(1.a) **(10 pts)** Find the following derivative.

$$\frac{d}{dx} \left(\int_x^{x^2-1} \sin^3(7t-1) \ dt \right)$$

(1.b) **(10 pts)** Given that the derivative of $e^x(x^2 - 2x - 1)$ is equal to $e^x(x^2 - 3)$ evaluate the following integral.

$$\int_0^1 e^x(x^2 - 3) \ dx$$

(2) Evaluate the following integrals.
(2.a) **(10 pts)**

$$\int x \cos x \ dx$$

(2.b) **(10 pts)**

$$\int \frac{4x^2}{(x+1)^2(x^2+1)} \ dx$$

Question 3: (15 Points)
(a) Write an integral expression for the volume of the solid generated by revolving the region bounded by $y = -x + 2$, and the lines y = 0, x = 0, and x = 2, about the x-axis.
(b) Write an integral expression for the volume of the solid generated by revolving the region bounded by $y = -x + 2$, and the lines y = 0, x = 0, and x = 2, about y = 3.
(c) Write an integral expression for the volume of the solid generated by revolving the region bounded by $y = -x + 2$, and the lines y = 0, x = 1, and x = 2, about the y-axis.

Question 4: (10 Points)
Find the area of the region between the curve $y = 2 - \sqrt{x}$ and the x-axis for $0 \le x \le 4$.

Question 5: (10 Points)
Find the derivatives of the inverse functions $f^{-1}(x)$ of the following functions $f(x)$:
(a) $f(x) = 2^x$
(b) $f(x) = \log_3(x)$
(c) $f(x) = 2\sin(x)$

Question 6: (10 Points)
Find the integrals of the following functions:
(a) $f(x) = x^\pi$
(b) $f(x) = \pi^x$
(c) $f(x) = 6\tan(3x)$

Question 7: (40 Points)
Evaluate the following integrals

(a) $\int \cos^3(x)\sin(x)dx$

(b) $\int \dfrac{dx}{x^2 - 2x + 2}$

(c) $\int \dfrac{2x^3}{x^2 - 1}dx$

(d) $\int \dfrac{\log_2(x^2)}{x}dx$

Here are some derivatives :

1) $\dfrac{d}{dx}a^x = \ln(a)a^x$

2) $\dfrac{d}{dx}\log_a(x) = \dfrac{1}{x\ln(a)}$

3) $\dfrac{d}{dx}\tan(x) = \sec^2(x)$

4) $\dfrac{d}{dx}\cot(x) = -\csc^2(x)$

5) $\dfrac{d}{dx}\sec(x) = \sec(x)\tan(x)$

6) $\dfrac{d}{dx}\csc(x) = -\csc(x)\cot(x)$

7) $\dfrac{d}{dx}\sin^{-1}(x) = \dfrac{1}{\sqrt{1-x^2}}$

8) $\dfrac{d}{dx}\cos^{-1}(x) = \dfrac{-1}{\sqrt{1-x^2}}$

9) $\dfrac{d}{dx}\tan^{-1}(x) = \dfrac{1}{1+x^2}$

10) $\dfrac{d}{dx}\cot^{-1}(x) = \dfrac{-1}{1+x^2}$

11) $\dfrac{d}{dx}\sec^{-1}(x) = \dfrac{1}{|x|\sqrt{1-x^2}}$

12) $\dfrac{d}{dx}\csc^{-1}(x) = \dfrac{-1}{|x|\sqrt{1-x^2}}$