

Introduction

I have modified and provided answers to some of the more illuminating review questions and exercises from Hewitt's *Conceptual Physics*, **11th** edition. I have also included 'Things to Know by Heart' at the end of the three major divisions. You should commit these rules to memory as we cover them in class. This workbook should be used as another resource that is available to assist you in this introductory physics course. It is not a substitute for the classroom teacher or the textbook-your two main resources. I hope this helps you in your studies.

Sincerely,

R. E. Tremblay

Conceptual Physics-11th edition Answers by R. E. Tremblay
Ch. 3 Pg. 46

Review questions

2. What two units of measurement are necessary for describing speed?

Ans. Distance and time.

3. What kind of speed is registered by an automobile?

Ans. Instantaneous speed.

5. What is the average speed in kilometers per hour for a horse that gallops a distance of 15 km in a time of 30 min?

Ans. $\frac{15 \text{ km}}{\frac{1}{2} \text{ hr}} = 30 \frac{\text{km}}{\text{hr}}$

6. How far does a horse travel if it gallops at an average speed of 25 km/hr for 30 min.?

Ans. Our distance rule is given by $\Delta X = V_0 t + \frac{1}{2} a t^2$. Since there is no acceleration, the rule simplifies to $\Delta X = V_0 t = 25 \frac{\text{km}}{\text{hr}} \cdot 0.5 \text{ hr} = 12.5 \text{ km}$

7. Distinguish between speed and velocity.

Ans. Speed is the rate at which an object changes its position. Velocity is the speed and direction of an object.

8. If a car moves with constant velocity, does it also move with constant speed?

Ans. Yes.

9. If a car is moving at 90 km/hr and it rounds a corner, also at 90 km/hr, does it maintain a constant speed? A constant velocity?

Ans. It maintains a constant speed but its velocity is changing because its direction of travel is changing.

10. Distinguish between velocity and acceleration.

Ans. Velocity is the speed and direction of an object. Acceleration is the rate at which an object changes its velocity.

11. What is the acceleration of a car that increases its velocity from 0 to 100 km/hr in 10 seconds?

Ans. $a \equiv \frac{\Delta V}{\Delta t} = \frac{V_2 - V_1}{\Delta t} = \frac{100 \frac{\text{km}}{\text{hr}} - 0 \frac{\text{km}}{\text{hr}}}{10 \text{ s}} = 10 \frac{\frac{\text{km}}{\text{hr}}}{\text{s}}$ forward.

12. What is the acceleration of a car that maintains a constant velocity of 100 km/hr for 10 seconds?

Ans. Note the velocity is not changing. If there is no change in velocity, there is no acceleration.

If we follow the definition, we get the same answer. $a \equiv \frac{\Delta V}{\Delta t} = \frac{100 \frac{\text{km}}{\text{hr}} - 100 \frac{\text{km}}{\text{hr}}}{10 \text{ s}} = \frac{0 \text{ km}}{\text{hr} \cdot \text{s}}$

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Review questions continued.

13. When are you most aware of motion in a moving vehicle?

Ans. You are most aware of motion in a moving vehicle when it changes its speed or direction-when it accelerates.

18. What is meant by a “freely falling body”.

Ans. A freely falling body is an object that only has the force of gravity on it.

19. What is the gain in speed per second for a freely falling object?

Ans. All objects in free fall near the Earth’s surface accelerate down at 10 m/s².

20. What is the velocity of an object, 5 seconds after it is dropped? 6 seconds?

Ans. After 5 seconds it is moving 50 m/s downward; After 6 seconds it is moving 60 m/s downward.

23. What relationship between distance traveled and time did Galileo discover for accelerating objects?

Ans. The distance traveled is proportional to the falling time squared.

