Question 1:

(a) Find the most general antiderivative:

    (i) $f(x) = \sqrt{x}(x - 1) - \dfrac{\csc^2(x)}{\pi}$

<div align="right">[2]</div>
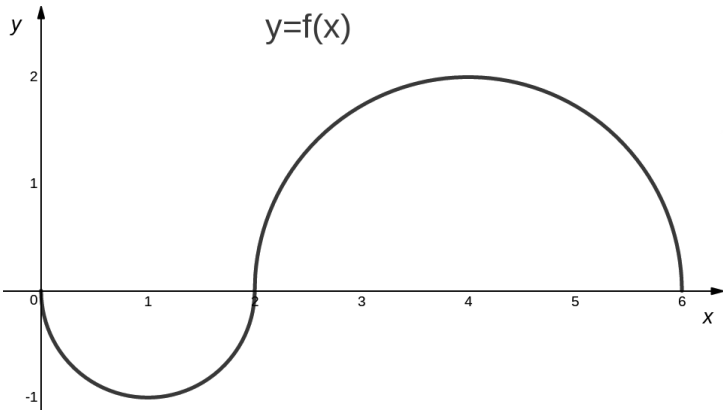
    (ii) $f(x) = \dfrac{4}{x} - \dfrac{3}{x^4} - e^2$

<div align="right">[2]</div>

(b) A particle starts at $(0, 0)$ at time $t = 0$ and heads out along the x-axis with initial velocity of $s'(0) = 10$ m/s. If the particle has acceleration at time t given by $s''(t) = -t$ m/s^2, what is the particle's displacement when the velocity is 2 m/s?

<div align="right">[6]</div>

Question 2: For this question use the following graph of $y = f(x)$. Each of the two parts of the graph are semicircles:

(a) Compute $\displaystyle\int_{1}^{4} f(x)\,dx$

[2]

(b) Compute $\displaystyle\int_{0}^{6} 2f(x)\,dx$

[2]

(c) Compute $\displaystyle\int_{1}^{6} (2 + |f(x)|)\,dx$

[2]

Question 3: Evaluate $\displaystyle\int_{-1}^{2} (x - 2|x|)\,dx$

[4]

Question 4: For this question let $f(x) = \int_0^{\sin(x)} \sqrt{1 + t^2}\, dt$ and $g(u) = \int_1^u f(x)\, dx$.

(a) Compute $f'(0)$

[2]

(b) Compute $g''(\pi/6)$

[3]

Question 5: Determine the value of the positive real number k if the average value of $f(x) = x^2 - x$ over the interval $[0, k]$ is k.

[5]

Question 6: Evaluate the following definite integrals:

(a) $\int_1^4 \left(\frac{x}{2} + \frac{2}{x} \right) dx$

[2]

(b) $\int_0^{\pi/4} \left(\sqrt{2}\cos(x) - \sec^2(x) \right) dx$

[3]

(c) $\int_{-1}^2 t(t-3)(t+2)\, dt$

[3]

(d) $\int_{-1000}^{1000} \frac{x^5}{1 + e^{(x^2)}}\, dx$

[2]

Question 7: (Substitution Method) Determine the following:

(a) $\displaystyle\int \frac{\cos\left(\ln\left(x\right)\right)}{x}\,dx$

[3]

(b) $\displaystyle\int \frac{\cos\left(5x\right)}{\left(1+\sin\left(5x\right)\right)^2}\,dx$

[3]

(c) $\displaystyle\int t(t+1)^{1/4}\,dt$

[4]