Quiz 0
20 minutes, open book.

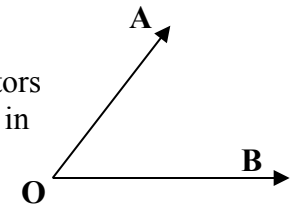
Name: _____

ID: _____

Mathematics is the language in sciences. Certain knowledge in mathematics and mechanics (PHYS1303) is required to understand the material in this course. To help you check how well you are prepared for this course, please complete this quiz in class. The grade of this quiz will not be counted towards your final course grade. However if you find this quiz difficult, you may want to talk to your advisor.

1. The formula that links R with R_1 and R_2 is this: $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$
   If $R_1 = 2$, $R_2 = 3$, what is the value of R?

2. Two vectors **A** and **B** are drawn as in the figure. Both vectors originate from point **O**. Vector **C** = **A** + **B**. Draw vector **C** in the same figure.



3. In a Cartesian coordinate system, vector **A** = 2**i** + 3**j** + 4**k**, vector **B** = 3**i** + 4**j** + 5**k**. Here the vectors **i, j** and **k** are the unit vectors for the x-, y- and z-axes. Write the expression for vector **C** and scalar D if:
   (1) **C** = **A** + **B**

   (2) D = **A**·**B**

   (3) **C** = **A**×**B**

4. Solve the following equation for the variable x, make sure to get all possible solutions.

$$\frac{4}{(9-x)^2} = \frac{1}{x^2}$$

5. Solve the following equations for variables *x, y* and *z*.

$$3x + 3y + 4z = 0$$
$$x - y + 2z = 3$$
$$3x + y - 4z = 16$$

6. If $y = 3x^2 + \sin(6x) + \ln(x) + \frac{1}{x}$, What is $\frac{dy}{dx}$?

7. Solve this integral: $U(R) = \int_{\infty}^{R} \frac{dr}{r^2}$

8. Solve the equation for *q*. The variable *q is* a function of *t* . Here *R* and *C* are constants. When $t = 0$, $q = Q_0$.

$$\frac{q}{C} + R\frac{dq}{dt} = 0$$

9. A particle of mass m is located by a vector $\boldsymbol{r}$ in a coordinate system. There is a force $\boldsymbol{F}$ exerted on the particle. Express the velocity $\boldsymbol{v}$ and acceleration $\boldsymbol{a}$ of the particle as well as the changing rate of momentum $\boldsymbol{p}$ with respect to time t with the given variables.

10. A particle of mass m is attached to one end of an unstretchable string of length l. The mass of the string is negligible. The other end of the string is fixed to the ceiling of a teaching lab. The particle is initially stationary under its own weight and we define the potential energy of the particle to be 0 at that position. Now pull the particle with the string away from the initial vertical position such that the string makes a small angle θ_0 with the vertical line. Release the particle so that it starts oscillating. What is the total energy of the oscillating system? What is the speed of the particle when it reaches the lowest point? Write the equation of motion for this particle.