Physics 112

1D Motion Equations

1. A car undergoes a constant acceleration from rest to 28 m/s in 9.5 s. What distance was covered in that time?

2. Not noticing a red light a drivers slams on the brakes squeeling to a halt in 3.75 s. Just before hitting the brakes the car was traveling 17 m/s and was 30 m from the light. **a)** What was the average acceleration of the car? **b)** Determine if the driver able to stop before reaching the traffic light by finding the distance required to stop.

3. An airplane lands with a speed of 70 m/s. After 3.5 s the airplane is traveling 17.5 m/s. **a)** What was the average acceleration of the airplane? **b)** What distance does the airplane need to stop?

4. During take off a Boeing 747 airplane accelerates at a constant $10.8\,\mathrm{m/s^2}$. The airplane accelerated, from rest, for 7.8 s before it left the ground. **a)** With what speed did the airplane leave the ground? **b)** What distance was required for take-off?

5. A ball is thrown upwards, on the Earth ($a_{gravity} = -9.81\,\mathrm{m/s^2}$, with an initial speed of 17 m/s. **a)** How long will the ball be traveling upwards? **b)** How high up will the ball travel?

6. A loonie dropped from the observation deck on the CN Tower in Toronto takes 8.35 s to hit the ground. **a)** Assuming no air resistance, with what speed is the loonie striking the ground? **b)** How high is the observation deck from the ground? (ta ke $a_{gravity} = -9.81\,\mathrm{m/s^2}$)

7. During its fall to Earth, hail stones from cumulonimbus clouds reach a terminal velocity (a constant speed) because of air resistance. **a)** Calculate at what speed a hail stone would strike the Earth if it continued to accelerate at $a_{gravity} = -9.8\,\mathrm{m/s^2}$ during its 20.2 s fall to the ground.

8. A ball is thrown straight up (assume no air resistance) at the surface of the Earth with $v_o = 25$ m/s. How long will the ball be in the air?

9. The upward velocity of a cannon ball is initially 142 m/s. How long after the cannon ball is fired will it be 51.0 m above the ground?

10. What is the instantaneous velocity of a ball (launched upwards) that has a displacement of 21 m above the ground if the initial velocity was 32 m/s?

11. Use $d = v_o t + \frac{1}{2}at^2$ and $a = \frac{v_f - v_o}{t}$ to derived ${v_f}^2 = {v_o}^2 + 2ad$

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Answer List

1. d=133 m
2. **a)** $a_{avg} = -4.5\,\text{m/s}^2$, **b)** No, the driver needed 32 m to stop so the car ended up 2 m into the intersection.
3. **a)** $a_{avg} = -15\,\text{m/s}^2$ **b)** $d = 163\,\text{m}$
4. **a)** $v_f = 84\,\text{m/s}$ **b)** $d = 330\,\text{m}$
5. **a)** $t = 1.73\,\text{s}$; **b)** $d = 15\,\text{m}$
6. **a)**$v_f = -82\,\text{m/s}$; **b)**$d = 342\,\text{m}$
7. **a)**$v_f = -198\,\text{m/s}$;
8. $t = 5.1\,\text{s}$
9. $t = 0.364$ and 28.6 seconds
10. $v = +25\,\text{m/s}$ or $-25 m/s$
11. **a)**$v_f = -198\,\text{m/s}$;