Instructions

- *Show all your work.* Legibly, please!
- *If you have a question, ask it!*
- Use the back sides of the test sheets for rough work or extra space.
- You may use a calculator and an aid sheet.

1. Do any *three* (3) of **a**–**f**. *[12 = 3 × 4 each]*

   a. $\displaystyle\int \frac{1}{\sqrt{4-x^2}}\,dx$ **b.** $\displaystyle\int_{-1}^{1} (y+1)^2\,dy$ **c.** $\displaystyle\int \sec^2(w)\sqrt{\tan(w)}\,dw$

   d. $\displaystyle\int_0^1 te^t\,dt$ **e.** $\displaystyle\int \cos^3(x)\,dx$ **f.** $\displaystyle\int_0^1 \frac{4}{1+x^2}\,dx$

2. Do any *two* (2) of **a**–**c**. *[10 = 2 × 5 each]*

a. Sketch the region whose area is computed by the integral $\displaystyle\int_2^4 \left(\frac{x}{2}-1\right)dx$. Without evaluating the integral, what is its area?

b. Sketch the solid obtained by revolving the region below $y = 2$ and above $y = 1$, for $0 \le x \le 1$, about the x-axis, and find its volume.

c. Compute $\displaystyle\int_{-41\pi}^{41\pi} \arctan(\theta)\,d\theta$.

3. Do *one* (1) of **a** or **b**. *[8]*

a. Sketch the region between the curves $y = x^3 - x$ and $y = \sin(\pi x)$, where $-1 \le x \le 1$, and find its area.

b. Sketch the solid obtained by revolving the region between $y = \dfrac{1}{x}$ and $y = 1$, where $1 \le x \le 3$, about the line $x = -1$, and find its volume.

4. Do *one* (1) of **a** or **b**. *[10]*

a. Find the domain and any and all intercepts, horizontal and vertical asymptotes, local maxima and minima, and inflection points of $f(x) = e^{-x^2}$, and sketch its graph.

b. Max moves at 1 km/hr along the positive x-axis towards the origin while aiming a laser pointer at the $(0, 2)$ on the y-axis. How is the (smaller!) angle between the laser beam and the the x-axis changing at the instant that Max is at the point $(1, 0)$ on the x-axis? (All distances along the axes are in kilometres. You may assume Max and the laser pointer occupy a single point at any given instant ... :-)

[Total = 40]