COLLEGE PHYSICS

Chapter 2 INTRODUCTION: Kinematics in One Dimension

Lesson 6

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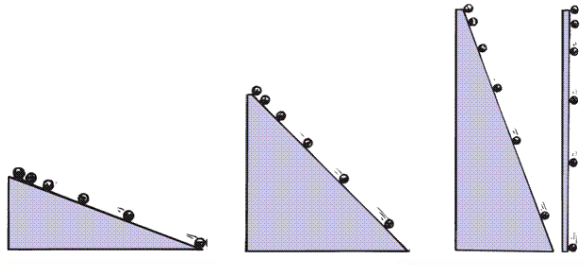
ACCELERATION

- Galileo increased the inclination of inclined planes.
- Steeper inclines give greater accelerations.
- When the incline is vertical, acceleration is maximum, same as that of the falling object.
- When air resistance is negligible, all objects fall with the same unchanging acceleration.



FREE FALL

- Falling under the influence of gravity only - with no air resistance
- Freely falling objects near the surface of the Earth accelerate at the rate of 9.80 m/s/s, i.e., 9.80 m/s^2
- The exact free fall acceleration depends on altitude and latitude on the earth.

FREE FALL

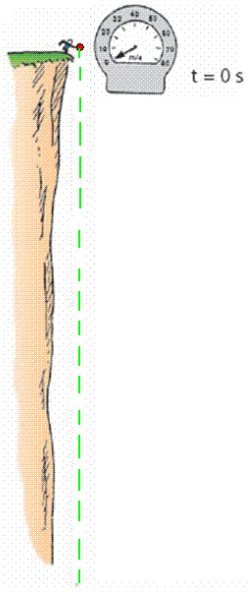
The velocity acquired by an object starting from rest is:

$$v = at$$

So, under free fall, when acceleration is about 10 m/s^2, the speed is approximately:

- 10 m/s after 1 s.
- 20 m/s after 2 s.
- 30 m/s after 3 s.

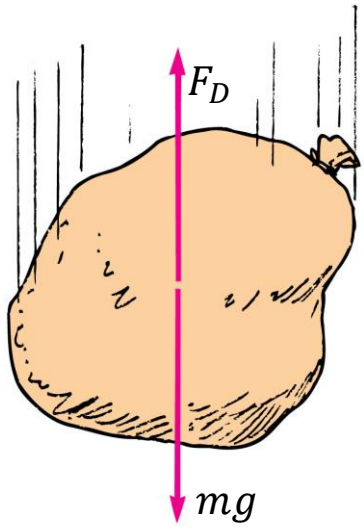
And so on.

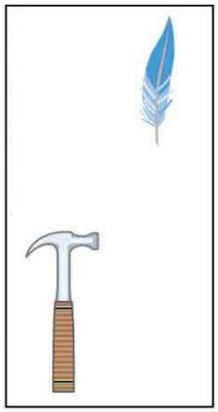


NON-FREE FALL

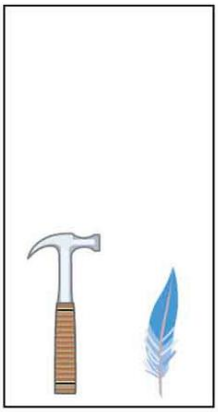
When an object falls downward **through the air** it experiences:

- force of gravity, mg, pulling it downward.
- air drag force, F_D, acting upward.
- F_D depends on the **speed** of the object relative to the air, and the **size** of the object