24. What is the distance traveled for a free falling object that starts from rest, 5 sec and 6 sec after it is released?

Ans. Our equation for distance is given by the displacement rule: $\Delta X = V_0t + \frac{1}{2}at^2$

Since the object starts from rest, its initial velocity is 0 m/s and the equation at 5 seconds reduces to:

$$\Delta X = \frac{1}{2}at^2 = \frac{1}{2}10 \frac{m}{s^2} (5s)^2 = 125m$$

$$\text{At 6 seconds we get: } \Delta X = \frac{1}{2}at^2 = \frac{1}{2}10 \frac{m}{s^2} (6s)^2 = 180m$$

25. What is the effect of air resistance on falling objects? What is the acceleration if there is no air resistance?

Ans. Air resistance reduces the acceleration due to gravity of a falling object. Without air resistance, all objects in free fall near the earth’s surface accelerate down at approximately 10 m/s/s.

26. Consider these measurements: 10 m, 10 m/s, 10 m/s². Which is velocity, which is acceleration and which is displacement?

Ans. You ask and answer this one in class for plus 1 point.

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Exercises

1. What is the impact speed when a car moving at 100 km/hr bumps into the rear of another car traveling in the same direction at 98 km/hr?

Ans. 2 km/hr.

2. Suzie Surefoot can paddle a canoe in still water at 8 km/hr. How successful will she be at canoeing upstream in a river that flows at 8 km/hr?

Ans. She will not go anywhere. Some days are like that.

3. Is a fine for speeding based on one's average speed or instantaneous speed?

Ans. It is based on your instantaneous speed.

4. One airplane travels due north at 300 km/hr while another travels due south at 300 km/hr. Are their speeds the same? Are their velocities the same? Explain.

Ans. Their speeds are the same because they are both changing their positions by 300 km every hour. Their velocities are not the same because they are moving in different directions.

5. Light travels at 3×10^8 m/s. What is the acceleration of light?

Ans. Light does not accelerate. Therefore its acceleration equals 0 m/s/s

6. Can an automobile with a velocity toward the north, have an acceleration toward the south?

Ans. Yes. The car can be moving north and slowing down. That would give it a change in velocity south, which means that it is accelerating south-even though it is going north.

8. Can an object reverse its direction of travel while maintaining a constant acceleration? 5. Can you give an example. If not, explain why.

Ans. Yes. A ball thrown straight up will rise and then reverse its direction and fall. All the while, it will have a constant acceleration of 10 m/s/s down.

10. Correct your friend who says, "The dragster rounded the curve at a constant velocity of 100 km/h."

Ans. The dragster rounded the curve at a constant speed of 100 km/h.

11. You are driving north on the highway. Then, without changing speed, you round a curve and drive east. (a) Does your velocity change? (b) Do you accelerate? Explain.

Ans. You have a new velocity and therefore have accelerated. Acceleration occurs whenever an object's velocity has changed.

13. Starting from rest, one car accelerates to a speed of 50 km/h, and another car accelerates to a speed of 60 km/h. Can you say which car underwent the greater acceleration?

Ans. No. You need to know how much time it took.

16. Cite an example of something with constant speed that also has a varying velocity. Can you also give an example of something with a constant velocity, that travels at a varying speed?

Ask and answer correctly in class for plus 1 point.

Conceptual Physics-11th edition ;EXERCISES CH.3 continued

17. (a) Can an object be moving when its acceleration is zero?

Ans. Yes. A car moving at constant velocity is an example.

(b) Can an object be accelerating when its speed is zero?

Ans. Yes, as long as its speed is zero for only on instant in time.

18. Can you give an example wherein the acceleration of a body is opposite in direction to its velocity? Do so if you can.

Ans. Yes. The direction of acceleration is the same as the direction of an object's change in velocity. If you are driving in your car and then apply the brakes, the change in velocity is backward so the acceleration is also backward.

21. What is the acceleration of a car that moves at a steady velocity of 100 km/hr for 100 seconds? Explain your answer.

Ans. Acceleration is zero. The problem states that the car is moving at constant velocity therefore there can be no acceleration.

25. Suppose that a freely falling object were somehow equipped with a speedometer. By how much would its speed increase with each second of fall?

Ans. Its speed reading would increase by 10 m/s every second.

26. Suppose that the freely falling object in the preceding exercise were also equipped with an odometer. Would the readings of distance fallen each second indicate equal or different falling distances for successive seconds? Explain.

