College Physics
Exam 1 Homework Set
(Mathematical Prerequisites)
For physics students everywhere!

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Instructions:

All diagrams and figures on this homework are rough sketches: they are not generally drawn to scale. Your answers should be based on the numbers given, not on measurements made with a ruler or protractor.

This homework set consists of 50 multiple-choice problems. You are to be your own grader for the homework. You will find solutions to these problems on the website underneath the homework set itself. The solutions are broken into two parts: the answer key (i.e., just the answers), and on the following pages the worked out solutions. Since you have access to all of the solutions, I will not grade the homework.

The idea is that you should work the problems, then circle the answers on the grade sheet that is located on page two of the homework. When you are finished with a section, you should then compare your solutions to the answers on the answer key of the corresponding homework solution set.

If you miss any of the problems, then you should look up the solution, check to see what you did wrong, and correct it. You should keep track of which problems you miss. A good way to do this is to take the grade sheet with your solutions on it and place a large red X on the number of the problem that you missed.

If you don’t understand the solution, then you should seek help. If you miss lots of similar type problems, then you should go to my large problem bank and work more similar type problems.

You should do your work either on the space provided or on scratch paper and then recopy it over to a notebook or ringed binder. You should not try to squeeze your work onto the small space between the problems on this homework set.

This homework set is for practice only. It has no due date since I do not grade homework. However, if you write the solutions out with all of your work clearly labelled, neatly written, and all in one notebook or binder (a.k.a., a homework portfolio) as described in the syllabus, then I will take this into consideration should you find yourself on the border between two grades. I will not ask to see your portfolio until the end of the semester.
Directions: Work the problems, then circle your answers below.

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Mathematical Preliminaries

Geometry

Problem 1. (Circles) If the diameter of a circle is $D$, what is its radius?

(a) $\pi D^2/2$  
(b) $2\pi D^2$  
(c) $D/2$  
(d) $2D$  
(e) none of these

Problem 2. (Circles) If the area of a circle is $A$, what is its circumference?

(a) $2\pi\sqrt{A}$  
(b) $2\sqrt{\pi A}$  
(c) $\sqrt{\frac{A}{\pi}}$  
(d) $\sqrt{\frac{2A}{\pi}}$  
(e) none of these

Problem 3. (Rectangles) What is the area of a rectangular windowpane measuring 20 cm wide by 25 cm high?

(a) 50 cm$^2$  
(b) 80 cm$^2$  
(c) 125 cm$^2$  
(d) 500 cm$^2$  
(e) none of these

Problem 4. (Rectangles) What is the volume of a rectangular room measuring 4 m long by 5 m wide by 3 m high?

(a) 12 m$^3$  
(b) 24 m$^3$  
(c) 30 m$^3$  
(d) 60 m$^3$  
(e) none of these

Problem 5. (Triangles) Find $r$ in the right triangle at right.

(a) 2  
(b) 3  
(c) 4  
(d) 5  
(e) none of these

Problem 6. (Triangles) Find $y$ in the right triangle at right.

(a) $\sqrt{3}$  
(b) 9  
(c) $\sqrt{21}$  
(d) $\sqrt{29}$  
(e) none of these
Problem 7. (Triangles) In the right triangle at right, which of the following equations is true?

(a) $b = \frac{1}{2} \sqrt{c + a}$  
(b) $b = \frac{1}{2} \sqrt{c - a}$  
(c) $b = \sqrt{c^2 + a^2}$  
(d) $b = \sqrt{c^2 - a^2}$  
(e) none of these

Problem 8. (Applications with triangles) An airplane flies a route involving three cities. From Rio Cordaro, it flies 100 miles straight east to Hackerville. From Hackerville, it flies 200 miles straight north to San Pitucco. How far does it fly from San Pitucco to Rio Cordaro?

(a) 225 miles  
(b) $100 \sqrt{3}$ miles  
(c) 250 miles  
(d) $100 \sqrt{5}$ miles  
(e) none of these

Problem 9. (Applications with triangles) A blimp is attached to a cable whose other end is fastened to the ground. The wind is strong enough to pull the cable into a straight line. When you are standing directly below the blimp, you are 4 km from the place where the cable is anchored in the ground. The blimp is 3 km above the ground. How long is the cable?

(a) 1 km  
(b) $\sqrt{5}$ km  
(c) $\sqrt{7}$ km  
(d) 5 km  
(e) none of these

Problem 10. (Applications with triangles) A physics instructor has locked himself out of his office, and tries to climb in through an upper window. He leans a 4-meter ladder against the side of the building so that the top of the ladder is 3 m above the ground. How far from the building is the bottom of the ladder?

