This review only covers the new material since Exam 2, but the Final is comprehensive. Use old exams, quizzes, homework, etc. to study the previous material.

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1. Evaluate the following integrals

(a). $\displaystyle\int_1^4 \int_1^{e^2} \int_0^{1/xz} \ln z \, dy \, dz \, dx$

2. Rewrite the integral using the indicated order of integration. (**Do NOT evaluate**):

(a). $\displaystyle\int_0^2 \int_{2x}^4 \int_0^{\sqrt{y^2-4x^2}} dz \, dy \, dx$ Rewrite using $dx \, dy \, dz$

3. The spherical coordinates of a point are $\left(4, \frac{\pi}{3}, \frac{\pi}{6}\right)$.

(a). Find the rectangular coordinates.

(b). Find the cylindrical coordinates

4. Given the rectangular coordinate $(-2, 2, \sqrt{17})$

(a). Find the cylindrical coordinates.

(b). Find the spherical coordinates

5. Section 15.7 #23.

6. Section 15.8 #41.

7.

(a). Describe the *surface* whose equation in spherical coordinates is $\phi = 2\pi/3$.

(b). Sketch the *solid* described by the inequalities $0 \le \phi \le 2\pi/3$ and $\rho \le 2$.

8. Use spherical coordinates to find the volume the region inside the sphere $x^2 + y^2 + z^2 = 36$ that is below the upper nappe of the cone $z = \sqrt{3}\sqrt{x^2 + y^2}$ and above the lower nappe of the cone $z = -\sqrt{x^2 + y^2}$.(**Set up the integral, but do NOT evaluate.**)

9. Section 16.1, #29-32

10. Evaluate the following line integrals.

(a). $\int_C 2x\, ds$, where C consists of the arc of the parabola $y = x^2$ from (0,0) to (1,1) followed by the line segment from (1,1) to (2,0).

(b). $\int_C x^3\, dx - x\, dy$ where C is the circle $x^2 + y^2 = 1$ with counterclockwise orientation.

(c). $\int_C \mathbf{F} \cdot d\mathbf{r}$, where $\mathbf{F}(x, y) = x^2 y\, \mathbf{i} - y\sqrt{x}\, \mathbf{j}$
and C is given by the vector function $\mathbf{r}(t) = t^2\, \mathbf{i} + t^3\, \mathbf{j},\ 0 \le t \le 1$

11. Is the integral line integral $\int_C 2xe^y\, dx + x^2 e^y\, dy$ independent of path. Justify your answer.

12. Section 16.3 #12

13. Find the work done by the force field $F(x, y, z) = \langle z, x, y\rangle$ in moving a particle from the point $(3, 0, 0)$ to the point $(0, \pi/2, 3)$ along the helix $x = 3\cos t, y = t, z = 3\sin t$.