1. Evaluate \( \int x \cos^2(3x) \, dx \)

2. Evaluate \( \int e^{2x} \sin x \, dx \).

3. Could you in principle compute \( \int x^{10^{10}} e^x \, dx \), and if so, how?

4. Evaluate \( \int \sin^3(x) \cos^4(x) \, dx \).

5. Evaluate \( \int \sec^4(x) \tan^4(x) \, dx \).

6. What substitution would you use to evaluate \( \int x^3 \sqrt{16 + x^2} \, dx \)?

7. Evaluate \( \int \frac{dx}{(9 - x^2)^{3/2}} \, dx \).

8. Is the angle between the vectors \( \mathbf{a} = \langle 3, -1, 2 \rangle \) and \( \mathbf{b} = \langle 2, 2, 4 \rangle \) acute, obtuse, or right?

9. Find the area of the parallelogram whose vertices are \((-1, 2, 0), (0, 4, 2), (2, 1, -2), \) and \( (3, 3, 0) \).

10. If \( \mathbf{a} \) and \( \mathbf{b} \) are both nonzero vectors and \( \mathbf{a} \cdot \mathbf{b} = |\mathbf{a} \times \mathbf{b}| \), what can you say about the relationship between \( \mathbf{a} \) and \( \mathbf{b} \)?

11. Consider the vectors \( \mathbf{a} = \langle 4, 1 \rangle \) and \( \mathbf{b} = \langle 2, 2 \rangle \), shown below. Compute \( \cos \theta, \mathbf{u}, \) and the length \( x \).

Note: you should not leave unevaluated trigonometric functions in your answer.
Find the equation of the plane which passes through the point \((2, -3, 1)\) and contains the line

\[
x = 3t - 2, \quad y = t + 3, \quad z = 5t - 3.
\]

Find the line of intersection of the planes \(x + y + z = 12\) and \(2x + 3y + z = 2\).

Compute the position vector for a particle which passes through the origin at time \(t = 0\) and has velocity vector

\[
r(t) = 2t \hat{i} + \sin t \hat{j} + \cos t \hat{k}.
\]

Show that if a particle moves at constant speed, then its velocity and acceleration vectors are orthogonal. Note that this does not mean that the velocity is 0! (Hint: consider the derivative of \(\mathbf{v} \cdot \mathbf{v}\).)

Consider the curve defined by

\[
r(t) = (4 \sin ct, 3ct, 4 \cos ct).
\]

What value of \(c\) makes the arc length of the space curve traced by \(r(t)\), \(0 \leq t \leq 1\), equal to 10?