(a) 1 m  
(b) $\sqrt{7}$ m  
(c) $\sqrt{12}$ m  
(d) 5 m  
(e) none of these
Algebra

Problem 11. If \( f(x) = \frac{x^2 + 1}{3} \), find \( f(2) \).

(a) \( \frac{5}{9} \)  
(b) 1  
(c) \( \frac{5}{3} \)  
(d) 3  
(e) none of these

Problem 12. If \( f(x) = \sqrt{x^2 - 5} \), find \( f(1) \).

(a) \( -2 \)  
(b) 2  
(c) \( -\sqrt{6} \)  
(d) No real value  
(e) none of these

Problem 13. If \( f(x) = x^2 - 3 \), find \( f(a - 1) \).

(a) \( a^2 - 2a - 2 \)  
(b) \( a^2 - 8a + 16 \)  
(c) \( a^2 - 6a + 8 \)  
(d) \( a^2 - 8a - 16 \)  
(e) none of these

Problem 14. If \( f(x) = (x - 2)^2 \), find \( f(a - 1) \).

(a) \( a^2 - 2a - 1 \)  
(b) \( a^2 - 6a + 9 \)  
(c) \( a^2 - 4a + 3 \)  
(d) \( a^2 + 4a + 4 \)  
(e) none of these

Problem 15. If \( f(x) = 3x + 2 \), find \( f(a + 1) \).

(a) \( 3a + 1 \)  
(b) \( 3a + 2 \)  
(c) \( 3a + 3 \)  
(d) \( 3a + 5 \)  
(e) none of these

Problem 16. If \( f(x) = 3x + 2 \), find \( f(a - 3) \).

(a) \( 3a - 3 \)  
(b) \( 3a - 7 \)  
(c) \( 3a - 13 \)  
(d) \( 3a - 15 \)  
(e) none of these
Problem 17. If an object is dropped from a height \( h \), the speed with which it hits the ground is: \( v = \sqrt{2gh} \), where \( g \) is the gravitational acceleration. (If you don’t know what gravitational acceleration is, don’t worry; you’ll learn about it during this course.) If an object is dropped from a height of 20, and the gravitational acceleration is 10, what is the speed with which the object hits the ground?

(a) 20 \( \sqrt{2} \)  
(b) 40 \( \sqrt{2} \)  
(c) 10\( \sqrt{2} \)  
(d) 20\( \sqrt{2} \)  
(e) none of these

Problem 18. The formula for the centripetal acceleration of an object moving in a circle is: \( a = \frac{v^2}{r} \), where \( v \) is the object’s speed and \( r \) is the radius of the circle. (If you’ve never heard of “centripetal acceleration”, don’t worry; you’ll learn about it during this course.) If an object is moving in a circle with radius 6 at a speed of 3, what is its centripetal acceleration?

(a) \( \frac{1}{4} \)  
(b) \( \frac{3}{2} \)  
(c) 4  
(d) 12  
(e) none of these

Problem 19. The position of a moving object is given by the formula: \( x = x_0 + vt \), where \( x_0 \) is the initial position, \( v \) is the velocity, and \( t \) is the time. What is the position of an object if \( x_0 = 5 \), \( v = 2 \), and \( t = 3 \)?

(a) 11  
(b) 21  
(c) 25  
(d) 30  
(e) none of these

Problem 20. The speed of an object is given by the formula: \( v = v_0 + at \), where \( v_0 \) is the initial speed, \( a \) is the acceleration, and \( t \) is the time. What is the speed of an object if \( v_0 = 5 \), \( a = 2 \), and \( t = 3 \)?

(a) 11  
(b) 13  
(c) 25  
(d) 30  
(e) none of these

Problem 21. If \( 3x + 11 = 6 \), find \( x \). Which of the following statements is true?

(a) \( x < -1 \)  
(b) \( -1 \leq x < 0 \)  
(c) \( 0 \leq x < 1 \)  
(d) \( x \geq 1 \)  
(e) none of these
Problem 22. If $3x - 2 = -9$, find $x$. Which of the following statements is true?
(a) $x < -1$  
(b) $-1 \leq x < 0$
(c) $0 \leq x < 1$  
(d) $x \geq 1$
(e) none of these

Problem 23. If $-4x + 5 = 8$, find $x$. Which of the following statements is true?
(a) $x < -1$  
(b) $-1 \leq x < 0$
(c) $0 \leq x < 1$  
(d) $x \geq 1$
(e) none of these

