p 028, q11

11. An object falling in a vacuum is affected only by the gravitational force. An equation that can model a free-falling object on Earth is $d = -4.9t^2$, where d is the distance travelled, in metres, and t is the time, in seconds. An object free falling on the moon can be modelled by the equation $d = -1.6t^2$.

a) Sketch the graph of each function.

b) Compare each function equation to the base function $d = t^2$.

$d_1(x)$

$d_2(x)$

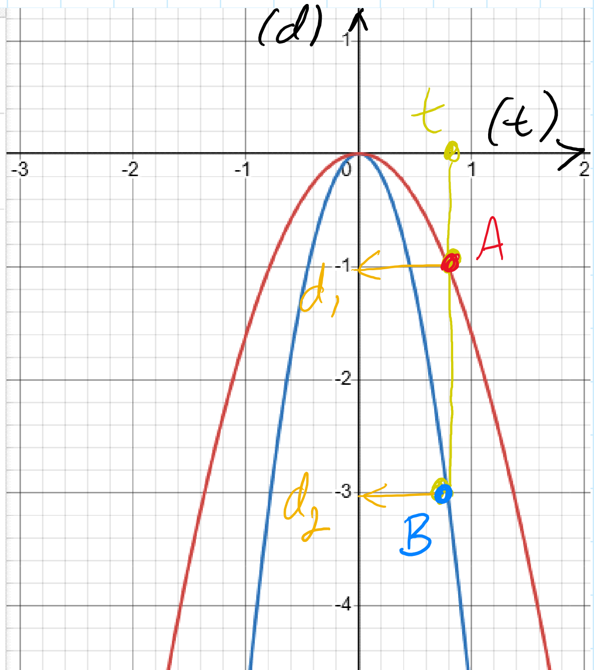
https://www.desmos.com/calculator/r1f1adwezp

a)

1 $d_1(x) = -4.9x^2$

2 $d_2(x) = -1.6x^2$

3



x acts as the parameter t.

b) parent function $f(t) = t^2$

$d_1(t) = -4.9t^2 = -4.9f(t)$ = a vertical stretch by a factor of 4.9 and a vertical reflection into the x-axis, so that these two can happen in any order.

earth

$d_2(t) = -1.6t^2 = -1.6f(t)$ = a vertical stretch by a factor of 1.6 and a vertical reflection into the x-axis, so that

moon

moon

and a vertical reflection into the x-axis, so that these two can happen in any order.

When comparing the two functions we can look for example at points:

d_2: A on the red graph (moon)

d_1: B " " blue " (earth)

both points were chosen to rest on the same t coordinate: $t_A = t_B$

but the distances d_A, d_B stretch differently: $|d_A| < |d_B|$

moon earth

← we take absolute value b/c we are talking about distances!

Therefore when an object falls on the moon, the distance the object travels is smaller than on earth. Or in transformation-wording: the earth graph is <u>more</u> stretched vertically than the moon one, b/c the distance (i.e. absolute value) is larger in the case of earth.