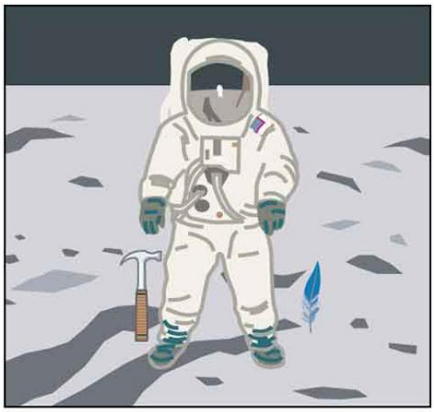




In air

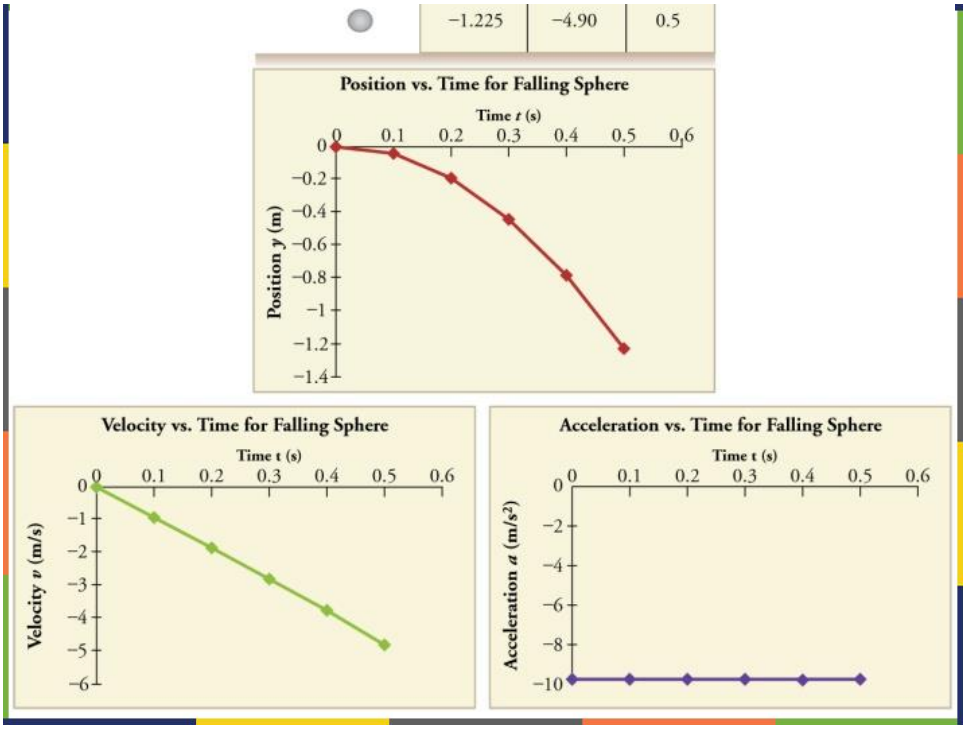


In a vacuum



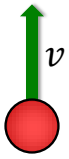
In a vacuum (the hard way)

y (m)	v (m/s)	t (s)
0	0	0
−0.049	−0.98	0.1
−0.196	−1.96	0.2
−0.441	−2.94	0.3
−0.784	−3.92	0.4
−1.225	−4.90	0.5



GIVE IT A TRY!

Jason throws a ball upward, it reaches a maximum height, then falls back down again.



While the ball is going up (after it has left Jason's hand), what is the direction of the acceleration vector of the ball?

A. up.

B. down.

C. zero.

GIVE IT A TRY!

When the ball is momentarily stopped at the top of its path, what is the direction of the acceleration vector of the ball?

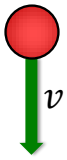
A. up.

B. down.

C. zero.

GIVE IT A TRY!

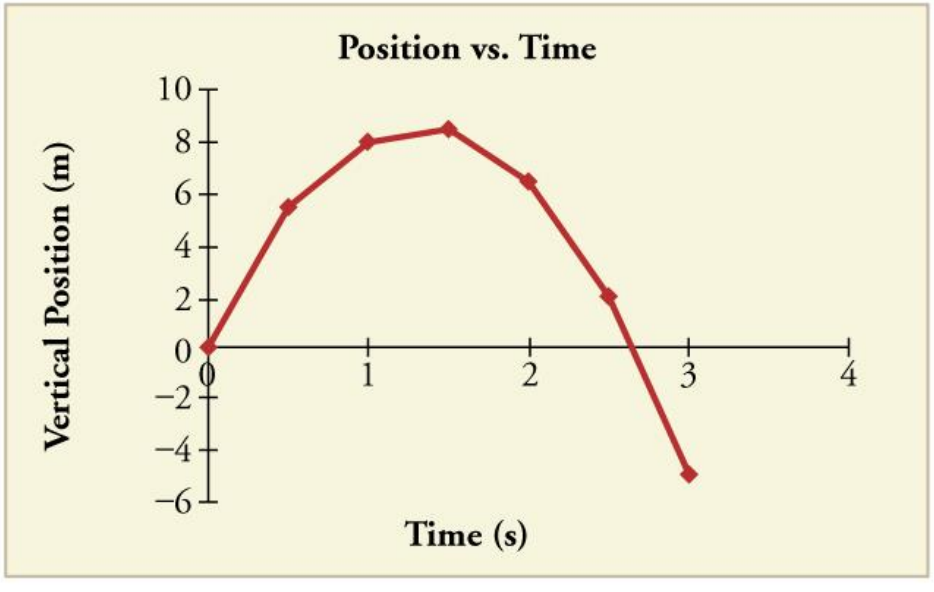
While the ball is going down (but before Jason catches it), what is the direction of the acceleration vector of the ball?

