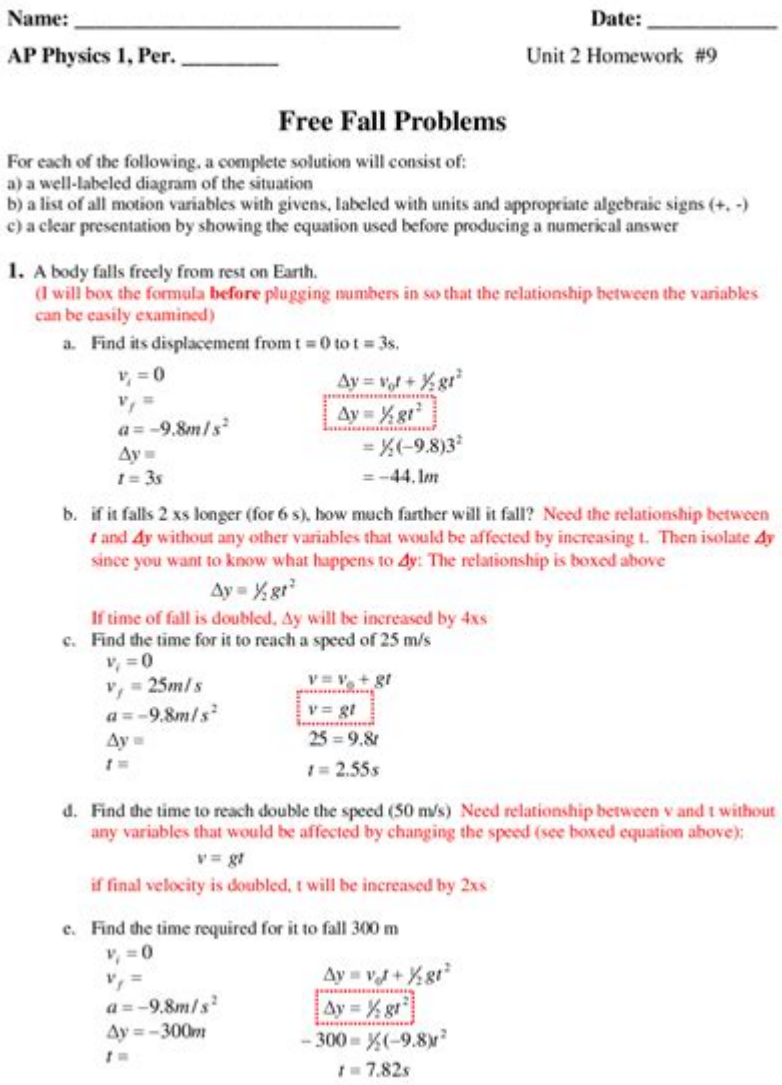
Free Fall Problems Worksheet With Answers



Name: _____ **Date:** _____

AP Physics 1, Per. _____ Unit 2 Homework #9

Free Fall Problems

For each of the following, a complete solution will consist of:
a) a well-labeled diagram of the situation
b) a list of all motion variables with givens, labeled with units and appropriate algebraic signs (+, -)
c) a clear presentation by showing the equation used before producing a numerical answer

1. A body falls freely from rest on Earth.
(I will box the formula **before** plugging numbers in so that the relationship between the variables can be easily examined)

a. Find its displacement from t = 0 to t = 3s.

$v_i = 0$
$v_f =$
$a = -9.8m/s^2$
$\Delta y =$
$t = 3s$

$\Delta y = v_0 t + \frac{1}{2} g t^2$
$\boxed{\Delta y = \frac{1}{2} g t^2}$
$= \frac{1}{2}(-9.8)3^2$
$= -44.1m$

b. if it falls 2 xs longer (for 6 s), how much farther will it fall? Need the relationship between t and Δy without any other variables that would be affected by increasing t. Then isolate Δy since you want to know what happens to Δy: The relationship is boxed above

$\Delta y = \frac{1}{2} g t^2$

If time of fall is doubled, Δy will be increased by 4xs

c. Find the time for it to reach a speed of 25 m/s

$v_i = 0$
$v_f = 25m/s$
$a = -9.8m/s^2$
$\Delta y =$
$t =$

$v = v_0 + gt$
$\boxed{v = gt}$
$25 = 9.8t$
$t = 2.55s$

d. Find the time to reach double the speed (50 m/s) Need relationship between v and t without any variables that would be affected by changing the speed (see boxed equation above):

$v = gt$

if final velocity is doubled, t will be increased by 2xs

e. Find the time required for it to fall 300 m

$v_i = 0$
$v_f =$
$a = -9.8m/s^2$
$\Delta y = -300m$
$t =$

$\Delta y = v_0 t + \frac{1}{2} g t^2$
$\boxed{\Delta y = \frac{1}{2} g t^2}$
$-300 = \frac{1}{2}(-9.8)t^2$
$t = 7.82s$

Free fall problems worksheet with answers is an essential resource for students and educators in understanding the principles of free fall in physics. This topic is crucial in grasping the concepts of gravity, acceleration, and motion. In this article, we will delve into the basics of free fall, present a variety of problems, and provide detailed answers to help learners enhance their understanding of the subject.

