

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.

1. Evaluate the following integrals

(a). $\int_1^4 \int_1^{e^2} \int_0^{1/xz} \ln z \, dy \, dz \, dx = 2 \ln 4 = \ln 16$

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

(a). $\int_0^2 \int_{2x}^4 \int_0^{\sqrt{y^2-4x^2}} dz \, dy \, dx$ Rewrite using $dx \, dy \, dz$ $\int_0^4 \int_z^4 \int_0^{\frac{1}{2}\sqrt{y^2-z^2}} dx \, dy \, dz$

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

(a). Find the rectangular coordinates. $(1, \sqrt{3}, 2\sqrt{3})$ (b). Find the cylindrical coordinates $(2, \frac{\pi}{3}, 2\sqrt{3})$

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

(a). Find the cylindrical coordinates. $(2\sqrt{2}, \frac{3\pi}{4}, \sqrt{17})$ (b). Find the spherical coordinates $(5, \frac{3\pi}{4}, \cos^{-1}(\sqrt{17}/5))$

5. Section 15.7 #23.

6. Section 15.8 #41.

7.

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

(b). Sketch the *solid* described by the inequalities $0 \leq \phi \leq 2\pi/3$ and $\rho \leq 2$. Solid sphere with the cone cut out of the bottom

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.**)

$$\int_0^{2\pi} \int_{\pi/6}^{3\pi/4} \int_0^6 \rho^2 \sin \phi \, d\rho \, d\phi \, d\theta$$

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 $(2,0)$. $\frac{1}{6} (5^{3/2} - 1) + 3\sqrt{2}$

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

(c). $\int_C \mathbf{F} \cdot d\mathbf{x}$, where $\mathbf{F}(x, y) = x^2y \mathbf{i} - y\sqrt{x} \mathbf{j}$
and C is given by the vector function $\mathbf{r}(t) = t^2 \mathbf{i} + t^3 \mathbf{j}$, $0 \leq t \leq 1$ $\frac{41}{63}$

11. Is the integral line integral $\int_C 2xe^y \, dx + x^2e^y \, dy$ independent of path. Justify your answer. Yes, since
 $P_y = Q_x$, it is conservative.

12. Section 16.3 #12 (a). $f(x, y) = 3x + x^2 + y^2$ (b). 9

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 $x = 3 \cos t, y = t, z = 3 \sin t$. $-\frac{3\pi}{4}$