Ans. The object would always fall further than it did in the preceding second because it would be falling faster and faster each second.

27. For a freely falling object dropped from rest, what is its acceleration at the end of the 5th second of fall? The 10th? Defend your answer.

Ans. 10 m/s/s. 10 m/s/s. All objects in free fall near the Earth's surface accelerate at 10m/s/s all the time (when we disregard air friction).

28. If air resistance can be neglected, how does the acceleration of a ball that has been tossed straight upward compare with its acceleration if simply dropped?

Ans. The acceleration will be the same in both cases. 10 m/s/s down.

29. When a ball player throws a ball straight up, by how much does the speed of the ball decrease each second while ascending? By how much does it increase each second while descending? How much time is required for rising compared to falling?

Ans. As long as we disregard air friction: a) 10 m/sec every second b) 10 m/sec every second c) Rising and falling times are equal.

Conceptual Physics-11th edition ; EXERCISES CH.3 continued

30. Someone standing at the edge of a cliff throws a ball straight up at a certain speed and another ball straight down with the same initial speed. If air resistance is negligible, which ball will have the greater speed when it strikes the ground below? Explain.

Ans. They will strike the ground at different times but with the same speed. The ball thrown upward will be moving at the initial speed when it returns to the point of release.

32. If you drop an object, its acceleration toward the ground is 10 m/s/s. If you throw it down instead, would its acceleration after throwing be greater than 10 m/s/s? Why or why not?

Ans. Once the object leaves your hand, it is in free fall. It will therefore accelerate down at 10 m/s/s if we disregard air friction.

33. In the preceding exercise can you think of a reason why the acceleration of the object thrown downward through the air would actually be less than 10 m/s/s?

Ans. If we consider air friction, then the acceleration of an object in free fall is always less than 10 m/s/s.

35. Consider a vertically-launched projectile when air drag is negligible. When is the acceleration due to gravity greater: when ascending, at the top, or when descending? Defend your answer.

Ans. The acceleration due to gravity is always constant. It is approximately equal to 10m/s/s.

36. Extend Tables 2.2 and 2.3 to 10 seconds, assuming no air resistance.

Time	Velocity	Rule: $V_f = V_o + at$
6 sec	60 m/sec	Since the object was dropped, we know that $V_o = 0$ m/s.
7 sec	70 m/sec	
8 sec	80 m/sec	Because the object is in free fall we know that $a = 10$ m/s/s. For example, the velocity at 9 seconds is determined as follows:
9 sec	90 m/sec	
10 sec	100 m/sec	
		$V = V_o + at = 0 \frac{m}{s} + 10 \frac{m}{s^2} \cdot 9s = 90 \frac{m}{s}$

37.

Time	Displacement
6 sec	180 m
7 sec	245 m
8 sec	320 m
9 sec	405 m
10 sec	500 m

Example: What is the displacement of the object after 6 seconds of free fall?

Write the rule and then substitute the appropriate values.

$$\text{Rule: } \Delta X = V_o t + \frac{1}{2} at^2 = 0 \frac{m}{s} \cdot 6s + \frac{1}{2} 10 \frac{m}{s^2} (6s)^2 = 180 \text{ meters}$$

Extra ch 3. Exercises; Conceptual Physics-11th edition

37. If it were not for air friction, why would it be dangerous to go outdoors on rainy days?

Ans. Air friction prevents an object from accelerating. Instead of falling faster and faster and faster, because of air friction, the rain actually falls at a constant velocity that is slow enough to prevent injury to physics students and their friends.

Extra: A climber near the summit of a vertical cliff accidentally knocks loose a large rock. She sees it shatter at the bottom of the cliff 8 seconds later. a) What was the speed of the rock when it hit the ground? b) How far did the rock fall?

$$a) \quad V = V_0 + at = 0 \frac{m}{s} + 10 \frac{m}{s^2} 8s = 80 \frac{m}{s}$$

$$b) \quad \Delta X = V_0 t + \frac{1}{2} at^2 = 0 \frac{m}{s} 8s + \frac{1}{2} \cdot 10 \frac{m}{s^2} (8s)^2 = 320 \text{ meters}$$

Extra. If you throw a rock off a cliff, how do the horizontal components of its velocity compare for all points along its trajectory?

