Baptist Lui Ming Choi Secondary School
F. 6 Physics (Gravitational Field 1: Projectile orbits and Satellite Orbits)
WORKSHEET

Name : ___________________
Class : F. 6 ____ ( ) Grade : __________

PROJECTILE ORBITS AND SATELLITE ORBITS

(A) **Apple and the Moon**
An apple will accelerate towards the Earth (i.e. downwards) when it falls freely on the Earth's surface. However, the Moon continues to rotate about the Earth without crushing onto it. ***Why? Are the forces acting on that apple and the Moon the same in nature? Or not?***

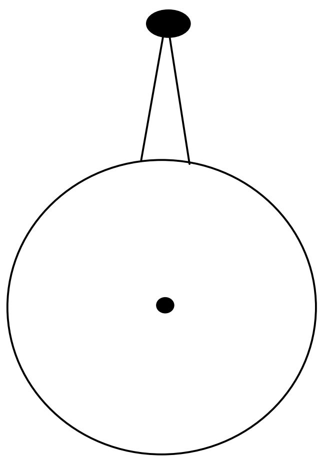
You may know the answer after you've finished part (B).

(B) Now, consider a stone is projected horizontally at the top of a very high tower (68375 km high) with different initial speed. We are going to look at the path of the motion for different initial velocity.

Go to the website http://drive.to/PhysicsSpace > Multimedia Notes > F. 6 > Projectile and Satellite Orbits

Vary the speed by pressing "+" or "-" and press start to see the motion of the stone.
For v_1 = 1581 ms^{-1}, v_2 = 2372ms^{-1}, v_3 = 3163 ms^{-1}, v_4 = 3953 ms^{-1}, and so on, observe the paths of motion.

1. Draw the motions for v_1, v_3, v_7, v_8, v_9 and v_{11} (with labels) on the following diagram.



2. The motion of stone with speed(s) (v_1, v_5, v_7, v_{11})______________________are parabolic.

3. Which stone (v_7, v_8 or v_9) start to go around without striking the ground?

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4. Which stone is moving in a circular orbit? ______________________

The path of motions differed for different speed of projectile . How to explain these motions with the aids of Newton's 2nd law of motion.

5. Consider the stone is projected with v_1 and v_{10}, draw the free body diagram just after it is projected at the top of the tower in the two cases. Label the force(s).

$v = v_1$	$v = v_{10}$

6. For $v = v_1$, the magnitude of velocity is (increasing / decreasing / uniform) __________________ and the direction is (changing / constant) ________________.

   For $v = v_{10}$, the magnitude of velocity is (increasing / decreasing / uniform)__________________ and the direction is (changing / constant) ________________.

7. With the free body diagrams drawn in (5), try to explain the motions by Newton's law of motion.

   The path of the stone with speed v_1 is a ______________________, the net force acting on it is to change the _________________ and _________________ of the stone. However, the path of the stone with speed v_{10} is a _________________________, the net force acting on it is to change the ______________________ of it only.

SUMMARY

The forces acting on a dropping apple on the Earth's surface and the Moon in orbit of the Earth are _______________. The force on the former object is to ____________________________________ and the force on the latter one is to __________________________________. These forces are the weight and also known as ____________________________.

Also, the path of motion highly depends on the _______________ of the projected object.

(C) More about the path of motion

If the mass of the Earth is considered to be concentrated at the center of it (please press "full" once to choose it), then, observe the full motion of the object without any blocking by the solid Earth.

1. It is observed that the projectile motion of the object is actually a part of an __________________ motion.

2. For v_1 to v_7, observe the change in speed throughout the motion. The speed is (increasing / decreasing) _____________________ while it is moving near to the earth's center. This can be explained by the fact that the angular momentum of the stone about the earth's center is (conserved / not conserved) _______________ as there is no net torque acting on it (the weight is pointing towards the center of the Earth.) i.e. angular momentum L = _____________

   The greater the distance from the center of the Earth, the (larger / smaller) _____________ the speed is.

3. Adjust the speed to v_{13} = 11071 ms^{-1} and then observe the motion. The speed is (increasing / decreasing) ________________________ throughout the motion.

   Will the speed of the stone stop changing after a very long time? What does this mean?

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SUMMARY

A rock thrown from a tall building sails in a modest orbit that soon intersects the earth not far from its point of launch. If the ball were fired more swiftly to start with, it would travel further. Further increasing the speed would result in ever (larger / smaller) ________________, (rounder / flatter) _________________ elliptical paths and more distant impact point. Finally, at one particular launch speed, the ball would glide out just above the planet's surface all the way around to the other side without ever striking the ground.

At successively (greater / smaller) _________________launch speeds, the ball would resolve in ever-increasing elliptical orbit until it moved so (fast / slow) _____________ initially that it sailed off in an open parabolic or into a still flatter, hyperbolic orbit, never come back to its starting point.