Instructions. Attempt all questions. Answers must be justified in order to gain full credit. Calculators are not permitted.

Time allowed: 1 hour

1. (5 points) By making a substitution, find

$$\int \frac{e^{\sqrt{x}}}{\sqrt{x}}\,\mathrm{d}x$$

2. (7 points) Use integration by parts to evaluate

$$\int_0^\pi x \cos x \,\mathrm{d}x$$

3. (15 points) By making a trigonometric substitution, find

$$\int \frac{1}{(1+x^2)^{5/2}}\,\mathrm{d}x$$

The following reduction formula maybe useful:

$$\int \cos^n x \,\mathrm{d}x = \frac{1}{n}\cos^{n-1} x \sin x + \frac{n-1}{n}\int \cos^{n-2} x \,\mathrm{d}x, \quad n \text{ positive}$$

4. (15 points) Use the method of partial fractions to find

$$\int \frac{x^2 - x}{x^3 + x^2 + x + 1}\,\mathrm{d}x$$

5. (i) (4 points) Calculate the approximations MID(2) and TRAP(2) to $\int_0^4 (1 - x^2)\,\mathrm{d}x$.

(ii) (4 points) Without evaluating the integral, determine if the approximation is an under-estimate or an over-estimate.

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