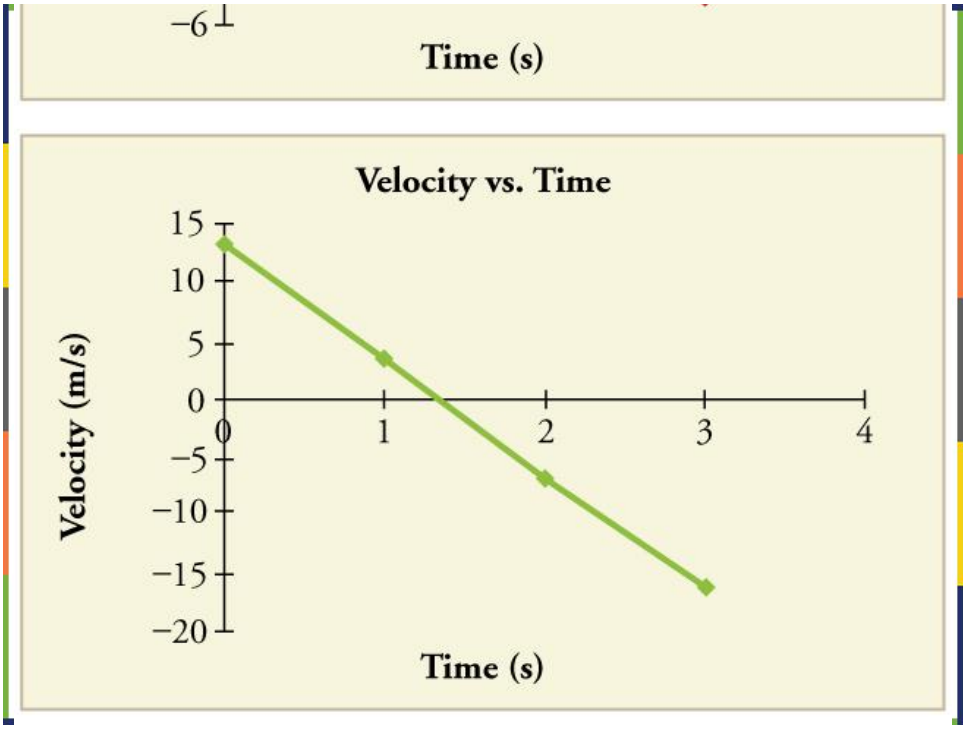


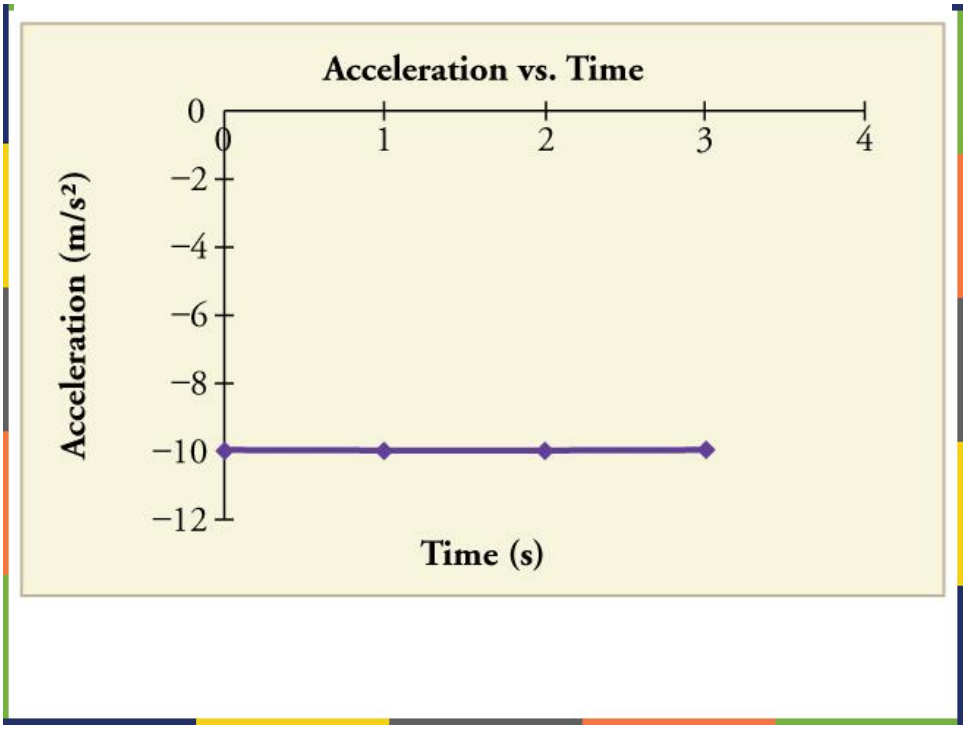
A. up.

B. down.

C. zero.




−6
Time (s)
Velocity vs. Time
15
10
5
0
−5
−10
−15
−20
0
1
2
3
4
Velocity (m/s)
Time (s)


Acceleration vs. Time
0
−2
−4
−6
−8
−10
−12
0
1
2
3
4
Acceleration (m/s²)
Time (s)