Problem 24. If $x + 7 = -4x + 9$, find $x$. Which of the following statements is true?
(a) $x < -1$  
(b) $-1 \leq x < 0$
(c) $0 \leq x < 1$  
(d) $x \geq 1$
(e) none of these

Problem 25. If $2x - 4 = 5x + 7$, find $x$. Which of the following statements is true?
(a) $x < -1$  
(b) $-1 \leq x < 0$
(c) $0 \leq x < 1$  
(d) $x \geq 1$
(e) none of these

Problem 26. If $-3x - 5 = 2x - 11$, find $x$. Which of the following statements is true?
(a) $x < -1$  
(b) $-1 \leq x < 0$
(c) $0 \leq x < 1$  
(d) $x \geq 1$
(e) none of these

Problem 27. If $PV = nRT$, find $P$.
(a) $P = \frac{V}{nRT}$  
(b) $P = \frac{nRT}{V}$
(c) $P = V - nRT$  
(d) $P = nRT - V$
(e) none of these

Problem 28. If $PV = nRT$, find $T$.
(a) $T = \frac{nR}{PV}$  
(b) $T = \frac{PV}{nR}$
(c) $T = nR - PV$  
(d) $T = PV - nR$
(e) none of these
Problem 29. If \( v = v_0 + at \), find \( v_0 \).

(a) \( v_0 = \frac{v}{at} \)  
(b) \( v_0 = -\frac{v}{at} \)  
(c) \( v_0 = v + at \)  
(d) \( v_0 = v - at \)  
(e) none of these

Problem 30. If \( v = a(t - t_0) \), find \( t \).

(a) \( t = \frac{a - v}{t_0} \)  
(b) \( t = \frac{v + at_0}{a} \)  
(c) \( t = v - at_0 \)  
(d) \( t = v + at_0 \)  
(e) none of these

Problem 31. If \( x = a(t - t_0) \), find \( t_0 \).

(a) \( t_0 = \frac{at - x}{a} \)  
(b) \( t_0 = \frac{x + at}{a} \)  
(c) \( t_0 = \frac{x - t}{a} \)  
(d) \( t_0 = \frac{x + t}{a} \)  
(e) none of these

Problem 32. For the following pair of equations, find \( x \) and \( y \):

\[
\begin{align*}
6x - y &= -12 \\
-5x + 2y &= -4
\end{align*}
\]

What is the product \( xy \)?

(a) \( xy = -48 \)  
(b) \( xy = -60 \)  
(c) \( xy = 48 \)  
(d) \( xy = 60 \)  
(e) none of these

Problem 33. For the following pair of equations, find \( x \) and \( y \):

\[
\begin{align*}
x + 3y &= -1 \\
-2x - 5y &= 5
\end{align*}
\]

What is the product \( xy \)?

(a) \( xy = 24 \)  
(b) \( xy = 30 \)  
(c) \( xy = -24 \)  
(d) \( xy = -30 \)  
(e) none of these
Problem 34. Solve the equation: \( x^2 + 4x - 21 = 0 \). There are two solutions, \( x_1 \) and \( x_2 \), with \( x_1 \geq x_2 \). (It is possible that \( x_1 = x_2 \).) What is the difference \( x_1 - x_2 \)?

(a) \( x_1 - x_2 = 0 \)  
(b) \( x_1 - x_2 = 4 \)  
(c) \( x_1 - x_2 = 10 \)  
(d) \( x_1 - x_2 = 17 \)  
(e) none of these

Problem 35. Solve the equation: \( 3x^2 - 3x = 1 \)

(a) \( x = \frac{3 \pm \sqrt{3}}{2} \)  
(b) \( x = \frac{3 \pm \sqrt{21}}{6} \)  
(c) \( x = \frac{1}{3} \) or \( x = 1 \)  
(d) No real solution  
(e) none of these

Problem 36. Solve the equation: \( 2x^2 - 5x = -1 \)

(a) No real solution  
(b) \( x = \frac{5 \pm \sqrt{17}}{4} \)  
(c) \( x = \frac{-5 \pm \sqrt{33}}{2} \)  
(d) \( x = \frac{-2 \pm \sqrt{23}}{2} \)  
(e) none of these

Problem 37. Solve the equation: \( 3x^2 - 4x = 7 \). There are two solutions, \( x_1 \) and \( x_2 \), with \( x_1 \geq x_2 \). (It is possible that \( x_1 = x_2 \).) What is the difference \( x_1 - x_2 \)?

