Calculations On Motion Under Gravity

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http://waponpoint.com/calculations-on-motion-under-gravity/

Last class we talk and explain deeply on motion under the influence of gravity, and we set proposed class session to solve examples and do some calculations on motion under gravity.
So let get started, shall we?
We should be able to take five or more examples but shouldn't be less, have you get paper and a pen besides you, and yea, a calculator. So leeettgoooo

Calculations On Motion Under Gravity

Question 1

A tennis ball is thrown vertically upward from the ground with a velocity of 75m/s. Calculate the maximum height reached, the time to reach the maximum height and the time of flight of the ball.

Solution

First, how many questions are we ask to calculate? Yea, 3, so let list the questions and next the parameters given.

Calculate:
a] The maximum height reached,
b] The time to reach the maximum height and,
c] The time of flight.

Parameters:
Initial velocity, u = 75m/s
From our last class session on physics, what do we say happens when an object is moving upward?

If you have forgotten or you are a new candidates, well, let me quickly remind you.

Gravity always act downward, so when an object is moving upward, that is, in upward direction, the acceleration of the upward moving object is moving in opposite direction of acceleration due to gravity. That is, acceleration due to gravity is coming down and acceleration of the moving upward object is moving upward, hence, **a negative sign comes in.**

That is,
Acceleration of the moving upward object = ? Acceleration due to gravity (because of the retarding effect of gravity as the object rises).

Hence, our overall parameters becomes, u = 75m/s g = ?10m/s²

Note : the negative sign will not reflect in you solution but only if you are using the three equations of motion under the influence of gravity

a] calculate the maximum height reached?
At maximum height reached:
Final velocity, v = zero.

Remember the formula for solving maximum height reached as:

h = u² 2gh = (75)² 2 × 10h = 5625 20h = 281.25
Approximately, h = 281.3m
Ans = 281.25m or 281.3m.

Question b
b] calculate the time to reach the maximum height?
Time to reach the maximum height is calculated by:

t = u gt = 75 10t = 7.5s

Question c,
c] Calculate the time of flight?

As it has already been explain during our last session that, *time of flight* **is two times the time to reach maximum height**.

So as a sharp candidate, you've already know the answer, but yes, I will still explain.

Time of flight, **T** = 2 × time to reach maximum height, **t**
T = 2t
So basically, T = 2 × 7.5
T = 15s

Or

T = 2t

T = 2 × u gT = 2 × 75 10T = 75 5

T = 15sThe second method, will be like you're just stressing yourself, especially if you are doing

objective examination such as jamb. And even if it is theory examination, the first method is okay, using the second method is like wasting your time and your sheet paper, but it for better understanding. #Using long processes to solve issues take a while, but thus introduces more ideas#

That is our first question, like four more to go, so don't let us waste time atall, afterall, we call this class session, "calculations on motion under gravity. So number 2:

Question 2

A bullet is fired horizontally with a velocity of 60m/s from the top of a building 80m high. Calculate, how far from the foot of the building will the bullet be assumed to touch ground.

Solution

What do you do first? Yes, you write out the given parameters.
I don't need to remind or tell you that whenever acceleration due to gravity is not given, you should assume 10m/s, not 9.8m/s. **Only use 9.8m/s, *only when it is given*: because in most cases, 9.8 always leads to decimal answer.**

u = 60m/s, h = 80m

From the question you are asked to calculate "how far from the foot of the building will the bullet be assumed to touch ground" - that is simply the definition for ***Range* of projectile**

What is the formula for Range?

Yea, $h = ½gt^2$, and we have h = 80m, g = 10 m/s^2 and t =?

So our first calculation is to calculate **t,** {time taken to reach the ground} from the given parameters so that we could use the *time taken,* **t** to calculate **The Range**

So therefore,

t = ?2h gt = ?2 × 80 10t = ?160 10t = ?16t = 4sNow we can calculate **The Range**

The Range = $h = ½gt^2$
$h = ½gt^2$
$h = ½ \times 10 \times 4^2$
$h = ½ \times 10 \times 16$
$h = ½ \times 160$
h = 80m

Hence, **The Range** = 80m

Question 3

A stone is thrown horizontally with a velocity of 9m/s² from a height of 95m. Calculate the speed at which the stone hits the ground.

Solution 3

A brilliant candidate should have already know what we are asked to calculate, yea, it is the *final velocity of the stone*. Take g = 10m/s²
Now write out your given parameters:

Height of projection, **h** = 95m
Horizontal velocity of projection, **u** = 9m/s², v = ? and g = 10m/s².