Ans. Since the horizontal velocity of an object in free fall never changes (when we disregard air friction), the horizontal components are equal at all points along its trajectory.

Extra. How far below an initial straight line path will a projectile fall in 1 sec? Does your answer depend on the angle of launch or on the initial speed of the projectile? Defend your answer.

Ans. The projectile will fall 5 meters below a straight-line path in the first second-regardless of the launch angle or speed. The projectile is in free fall and accelerates down at 10 m/s/s.

Extra. Suppose you are on a ledge in the dark and wish to estimate the height of the ledge above the ground. So you drop a stone over the edge and hear it strike the ground in 1 second. What is the height of the ledge? How could you use the stone to estimate the height if you weren't close enough to the edge to simply drop the stone? Explain.

Ans. Distance below a straight-line path in 1 second is given by:

$$\Delta X = \frac{1}{2} gt^2 = \frac{1}{2} 10 \frac{m}{s^2} (1s)^2 = 5 \text{ meters}$$

Extra: Suppose you swim in a direction directly across a flowing river and end up a distance downstream that is less than the width of the river. How does your swimming speed compare to the flow rate of the river?

Ans. Your swimming speed must be faster than the river because you swam further across stream than the river carried you down stream.

Extra: Suppose you are driving along in a bus and throw a ball straight up into the air. While the ball is still in the air the driver steps on the brake. Where does the ball land relative to the car?

Ans. The ball lands forward

Extra: Is acceleration how fast you go or how fast you get fast?

Ans. How fast you get fast is closer to the answer. It also should include how fast you get slow or how fast you change direction. More specifically, acceleration is the rate at which an object changes its velocity.

CH 3 PROBLEMS, p 50; Conceptual Physics-11th edition

3. a) What is the instantaneous velocity of a freely falling object 10 seconds after it is released from a position of rest? b) What is its average velocity during this 10 second interval? c) How far will it go during this time?

a) $V = V_0 + at = 0m/s + 10m/s^2 * 10s = 100m/s$

b) Let's do part c first and come back to part b.

c) $\Delta X = V_0t + 1/2at^2 = 0m/s \cdot 10s + 1/2 \cdot 10 m/s^2(10s^2) = 500 \text{ meters}$

b) Back to part b.

Average velocity equals total distance divided by total time.

$$\bar{V} = \frac{\text{Total distance}}{\text{Total time}} = \frac{500 \text{ m}}{10s} = 50 \frac{\text{m}}{\text{s}}$$

4. A car goes from 0 to 50 m/s in 10 seconds. If you wish to find the distance traveled using the equation $\Delta X = V_0t + 1/2at^2$, what value should you use for 'a' ?

Ans. Since we are **not told** that the car is in free fall, we must calculate the acceleration of the car as follows:

$$a \equiv \frac{\Delta V}{\Delta t} = \frac{V_2 - V_1}{\Delta t} = \frac{50 \frac{\text{m}}{\text{s}} - 0 \frac{\text{m}}{\text{s}}}{10 \text{ s}} = 5 \frac{\text{m}}{\text{s}^2}$$

Project #1, pg 47 hand in for 1 pts extra credit

Extra Ch. 3 problem: Conceptual Physics-11th edition

What is the acceleration of a vehicle that changes its velocity from 100 km/hr to a dead stop in 10 seconds?

$$a \equiv \frac{\Delta V}{\Delta t} = \frac{V_2 - V_1}{\Delta t} = \frac{0 \frac{\text{Km}}{\text{hr}} - 100 \frac{\text{Km}}{\text{hr}}}{10 \text{ s}} = -10 \frac{\text{Km/hr}}{\text{s}} \text{ Note that the negative sign indicates that the vehicle actually accelerated backward.}$$

Ans. The vehicle is accelerating backward at the rate of $10 \frac{\text{Km}}{\text{hr}}$ every second