(a) \( x_1 - x_2 = 0 \)  
(b) \( x_1 - x_2 = \frac{1}{3} \)  
(c) \( x_1 - x_2 = \frac{4}{3} \)  
(d) \( x_1 - x_2 = \frac{10}{3} \)  
(e) none of these

Problem 38. In the physics lab, you find two circular pieces of sheet metal. The radius of one of the circles is 5 centimeters greater than the radius of the other. The area of the larger circle is three times the area of the smaller one. Which of the following equations describes the radius of the smaller circle?

(a) \( r^2 - 10r + 25 = 0 \)  
(b) \( 2r^2 - 10r - 25 = 0 \)  
(c) \( r^2 - 5r + 10 = 0 \)  
(d) \( 3r^2 + 5r - 10 = 0 \)  
(e) none of these
Problem 39. You go on a ten-mile bicycle ride. You ride the first nine miles at 15 miles per hour; but then you get a flat tire and have to walk your bike the remaining mile at 3 miles per hour. What is your average speed for the trip?

(a) 5 miles per hour  
(b) 9 miles per hour  
(c) \( \frac{5}{7} \) miles per hour  
(d) \( \frac{13}{5} \) miles per hour  
(e) none of these

Problem 40. A boat moves at 5 miles per hour in still water. It is launched in a river that flows at 3 miles per hour. From its launch point, it goes downstream for 4 miles, then turns around and comes back upstream to the launch point. How long does the round trip take?

(a) \( \frac{4}{5} \) hours  
(b) \( \frac{8}{5} \) hours  
(c) 2 hours  
(d) \( \frac{5}{2} \) hours  
(e) none of these

Problem 41. An airplane flies at a speed of 80 miles per hour in still air. On a day when the wind is blowing from the north at 20 miles per hour, the airplane flies 200 miles straight north, then turns around and returns to its starting point. What is its average speed on the round trip?

(a) 64 miles per hour  
(b) \( 66\frac{2}{3} \) miles per hour  
(c) 75 miles per hour  
(d) 80 miles per hour  
(e) none of these

Problem 42. A runner and a bicyclist start from the same point at the same time, with the runner going straight north and the bicyclist going straight south. The bicyclist is 7 miles per hour faster than the runner. At the end of two hours, the two are 60 miles apart. What is the bicyclist’s speed?

(a) \( 11\frac{1}{2} \) miles per hour  
(b) 14 miles per hour  
(c) \( 18\frac{1}{2} \) miles per hour  
(d) 23 miles per hour  
(e) none of these
Problem 43. You drive from Smithtown to Jonesville at a speed of \( v \), making the trip in time \( t \). On the return trip, you are able to drive 10 miles per hour faster, which shortens your travel time by one hour. Which of the following equations is true?

(a) \((v - 10)t = v(t + 1)\)
(b) \((v + 10)t = v(t - 1)\)
(c) \((v - 10)(t + 1) = vt\)
(d) \((v + 10)(t - 1) = vt\)
(e) none of these

Graphs

Problem 44. The graph at right shows four points labelled with letters. Which of the four points is \((2, -5)\)?

(a) \(A\)  (b) \(B\)
(c) \(C\)  (d) \(D\)

Problem 45. The graph at right shows four points labelled with letters. The points are

\((2, 2), (3, 9), (7, 2), \text{ and } (8, 8).\)

Which of the four points is \((2, 2)\)?

(a) \(A\)  (b) \(B\)
(c) \(D\)  (d) \(C\)

Problem 46. Which equation is shown on the graph at right? (The scale is the same for the \(x\)- and \(y\)-axes.)

(a) \(y = 3x\)
(b) \(y = -3x\)
(c) \(y = \frac{x}{3}\)
(d) \(y = -\frac{x}{3}\)
Problem 47. Which equation is shown on the graph at right?
(a) \( y = x^2 + 1 \)
(b) \( y = x^2 - 1 \)
(c) \( y = -x^2 + 1 \)
(d) \( y = -x^2 - 1 \)

Problem 48. Which equation is shown on the graph at right?
(a) \( y = x^2 + 1 \)
(b) \( y = x^2 - 1 \)
(c) \( y = -x^2 + 1 \)
(d) \( y = -x^2 - 1 \)

Problem 49. Which equation is shown on the graph at right?
(a) \( y = x^2 + 1 \)
(b) \( y = x^2 - 1 \)
(c) \( y = -x^2 + 1 \)
(d) \( y = -x^2 - 1 \)
Problem 50. The four graphs (a), (b), (c), and (d) below are all drawn on the same scale. They represent four different equations:

\[ y = 2x^2 \quad y = \frac{x^2}{2} \quad y = -2x^2 \quad y = -\frac{x^2}{2} \]

Which of the four graphs represents \( y = -2x^2 \)?