A+ Academy – Online Teaching

فيزياء طبية (طب بشري)

Topic: Medical physics (6102111)

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Lecture: (3)

Motion in one dimension Part (3)

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Freely Falling

- A freely falling object is any object moving freely under the influence of gravity alone, regardless of its initial motion.

- The gravitational acceleration is the same for all falling objects, no matter what their size or composition.

- The gravitational acceleration is constant. lt does not change as the object falls.

- We denote the magnitude of the **free-fall acceleration** by the symbol *g*.

Thrown:

1 – up (g = -10 m/s^2).

2– down (g = 10 m/s^2).

$$\Delta\, \boldsymbol{x} \;\rightarrow\; \Delta\, \boldsymbol{y}$$
$$\boldsymbol{a} \;\rightarrow \boldsymbol{g}$$

$V_f = V_i + gt$	(1)
$\Delta y = V_i\, t + \frac{1}{2}\, g\, t^2$	(2)
$V_f^2 = V_i^2 + 2g\Delta y$	(3)
$\bar{V} = \left(\frac{v_f + v_1}{2}\right) = \frac{\Delta y}{\Delta t}$	(4)

1. **For Thrown up (g = -10 m/s^2)**
   I. **From ground to ground.**

- At maximum point the velocity is zero.
- At maximum point the acceleration = g = 10 m/s^2.

- The time needed to reach maximum height. الزمن للوصل الى اقصى ارتفاع

$$t_{up} = \frac{v_i}{10}$$

- Total time = Time to reach the ground = time to complete the whole trip.(الزمن الكلي)

$$t_{total} = 2t_{up}$$

- Maximum height = maximum point

$$\Delta y_{max} = v_i t_{up} + \frac{1}{2} g\, t_{up}^2$$

Ex (1): A stone is thrown up ward from the ground, if it took 14 s to strike back the ground. What is the velocity it was thrown.

Ex (2): A ball is shot up from the ground with 20 m/s. Find

1- The magnitude of the displacement after 1 s.
2- Maximum height.
3- The velocity of the ball just before hitting the ground.

Ex (3): A ball is thrown up with 40 m/s. Find

1- Time needed to reach the maximum point.
2- Maximum height.
3- Total time.
4- Displacement after 3s.
5- The velocity just before hitting the ground.

Ex (4): A ball is thrown up ward from ground and goes its maximum height and return the ground. What is the maximum height, if it took 4 s to complete the whole tripe?
2. Find the velocity just before it hitting the ground.

Ex (5): A ball is thrown vertically upward with speed of 20 m/s.
1. How long dose stay in the air.
2. Find the maximum height.
3. Displacement after 1s.

II. From height (building).

g= -10 m/s^2

- The time needed to reach maximum height. الزمن للوصل الى اقصى ارتفاع

$$t_{up} = \frac{v_i}{10}$$

- Maximum height = maximum point

$$\Delta y_{max} = v_i t_{up} + \frac{1}{2} g\, t_{up}^2$$

- Height of the building (في حال طلب ارتفاع البناية أو الزمن الكلي)
  - $\Delta y = v_i t_{tot} + \frac{1}{2} g\, t_{tot}^2$

- The velocity just before hitting the ground

$V_f = V_i + gt$ (في حال معك الزمن الكلي)

Or

$V_f^2 = V_i^2 + 2g\Delta y$ (في حال معك ارتفاع البناية)

Ex (6): A stone thrown up vertically from the top of bulding100 m with 20 m/s, find.

1- The maximum height from the building.
2- The maximum height from the ground.
3- The velocity just before hitting the ground.

Ex (7): A ball thrown up vertically from the top of building with 10 m/s, if the flight time is 5 s.

1- What is the building height?
2- The velocity just before hitting the ground.

Ex (8): A ball thrown up vertically from the top of building with 12 m/s, from building 80m height.

1- What is the velocity just before hitting the ground.
2- The maximum height from the ground.
3- The flying time.

Ex (9): A stone is thrown vertically upward from 20 m height, with 10 m/s. What is the velocity of the ball when it's at 10 m from the ground?

2. Thrown down (g= +10 m/s^2)

- Height of the building (في حال طلب ارتفاع البناية أو الزمن الكلي)
  - $\Delta y = v_i t_{tot} + \frac{1}{2} g\, t_{tot}^2$

- The velocity just before hitting the ground

$V_f = V_i + gt$ (في حال معك الزمن الكلي)

Or

$V_f^2 = V_i^2 + 2g\Delta y$ (في حال معك ارتفاع البناية)

Ex (10): A stone is thrown down ward from 100 m height with 20 m/s, find

1- The velocity just before hitting the ground.
2- The time needed to reach the ground.

Ex (11): An object is thrown down ward from a building with 10 m/s it took 3 s to reach the ground, find

1- The building height.
2- The velocity just before hitting the ground.

Ex (12): A ball is released from rest from top of the building. How long distance has the ball moved in time interval from t = 2s to t = 3s.

