Mathematics Self-Assessment

The lack of mathematical sophistication is one of common causes of difficulty for students in Physics With Calculus. The following questions are representative of the minimum level of mathematics which we expect. You should feel comfortable with mathematics at the level of these questions. The answers are not given. If you are uncertain whether your answers are correct for any of these questions then you are not comfortable with mathematics at the level required for PHY2048.

- Algebra

1) Solve for x: $ax^2 + bx + c = 0$.

2) Factor:

a) $a^2 + 4ab + 4b^2 =$

b) $a^2 - 9b^2 =$

3) Solve for x: $\frac{1}{2} = \frac{1}{x} + \frac{1}{3}$

4) Make a sketch of the function $y(x) = mx + b$, where m and b are constants.

5) What are the meanings of the constants m and b in terms of your sketch?

- Calculus

1) $x(t) = x_0 + v_0 t + \frac{1}{2}at^2$, where x_0, v_0 and a are constants.

a) $dx/dt =$

b) $d^2x/dt^2 =$

c) If $a < 0$, does the function $x(t)$ curve up or down?

d) If x is negative when $t = 0$ and x is positive when t is very large: then for precisely which values of t is x positive (express your answer in terms of constants x_0, v_0 and a)?

2) Evaluate the derivative $\frac{d}{dt} A \cos(\omega t + \phi)$, where A, ω and ϕ are constant.

3) Evaluate the following integrals:

a) $\int_0^\pi \sin \theta \, d\theta =$

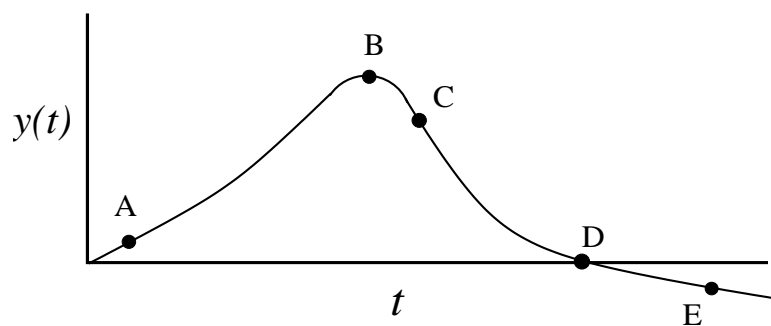b) If k is a constant, $\int_0^x kx \, dx =$

3) In the figure below, at which point is the first derivative of $y(t)$
a) the greatest?
b) the least?
c) equal to zero?
d) At the point D is the second derivative positive or negative?

- Trigonometry
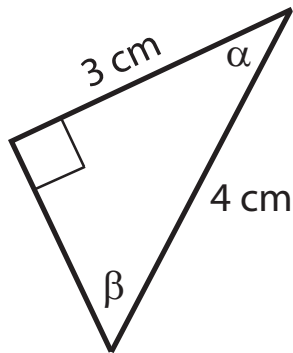
1) Using trig identities, simplify these expressions:

a) $\cos^2\theta + \sin^2\theta =$

a) $\cos^2\theta - \sin^2\theta =$
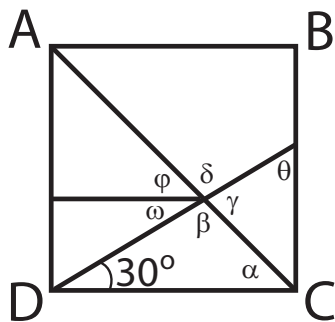
c) $\sin\theta/\cos\theta =$

d) $\sin A \cos B \pm \cos A \sin B =$

2) Find $\sin\alpha$, $\cos\alpha$ and $\tan\beta$, where α and β are angles in the right angle triangle shown below.

3) The figure below shows a square ABCD. The horizontal segment inside the square is parallel to the top and bottom square sides. Find all marked angles.

- Vectors

(We will review vectors in the class. The example below asks you to perform the key operations that you will need to know/learn for this course.)

1) The figure below shows two vectors $\vec{a}$ and $\vec{b}$.

a) Draw a vector $\vec{c}$ representing their sum: $\vec{c} = \vec{a} + \vec{b}$

b) If $a=2$ cm, $b=3$ cm, and $\alpha=0.5$ radians, what is the length of the vector $\vec{c}$?

c) What is a dot-product $\vec{a} \cdot \vec{b}$?

d) What is the length of the vector $\vec{d} = \vec{a} \times \vec{b}$

e) Where does the vector $\vec{d}$ point?
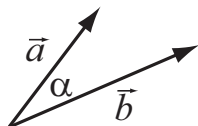
- Approximations

1) To examine limitations of your calculator evaluate

$$1 - \sqrt{1 - 3 \times 10^{-20}}$$

Despite what your calculator says, the answer is not zero. Find an approximate value of the answer without using a calculator or computer.