Note : the stone is thrown *horizontally*, hence, **g = +positive** {I believed I explained this deeply during last class

To solve this question, we use the third equation of motion:

$v^2 = u^2 \pm 2gh$
$v^2 = (9)^2 + 2 \times 10 \times 95$
$v^2 = 81 + 2 \times 950$
$v^2 = 81 + 1900$
$v^2 = 1981$
$v = ?1981$
$v = 45.508$
$v = 45.51m/s$
Ans = 44.51m/s

Question 4

A smooth object slides down an inclined plane at an angle 60° to the horizontal.

a] Calculate the components of the acceleration of the object,

1} along the inclined plane,

2} perpendicular to the planeb] Calculate the velocity of the object at the base of the plane after 10s,

c] Calculate the vertical height of fall, assuming g = 10m/s².

Solution

Always write out the parameters first:
Angle of inclination of plane, **?** = 60°
Time taken to slide down the inclined plane, **t** = 10s

Let **gx** represents the component of **g** along the plane, and
Let **gy** represents the component of **g** perpendicular to the plane.{from the diagram above}

So the first question,
a1} Calculate the components of acceleration of the object along the inclined plane
gx = g sin ?
= 10 sin 60
= 10 × 0.866
= 8.67m/s²

a2} Calculate components of the acceleration of the object perpendicular to the plane.
gy = g cos ?
= 10 cos 60
= 10 × 0.5
= 5m/s²

You might not understand what I just did above, well let me quickly explain:
You see, in physics, under forces there is a sub-topic called, **resultant of forces** {we haven't treated this aspect yet}, but the key points you need to know is that. **Whenever you are resulting a force to the horizontal: you'll use *cos* and whenever you are resulting a force to vertical: you'll use *sin***, I will explain better next class.

So question b,
b} Calculate the velocity of the object at the base of the plane after 10s.

Let velocity at the base of the plane = v
The formula to use is, $v = gxt$, how?

acceleration, **a** = ?v t
And since we are dealing with only one velocity then:

a = v t
Cross multiply: $v = at$
And acceleration = acceleration at the base **gx**
a = gx
Then,
v = gxt
v = 8.67 × 10
= 86.7m/s²

c} Calculate the vertical height of the fall.

I believed you still remember this formula from our last class

h = v² 2g

$= 86.7^{2}2 \times 10$

$= 7516.8920$

$h = 375.84$

$h = 375.8m$

One more question and we are done for today.

Question 5

A ball is projected at an angle of elevation of 30° with an initial velocity of 10m/s.
Calculate:
a} The time of flight
b} Maximum height attained and
c} The range.

Solution

Initial velocity, u = 10m/s, angle of projection 20°.

a} Calculate the time of flight

Time of flight = 2u sin ? g

$= 2 \times 10 \sin 3010$

$= 2 \times 10 \times 0.5\ 10$

Time of flight = 1s.

b} Calculate the maximum height, h attained.

maximum height, $h = u^{2} \sin^{2}?$ 2g

$h = 10^{2} \sin^{2}30$ 2×10

$h = 100 \times (0.5)^{2}20$

$h = 100 \times 0.2520$

h = 25 20

h = 1.25mc} Calculate the range,

The range, $R = u^2 \sin 2?\ g$

$R = 10^2 \sin 2 \times 3010$

$R = 100 \sin 60\ 10$

$R = 100 \times 0.86610$

$R = 86.6\ 10$

8.66m

Voilla !!!, we just come to the end, I think those five questions are enough for you to understand.

wait wait Wait!!!! Where do you think you are going? C'mon, of course I have questions for you too or do you just want to read calculations on motion under gravity without questions for you to solve, you must be joking, c'mon sit down and solve this question for me.

Question 1

A bullet is fired at an angle of 45° to the horizontal with a velocity of 490m/s.

Calculate,
a} the time taken to reach maximum height.
Options a) 0.345s b) 48s c) 4.8s d) 34.6s e) 3.54s

b} the maximum height attained
Options a) 610000 b) 61000 c) 600 d) 61200 e) 6000

c} the horizontal distance (range) from the point of projection.
Options a) 0.0243 b)0.00242 c) 24000 d) 243 e) 2400

And now you are free to go and Join other classes but before you go, answer my question via the comment box or send me a private message{just register and you will be able to}, hit the share button and spread the word. ... hi John, have you read calculations on motion under gravity on waponpoint.com, if you haven't quickly go there now, thanks. Always write a comment please.
