domain of f is all real numbers. Find all solutions to $f''(x) = 0$.

[5]