PHY 3323 "Electromagnetism 1" Fall 2018
Quiz 4 (30 points) 19 October 2018
Professor Mark W. Meisel

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 Name** *and* Provide Signature): _____

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

$$\int (\sin^2 ax)\,dx \;=\; \tfrac{1}{2}\,x \;-\; \tfrac{1}{4a}\,\sin 2ax \qquad \int (\cos^2 ax)\,dx \;=\; \tfrac{1}{2}\,x \;+\; \tfrac{1}{4a}\,\sin 2ax$$

$$\int (\sin ax)(\cos ax)\,dx \;=\; \tfrac{1}{2a}\,\sin^2 ax \qquad \int \frac{x\,dx}{\sqrt{(x^2 \pm a^2)^3}} \;=\; \frac{-1}{\sqrt{(x^2 \pm a^2)}}$$

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

$$\int \frac{dx}{\sqrt{x^2 \pm a^2}} \;=\; \ln(x \,+\, \sqrt{x^2 \,\pm\, a^2}\,) \qquad \int \frac{x^3\,dx}{\sqrt{x^2 \pm a^2}} \;=\; \tfrac{1}{3}\sqrt{(x^2 \,\pm\, a^2)^3} \;\mp\; a^2\sqrt{x^2 \,\pm\, a^2}$$

$$\int \sqrt{x^2 \,\pm\, a^2}\,dx \;=\; \tfrac{1}{2}\,\left[x\,\sqrt{x^2 \,\pm\, a^2} \,\pm\, a^2\,\ln(x \,+\, \sqrt{x^2 \,+\, a^2}\,)\,\right]$$

$$\int e^{ax}\,dx \;=\; \tfrac{e^{ax}}{a} \qquad \int x\,e^{ax}\,dx \;=\; \tfrac{e^{ax}}{a^2}\,(ax - 1)$$

$$\int x^m\,e^{ax}\,dx \;=\; \tfrac{x^m\,e^{ax}}{a} \;-\; \tfrac{m}{a}\int x^{m-1}\,e^{ax}\,dx \qquad \int \frac{dx}{a^2 + x^2} \;=\; \tfrac{1}{a}\,\tan^{-1}\tfrac{x}{a}$$

$$\int \frac{\sin\theta\,d\theta}{(z^2 + R^2 - 2zR\cos\theta)^{1/2}} \;=\; \tfrac{1}{zR}\,(z^2 + R^2 - 2zR\cos\theta)^{1/2} \qquad \sinh\,x \;=\; \tfrac{1}{2}\,(e^x \,-\, e^{-x})$$

$$\int \frac{\sin\theta\,d\theta}{(a^2 + R^2 - 2aR\cos\theta)^{3/2}} \;=\; -\tfrac{1}{aR}\,(a^2 + R^2 - 2aR\cos\theta)^{-1/2} \qquad \cosh\,x \;=\; \tfrac{1}{2}\,(e^x \,+\, e^{-x})$$

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

$$P_l(x) \;=\; \tfrac{1}{2^l\,l!}\left(\tfrac{d}{dx}\right)^l\,(x^2 \,-\, 1)^l\;, \qquad P_0(x) = 1\;, \qquad P_1(x) = x\;, \quad P_2(x) = (3x^2 - 1)/2$$

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

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

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

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

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DO NOT TURN OVER until instructed.

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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? 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? Have you read the *Honor Code* statement and subsequently printed and signed your name? (Circle your response on this sheet.)

YES **NO**