Q:1	A ball is thrown straight upward from the ground and goes to its maximum height. What is the maximum height if it takes 8 sec to complete the whole trip? A) 80 m B) 11.25 m C) 20 m D) 5.6 m
Q:2	A ball is thrown downward from 30 m above the ground with initial velocity of 5 m/s. Find the time needed for the ball to reach the ground? A) 3 s B) 5 s C) 2 s D) 6 s
Q:3	A ball is thrown upward with an initial velocity of 20 m/s. What maximum height does the ball reach? A) 31.9 m B) 20 m C) 10.2 m D) 16 m
Q:4	A ball is thrown upward with an initial velocity of 12 m/s from a building of 40 m high. What is the velocity of the ball when it hits the ground? A) -30.7 m/s B) 25.8 m/s C) 41.8 m/s D) 30.7 m/s
Q:5	A ball is thrown vertically upward with a speed of 20 m/s. How long does stay in air? A) 3 s B) 5 s C) 4 s D) 2.5 s
Q:6	A stone is thrown straight upward from the ground. If it took 20 s for the stone to strike back the ground, what is the initial velocity it was thrown with? A) 30 m/s B) 60 m/s C) 100 m/s D) 70 m/s
Q:7	A ball is thrown upward with an initial velocity of 12 m/s from a building 80 m high. What is the velocity of the ball just before hitting the ground? A) 400 m/s B) 900 m/s C) 41.8 m/s D) 30.7 m/s
Q:8	A ball is thrown vertically upward from the top of building of 20 m high from the ground with initial velocity 10 m/s. What is the velocity of the ball when it is at 5 m from the ground level? A) 20 m/s B) 400 m/s C) -20 m/s D) 17.3 m/s
Q:9	An object is thrown downward from the top of building of 90 m high with initial velocity 30 m/s. Find its velocity just before hits the ground? A) 33 m/s B) -30 m/s C) 52 m/s D) -38.7 m/s
Q:10	A ball released from rest from a high of building. It strikes the ground after 4 s, What is the height of the building (in m)? A) 60 B) 80 C) 40 D) 160
Q:11	A ball is thrown downward with initial velocity of 5 m/s from the top of building 60m high. What is the time to reach the ground? A) 5 s B) 3 s C) 4 s D) 2 s
Q:12	A ball is thrown up with initial velocity of 30 m/s. How far it will travel in (1 sec) from the point of released: A) 30 m B) 25 m C) 10 m D) 20 m
Q:13	A stone is thrown up vertically with initial velocity 20m/s from the top of building 50m high. Determine the position of the stone after 5 sec later. A) 25m above the top of the building. B) 25m below the top of the building. C) 15m below the top of the building. D) 15m above the top of the building.
Q:14	A ball is released from rest at the top of a building. The time it takes the ball to fall halfway to the ground is 1.2 s. Find the total time it takes for the ball to fall from the top of the building to the ground. A) 1.7 s B) 1.8 s C) 1.5 s D) 1.9 s
Q:15	A ball is dropped from a height of 100 m at t = 0. Later, at t = 1.00 s, a second ball is thrown downward with a speed of 19.8 m/s. At what time will the two balls be at the same height? A) 1.49 s B) 2.54 s C) 4.95 s D) 0.543

Q:16	When an object is released from rest and falls in the absence of friction, which of the following is true concerning its motion? A) Its acceleration is constant. B) Its velocity is constant. C) Neither its acceleration nor its velocity is constant. D) Both its acceleration and its velocity are constant.
Q:17	Suppose a ball is thrown straight up. What is its acceleration just before it reaches its highest point? A) Zero B) slightly less than g C) exactly g D) slightly greater than g
Q:18	A bullet shot straight up returns to its starting point in 10 s. What is the initial speed of the bullet? A) 9.8 m/s B) 25 m/s C) 20 m/s D) 98 m/s
Q:19	A ball is thrown straight up with a speed of 36.0 m/s. How long does it take to return to its starting point? A) 3.67 s B) 7.2 s C) 11.0 s D) 14.7 s
Q:20	An object is shot vertically upward. While it is rising: A) Its velocity is downward and its acceleration is upward. B) Its velocity and acceleration are both decreasing. C) Its velocity is upward and its acceleration is downward. D) Its velocity and acceleration are both upward.
Q:21	A ball is thrown straight up in the air. For which situation are both the instantaneous velocity and acceleration are zero. A) Everywhere along the projectile path B) At the peak of its path C) No where of its path
Q:22	A rock is dropped from rest from a very tall bulding and falls vertically under the influence of the gravity. What is the ration of the speed of the ball after 2 seconds to the speed of the ball after 10 seconds? A) 1/5 B) 1 C) 1/4 D) 2

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
A	C	B	A	C	C	C	C	C	B	B	B	B	B	A
16	17	18	19	20	21	22								
A	C	C	B	C	C	A								