PROJECTILE MOTION PROBLEMS
brief answers

Full solutions to the problems are available in the Solutions document, and in the YouTube videos.

You can find links to these resources at my website:
http://www.freelance-teacher.com/videos.html

Links to the documents are also in the video description boxes for the YouTube videos.

You can support these resources with a monthly pledge of $1 (or more) at my Patreon page: http://www.patreon.com/freelanceteacher

As discussed in Video (1), if you keep more digits in your intermediate results than I do in the videos, your answers may differ slightly from the answers reported in this document.

Video (1)

H = 1.88 m

Video (2)

(a) H = 2.17 m

(b) $\vec{v} = +16.4 \frac{\text{m}}{\text{s}} \hat{i} + \left(-7.87 \frac{\text{m}}{\text{s}} \right) \hat{j}$

Video (3)

The package will land at a horizontal distance of 175 m from the release point.

Video (4)

(a) The motorcyclist travels a horizontal distance of 51.2 m.

(b) The smallest value for the motorcyclist's speed occurs at the peak of the trajectory, at which point the speed is 12.3 $\frac{\text{m}}{\text{s}}$.

Video (5)

(a) It takes the ball 0.88 s to reach its highest point.

(b) The ball travels 40 m horizontally before it hits the ground.

(c) The ball's speed right before it hits the ground is 25 $\frac{\text{m}}{\text{s}}$.

(d) The smallest value of the ball's speed over its entire trajectory is 23 $\frac{\text{m}}{\text{s}}$.

Video (6)

(a) The ball was hit with an initial speed of 52.5 , at an angle of 24.9° above the horizontal.

(b) The ball was in the air for 4.52 s.$\frac{\text{m}}{\text{s}}$

(c) The acceleration has magnitude 9.8 $\frac{\text{m}}{\text{s}^2}$ and direction “down”.

Video (7)

(a) $D = v_0\sqrt{\frac{2h}{g}}$

(b) unsimplified: $v_f = \sqrt{v_0^2 + \left(g\sqrt{\frac{2h}{g}}\right)^2}$

simplified: $v_f = \sqrt{v_0^2 + 2gh}$

Most professors don’t require you to simplify your exam answers, so for most courses either of the expressions for v_f above would be considered a correct answer for part (b). Some other acceptable versions of the answer are listed in the solutions document.

Video (8)

$h = \frac{1}{2}g\left(\frac{D}{v}\right)^2$

Video (9)

(a) The ball was initially hit at 34.6 $\frac{\text{m}}{\text{s}}$, at an angle of 50° above the horizontal.

(b) After being hit, it takes the ball 2 s to reach a height of 34.0 m above the ground.

(c) At that point, the ball has traveled a horizontal distance of 44 m from the point at which it was hit.

Video (10)

(a) The plane is traveling at a speed of 240 $\frac{\text{m}}{\text{s}}$.

(b) The package travels a horizontal distance of 918 m while it is falling.

(c) Just before the package hits the ground:

v_x = +204 $\frac{\text{m}}{\text{s}}$

v_y = -171 $\frac{\text{m}}{\text{s}}$

By the way, for those who want to deepen their understanding of acceleration, the solutions in the solutions document and in the video contain a “bonus” discussion of why the object’s negative a_y does *not* indicate that it is slowing down in the vertical component. The video discussion begins at 1:33:00.

Video (11)

$$\frac{v_0 \sin\alpha}{g} + \frac{D}{v_0 \cos\alpha} + \frac{v_0 \sin\alpha}{g}$$

Video (12)

(a) The rock was thrown with initial speed 10 $\frac{\text{m}}{\text{s}}$, at an angle of 61° above the horizontal.

(b) The total horizontal distance traveled by the rock is 19.2 m.