Understanding Free Fall

Free fall refers to the motion of a body where gravity is the only force acting upon it. When an object is in free fall, it experiences constant acceleration due to gravity, typically denoted as \(g \), which on Earth is approximately \(9.81 \, \text{m/s}^2 \). This means that the velocity of the object increases by about \(9.81

\, \text{m/s} \) each second during its descent.

The Physics Behind Free Fall

In free fall, the following equations of motion are commonly used:

1. Velocity:
\[
v = u + gt
\]
where:
- \(v \) = final velocity
- \(u \) = initial velocity (0 m/s if dropped)
- \(g \) = acceleration due to gravity (\(9.81 \, \text{m/s}^2 \))
- \(t \) = time in seconds

2. Displacement:
\[
s = ut + \frac{1}{2}gt^2
\]
where:
- \(s \) = distance fallen

3. Final Velocity Squared:
\[
v^2 = u^2 + 2gs
\]

These equations are foundational for solving free fall problems and can help students find various unknowns when given certain initial conditions.

Free Fall Problems Worksheet

To assist students in practicing free fall concepts, we will present a series of problems along with their answers. Each problem will encourage critical thinking and application of the equations of motion.

Problem Set

1. Problem 1: An object is dropped from a height of 20 meters. How long does it take to hit the ground?

2. Problem 2: A rock is thrown downward with an initial velocity of $5 \, \text{m/s}$ from a height of $10 \, \text{m}$. How far does it fall in $2 \, \text{s}$?

3. Problem 3: A stone is dropped from a height of $45 \, \text{m}$. What will be its velocity just before it hits the ground?

4. Problem 4: An object falls freely for $3 \, \text{s}$. How far does it fall during this time?

5. Problem 5: A ball is thrown upwards with an initial velocity of $15 \, \text{m/s}$. How high does it rise before it starts to fall back down?

Answers to the Free Fall Problems

Here are the solutions to the problems presented above:

Solution to Problem 1

To find the time taken to hit the ground, we use the second equation of motion:

$$
s = ut + \frac{1}{2}gt^2
$$

Given:
- $s = 20 \, \text{m}$
- $u = 0 \, \text{m/s}$ (since it is dropped)

Substituting the values:

$$
20 = 0 \cdot t + \frac{1}{2}(9.81)t^2
$$

$$
20 = 4.905t^2
$$

$$
t^2 = \frac{20}{4.905} \approx 4.07
$$

$$
t \approx 2.02 \, \text{s}
$$

Time taken to hit the ground is approximately $2.02 \, \text{s}$.

Solution to Problem 2

Using the second equation of motion:

$$
s = ut + \frac{1}{2}gt^2
$$

Given:
- $u = 5 \, \text{m/s}$
- $t = 2 \, \text{s}$

Substituting the values:

$$
s = (5)(2) + \frac{1}{2}(9.81)(2^2)
$$

$$
s = 10 + \frac{1}{2}(9.81)(4) = 10 + 19.62 = 29.62 \, \text{m}
$$

The rock falls $29.62 \, \text{m}$ in 2 seconds.

Solution to Problem 3

Using the third equation of motion:

$$
v^2 = u^2 + 2gs
$$

Given:
- $u = 0 \, \text{m/s}$
- $s = 45 \, \text{m}$

Substituting the values:

$$
v^2 = 0 + 2(9.81)(45)
$$

$$
v^2 = 882.9
$$

$$
v = \sqrt{882.9} \approx 29.7 \, \text{m/s}
$$

The velocity just before it hits the ground is approximately $29.7 \, \text{m/s}$.

Solution to Problem 4

Using the second equation of motion:

$$
s = ut + \frac{1}{2}gt^2
$$

Given:
- $u = 0 \, \text{m/s}$
- $t = 3 \, \text{s}$

Substituting the values:

$$
s = 0 + \frac{1}{2}(9.81)(3^2)
$$

$$
s = \frac{1}{2}(9.81)(9) = 44.145 \, \text{m}
$$

The object falls $44.145 \, \text{m}$ in 3 seconds.

Solution to Problem 5

Using the first equation of motion to find the maximum height:

At the maximum height, the final velocity $v = 0$.

$$
v = u + gt
$$

Setting $v = 0$:

$$
0 = 15 - 9.81t
$$

$$
t \approx \frac{15}{9.81} \approx 1.53 \, \text{s}
$$

Now, using this time to find the height:

$$
s = ut + \frac{1}{2}gt^2
$$

Substituting the values:

$$
s = (15)(1.53) + \frac{1}{2}(-9.81)(1.53^2)
$$

Calculating:

$$
s \approx 22.95 - 11.36 \approx 11.59 \, \text{m}
$$

The ball rises to a height of approximately $11.59 \, \text{m}$ before falling back down.

Conclusion

The free fall problems worksheet with answers provides a structured approach to understanding the principles of free fall motion. By working through these problems and their solutions, students can reinforce their understanding of the physics involved, preparing them for more complex concepts in kinematics and dynamics. Mastery of free fall not only serves as a foundation for further studies in physics but also enhances critical thinking and problem-solving skills essential in scientific inquiry.

