Preliminary Math Self-Assessment
Physics 122

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The purpose of this self-assessment is to help you determine whether you should review some mathematical skills that are essential for success in Physics 122. Complete the problems below **without using any resources besides a scientific calculator**. You do not need to time yourself. This assessment will not be collected, but you are expected to keep a completed copy in your course binder throughout the quarter.

Use the space below each problem to show your work clearly. Showing your work is essential for identifying errors and strengthening your understanding. Simply reading solutions afterward does not count as reviewing the material.

An understanding of physics is *not* required to answer any of the following questions; however, the mathematical tools used here will appear repeatedly throughout the course.

1. Evaluate the following expressions and express your answers in scientific notation:

   (a) $(3.6 \times 10^{5})(4.2 \times 10^{-3})$

   (b) $\dfrac{7.5 \times 10^{-6}}{2.5 \times 10^{2}}$

2. Convert the following quantities:

   (a) 450 cm to meters

   (b) 2.4 L to cubic meters

   (c) 0.75 g/cm^3 to kg/m^3

3. An angle is measured to be $1\frac{1}{4}$ radians.

   (a) Find $\sin(\theta)$ and $\cos(\theta)$.

(b) Determine whether θ is closer to 90° or 180°.

4. Evaluate the following:

$$\ln(5.0) + \ln(2.0) - \ln(4.0)$$

5. Solve the following equation for x:

$$3x^2 - 12x + 9 = 0.$$

6. A quantity varies inversely with the square of x.

   (a) Write an equation expressing this relationship.

(b) If the quantity has value Q_0 at $x = x_0$, find its value at $x = 3x_0$.

7. The pressure of a gas is given by

$$P = \frac{nRT}{V}.$$

(a) Solve for V in terms of the other variables.

(b) If P is doubled while n, R, and T remain constant, how does V change?

8. A function is given by $y(t) = 2t^2 - 4t + 1$.

(a) Find the value of y at $t = 3$ s.

(b) Sketch $y(t)$ for $0 \leq t \leq 4$ s. Clearly label axes and units.

9. Solve the following system of equations:

$$\begin{cases} 2x + 3y = 13 \\ 4x - y = 5 \end{cases}$$

10. The intensity of a wave is proportional to the square of its amplitude.

(a) Write a proportionality relating intensity I and amplitude A.

(b) If the amplitude is tripled, by what factor does the intensity change?

11. Evaluate the following trigonometric expression:

$$\tan\left(\frac{3\pi}{4}\right) + \sin\left(\frac{\pi}{6}\right).$$

12. A quantity oscillates according to

$$x(t) = A\cos(\omega t).$$

(a) What is the maximum value of $x(t)$?

(b) What is the value of x when $\omega t = \pi$?

13. Light of wavelength λ passes through a narrow opening.

(a) If λ is doubled, how does any quantity proportional to $1/\lambda$ change?

(b) How does a quantity proportional to λ^2 change?

14. Solve for T_f in the equation

$$m_1 c_1 (T_f - T_{1i}) + m_2 c_2 (T_f - T_{2i}) = 0.$$

15. Using your result from the previous problem, find T_f given:

$$m_2 = 2m_1, \quad c_1 = c_2, \quad T_{1i} = 20^\circ\text{C}, \quad T_{2i} = 80^\circ\text{C}.$$