

Name: _____

Directions: Complete all questions and **show all applicable work**. Partial credit will be given.

1.) [5pts] Integrate:

$$\int_0^1 5x^4 + 4x^3 - 5 dx$$

2.) [5pts] Integrate:

$$\int e^x \cos(e^x) dx$$

3.) [5pts] Integrate:

$$\int 3 \cos^5(2x) dx$$

4.) [5pts] Integrate:

$$\int e^{2x} \cos x dx$$

5.) [5pts] If $\frac{dy}{dx} = xy^2$, find a function of y explicitly (Hint: Use integration).6.) [5pts] Convert the coordinates $(x, y, z) = (2, -4, -3)$ to spherical coordinates.

7.) [10pts] Use the midpoint rule with 6 boxes to approximate the integral. Find a reasonable bound for the maximum error that can be expected?

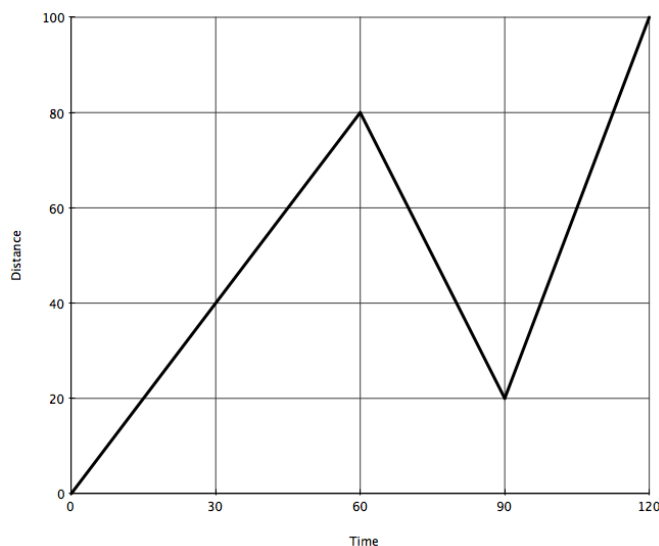
$$\int_0^3 x^2 dx$$

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8.) [5pts] Let $f(x) = \int_1^{x^2} \ln(t) \cos t \, dt$. Compute $f'(x)$. (Hint: there IS an easy way to compute this without actually computing the integral out.)

9.) [10pts] A new radio-active substance called mathotope has been discovered. Testing reveals that it has a half-life of 20 years. How much of a 30kg radioactive block of mathotope will be radioactive after 35 years? Hint: $\frac{dM}{dt} = kM$, where M is the amount of radioactive material and k is a constant.

10.) [5pts]



Using the graph above of $f(x)$, let $F(x) = \int_0^x f(x)dx$ and compute:

- $F(0) =$
- $F(30) =$
- $F(60) =$
- $F(90) =$
- $F(120) =$



Now create a sketch of F below.

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11.) [15pts] Let $f(x) = \frac{2}{3}\sqrt{x}$ and $g(x) = x$ and assume $x \geq 0$.

- Create a graph of $f(x)$ and $g(x)$. Be sure to label the intersection points.
- Find the area of the region enclosed between $f(x)$ and $g(x)$.
- Find the volume obtained by rotating the enclosed region of $f(x)$ and $g(x)$ about the x-axis.
- Find the volume obtained by rotating the enclosed region of $f(x)$ and $g(x)$ about the y-axis.

12.) [5pts] Draw a 3-dimensional axis with the positive z-axis pointing right. You may select the y- and z-axis, but they must satisfy the right-hand rule. Be sure to note which side of each axis is positive.

13.) [5pts] Let u be the vector:  and v be the vector: .

- Draw a plot with both u and v given.
- Draw a plot showing the geometry of $u + v$.
- Draw a plot showing the geometry of $u - v$.
- Draw a plot showing the geometry of $2u - 3v$.

14.) [15pts, 3 each] Let $P = (0, -3, 5)$, $Q = (3, 4, 5)$ and $R = (0, -3, 2)$.

- Compute the line \overrightarrow{PQ} and \overrightarrow{PR} .
- Compute $\overrightarrow{PQ} \times \overrightarrow{PR}$.
- Find a unit vector in the direction of \overrightarrow{PQ} .
- What is the angle between \overrightarrow{PQ} and \overrightarrow{PR} .
- Compute the vector projection of \overrightarrow{PQ} onto \overrightarrow{PR} .
- BONUS: (5pts) Find the equation of a line through the point P and perpendicular to the line \overrightarrow{QR} .