Frequently Asked Questions

What is a free fall problem in physics?

A free fall problem involves an object falling under the influence of gravity alone, without any air resistance or other forces acting on it.

How can I create a free fall problems worksheet?

You can create a worksheet by including various problems that ask for calculations of distance fallen, time of fall, and final velocity using the equations of motion under gravity.

What equations are commonly used in free fall problems?

Common equations include: d = 1/2 g t^2 (distance), v = g t (final velocity), and v^2 = 2gd (using initial velocity as zero). Here, g is the acceleration due to gravity.

Where can I find free fall problems worksheets with answers?

You can find worksheets online on educational websites, in physics textbooks, or through educational resources like Khan Academy or Teachers Pay Teachers.

What are some examples of free fall problems?

Examples include calculating how long it takes for an object to hit the ground from a certain height or finding the speed of an object just before impact.

How do I check my answers for free fall problems?

To check your answers, you can use the same equations involved in the problems or refer to provided answer keys if available on the worksheet.

Free Fall Problems Worksheet With Answers

Create a Gmail account - Google Help
Create an account Tip: To use Gmail for your business, a Google Workspace account might be better for you than a personal Google Account. With Google Workspace, you get increased storage, professional email addresses, and additional features. Learn about Google Workspace pricing and plans. Try Google Workspace The username I want is taken

Download Chrome - Google Help
On your iPhone or iPad, open App Store. In the search bar, enter Chrome. Tap Get. To install, follow the on-screen instructions. If prompted, enter your Apple ID password. To start browsing, tap Open. To open Chrome from your Home screen, tap Chrome .

Gmail Help
Official Gmail Help Center where you can find tips and tutorials on using Gmail and other answers to frequently asked questions.

Google Help
If you're having trouble accessing a Google product, there's a chance we're currently experiencing a temporary problem. You can check for outages and downtime on the Google Workspace Status Dashboard.

Download and install Google Chrome
How to install Chrome Important: Before you download, you can check if Chrome supports your operating system and other system requirements.

Create a Google Account - Computer - Google Account Help
You can search for “free email providers” to find another email provider you like and set up an account. Once you create a new email address, you can use that to set up a Google Account.

Google Translate Help
Official Google Translate Help Center where you can find tips and tutorials on using Google Translate and other answers to frequently asked questions.

知乎 - 有问题，就会有答案
知乎，中文互联网高质量的问答社区和创作者聚集的原创内容平台，于 2011 年 1 月正式上线，以「让人们更好的分享知识、经验和见解，找到自己的解答」为品牌使命。知乎凭借认真、专业、友善的社区氛围、独特的产品机制以及结构化和易获得的优质内容，聚集了中文互联网科技、商业、 ...

有什么可以免费追剧的**app**? - 知乎
知乎，中文互联网高质量的问答社区和创作者聚集的原创内容平台，于 2011 年 1 月正式上线，以「让人们更好的分享知识、经验和见解，找到自己的解答」为品牌使命。知乎凭借认真、专业、友善的社区氛围、独特的产品机制以及结构化和易获得的优质内容，聚集了中文互联网科技、商业、 ...

Find the Google Play Store app
On your device, go to the Apps section. Tap Google Play Store . The app will open and you can search and browse for content to download.

Create a Gmail account - Google Help
Create an account Tip: To use Gmail for your business, a Google Workspace account might be better for you than a personal Google Account. With Google Workspace, you get increased ...

Download Chrome - Google Help
On your iPhone or iPad, open App Store. In the search bar, enter Chrome. Tap Get. To install, follow the on-screen instructions. If prompted, enter your Apple ID password. To start …

Gmail Help
Official Gmail Help Center where you can find tips and tutorials on using Gmail and other answers to frequently asked questions.

Google Help
If you're having trouble accessing a Google product, there's a chance we're currently experiencing a temporary problem. You can check for outages and downtime on the Google Workspace …

Download and install Google Chrome
How to install Chrome Important: Before you download, you can check if Chrome supports your operating system and other system requirements.

Create a Google Account - Computer - Google Account Help
You can search for “free email providers” to find another email provider you like and set up an account. Once you create a new email address, you can use that to set up a Google Account.

Google Translate Help
Official Google Translate Help Center where you can find tips and tutorials on using Google Translate and other answers to frequently asked questions.

知乎 - 有问题，就会有答案
知乎，中文互联网高质量的问答社区和创作者聚集的原创内容平台，于 2011 年 1 月正式上线，以「让人们更好的分享知识、经验和见解，找到自己的解答」为品牌使命。知乎凭借认真、专业 …

有什么可以免费追剧的app? - 知乎
知乎，中文互联网高质量的问答社区和创作者聚集的原创内容平台，于 2011 年 1 月正式上线，以「让人们更好的分享知识、经验和见解，找到自己的解答」为品牌使命。知乎凭借认真、专业 …

Find the Google Play Store app
On your device, go to the Apps section. Tap Google Play Store . The app will open and you can search and browse for content to download.