

PLEASE PRINT and box final results. Use only pencil or blue or black ink. Show all work for full credit. Work must be clear and unambiguous for credit. Please place your name on the upper right-hand corner of every worksheet. Labels for your work must be unambiguous. Please **USE ONLY ONE-SIDE** of a sheet of paper. Calculators may **NOT** be used. This exam must be your own independent work. Unless otherwise stated, the notation is the same as used in lecture and the textbook.

If you agree with this statement: “*On my honor, I have neither given nor received unauthorized aid in doing this assignment.*”; then please **PRINT** and **SIGN** your name.

NAME (Print and Signature): _____

Some integrals and expressions, used while working some problems, that you might wish to recall.

$$\int (\sin^2 ax) dx = \frac{1}{2} x - \frac{1}{4a} \sin 2ax$$

$$\int (\cos^2 ax) dx = \frac{1}{2} x + \frac{1}{4a} \sin 2ax$$

$$\int (\sin ax)(\cos ax) dx = \frac{1}{2a} \sin^2 ax$$

$$\int \frac{x dx}{\sqrt{(x^2 \pm a^2)^3}} = \frac{-1}{\sqrt{(x^2 \pm a^2)}}$$

$$\int \frac{dx}{\sqrt{(x^2 \pm a^2)^3}} = \frac{\pm x}{a^2 \sqrt{(x^2 \pm a^2)}}$$

$$\int \frac{x dx}{\sqrt{x^2 \pm a^2}} = \sqrt{x^2 \pm a^2}$$

$$\int \frac{dx}{\sqrt{x^2 \pm a^2}} = \ln(x + \sqrt{x^2 \pm a^2})$$

$$\int \frac{x^3 dx}{\sqrt{x^2 \pm a^2}} = \frac{1}{3} \sqrt{(x^2 \pm a^2)^3} \mp a^2 \sqrt{x^2 \pm a^2}$$

$$\int \sqrt{x^2 \pm a^2} dx = \frac{1}{2} [x \sqrt{x^2 \pm a^2} \pm a^2 \ln(x + \sqrt{x^2 \pm a^2})]$$

$$\int e^{ax} dx = \frac{e^{ax}}{a}$$

$$\int x e^{ax} dx = \frac{e^{ax}}{a^2} (ax - 1)$$

$$\int x^m e^{ax} dx = \frac{x^m e^{ax}}{a} - \frac{m}{a} \int x^{m-1} e^{ax} dx$$

$$\int \frac{dx}{a^2 + x^2} = \frac{1}{a} \tan^{-1} \frac{x}{a}$$

$$\int \frac{\sin \theta d\theta}{(z^2 + R^2 - 2zR \cos \theta)^{1/2}} = \frac{1}{zR} (z^2 + R^2 - 2zR \cos \theta)^{1/2}$$

$$\sinh x = \frac{1}{2} (e^x - e^{-x})$$

$$\int \frac{\sin \theta d\theta}{(a^2 + R^2 - 2aR \cos \theta)^{3/2}} = -\frac{1}{aR} (a^2 + R^2 - 2aR \cos \theta)^{-1/2}$$

$$\cosh x = \frac{1}{2} (e^x + e^{-x})$$

$$\int_0^a \sin(n\pi y/a) \sin(n'\pi y/a) dy = \begin{cases} 0, & \text{if } n' \neq n, \\ \frac{a}{2}, & \text{if } n' = n. \end{cases}$$

$$\int_0^a \sin(n\pi y/a) dy = \begin{cases} 0, & \text{for } n \text{ even,} \\ \frac{2a}{n\pi}, & \text{for } n \text{ odd.} \end{cases}$$

$$P_l(x) = \frac{1}{2^l l!} \left(\frac{d}{dx}\right)^l (x^2 - 1)^l, \quad P_0(x) = 1,$$

$$P_1(x) = x, \quad P_2(x) = (3x^2 - 1)/2$$

$$\int_{-1}^1 P_l(x) P_{l'}(x) dx = \int_0^\pi P_l(\cos \theta) P_{l'}(\cos \theta) \sin \theta d\theta = \begin{cases} 0, & \text{if } l' \neq l, \\ \frac{2}{2l+1}, & \text{if } l' = l. \end{cases}$$

$$V(r, \theta) = \sum_{k=0}^{\infty} \left(A_k r^k + \frac{B_k}{r^{k+1}} \right) P_k(\cos \theta)$$

$$V(s, \phi) = a_0 + b_0 \ln s + \sum_{k=1}^{\infty} \left(a_k s^k + \frac{b_k}{s^k} \right) (c_k \cos k\phi + d_k \sin k\phi)$$

$$V(\vec{r}) = \frac{1}{4\pi\epsilon_0} \sum_{n=0}^{\infty} \frac{1}{r^{(n+1)}} \int (r')^n P_n(\cos \theta') \rho(\vec{r}') d\tau'$$

$$\vec{A}(\vec{r}) = \frac{\mu_0 I}{4\pi} \sum_{n=0}^{\infty} \frac{1}{r^{n+1}} \oint (r')^n P_n(\cos \theta') dl'$$

DO NOT TURN OVER until instructed.

You may wish to recall

$$\int \sin^3 ax \, dx = -\frac{1}{3a}(\cos ax)(\sin^2 ax + 2) \, , \quad \int \cos^3 ax \, dx = \frac{1}{3a}(\sin ax)(\cos^2 ax + 2) \, ,$$

$$\int_0^\pi \sin \theta \, d\theta = 2 \, , \quad \text{and/or} \quad \int_0^\pi \sin^3 \theta \, d\theta = \frac{4}{3} \, .$$

1. (3 points) Have you placed your name and page number in the upper right-hand corner of each sheet of your work except for the cover sheet and the top of this flip-side of the cover sheet? Have you avoided placing any information or work in the upper left-hand corner of any sheet as this space is “reserved” for the staple (if needed)? Have you clearly identified the work associated with each problem? Have you used only one side of each sheet of paper excluding the cover sheet? Have you read the *Honor Code* statement and subsequently printed and signed your on the cover sheet? (Circle your response on this sheet.)

YES

NO