APC Name: KEY

PHYSICS HOMEWORK #8 — KINEMATICS

ACCELERATION

7. A ball is thrown upward with a speed of 38.0 m/s from the top of a building 240. meters tall;
   a. How long will it take for this ball to reach the ground? a) 11.9 s
   b. How long will it take for this ball to reach the highest point? b) 3.88 s
   c. How long after the ball is thrown will the ball be found 265 meters above the ground? c) 7.03 s, 0.73 s
   d. What will be the velocity of this ball as it reaches the ground?
   e. What will be the velocity of this ball at the highest point?
   f. How high above the ground will the ball be when it reaches the highest point? d) −78.6 m/s
   g. What will be the average speed of the ball from the time it is thrown until the time it strikes the ground?
   Suppose that instead of throwing this ball upward it is thrown downward with a speed of 38.0 m/s; e) ∅
   h. How long will it take for the ball to reach the ground? f) 314 m
   i. What will be the speed of the ball as it reaches the ground? g) −20.3 m/s
   i) −78.4 m/s h) 4.12 s

8. A ball is thrown upward from the ground with a speed of 35.5 m/s. 5.25 seconds after the ball is thrown it lands on the roof of a building. What is the height of the building?

9. From the top of a building 85.0 meters tall a ball is dropped. At the same time another ball is thrown upward from the ground with a speed of 46.0 m/s.
   a. How long after the balls are released will they hit? a) 1.85 s
   b. How high above the ground will these two balls hit? b) 68.3 m

10. A ball is thrown upward so that it just barely reaches the top of a telephone pole and then falls back to the ground. The time from the release of the ball until its return to the ground is measured to be 5.20 seconds. What is the height of the telephone pole?

11. A ball is thrown downward from the top of a building 122 meters tall with an initial speed of 38.0 m/s. What will be the speed of this ball as it reaches the ground? −61.9 m/s

12. You are on the top of a building 44.2 meters tall. The adjacent building is 98.1 meters tall. You throw the ball upward so that the ball lands on the roof of the adjacent building 4.15 seconds after the ball is thrown. What will be the speed of this ball when it lands on the roof?

13. You are standing on the top of a building which is 115 meters tall. You throw one ball upward at 35.0 m/s and it lands on the ground some time later. You throw a second ball downward from the same building with a velocity of 35.0 m/s and it also hits the ground at a later time. Which ball will be moving faster when each hits the ground? Support your answer with calculations! same speed

14. You are driving your car down the highway with a speed of 31.5 m/s. You hit the brakes and skid to a halt in 5.2 seconds.
   a. What will be the rate of acceleration of your car?
   b. How far will your car move from the time you apply the brakes until the car stops?

15. You are rushing to the train station to catch your morning commute. The train leaves the train station from rest with an acceleration of 0.600 m/sec². You arrive at the station exactly 4.00 seconds after the train leaves and you immediately start running after the train with a constant velocity of 8.50 m/sec.
   a. How long after the train leaves the station do you catch up with the train? a) 4.82 s, 23.5 s
   b. How far from the train station do you catch up with the train? b) 6.97 m, 166 m
   c. With what minimum speed would you have to run in order to catch up with the train? c) 4.8 m/s

Answers to opposite side: 1a. 19.5 m/s b. 9.75 m/s c. 63.4 m/s 2a. 8.38 m/s
2b. 47.7 m c. 6.49 s d. 60.0 m 3a. 7140 m/s b. 1820 km 4a. -28.1 m/s b. -14.1 m/s
4c. 40.4 m 5a. zero b. -52.0 m/s c. 5.31 s d. 138 m e. 14.3 m/s f. 33.1 m/s
6a. 5.63 sec b. 104 meters c. v_f = -33.1 m/sec; v_f = -9.1 m/sec d. 24 m/s

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PHYSICS HOMEWORK #13 — KINEMATICS

TWO DIMENSIONAL PROJECTILES

[Remember that ALL vectors must be described by BOTH magnitude and direction!]

1. A ball, which has a mass of 3.35 kg., is thrown straight up from the ground with an initial velocity of 55.0 m/s.
   a. How long will it take for this ball to reach the highest point? a) 5.61 s
   b. How high above the ground will this ball be when it reaches the highest point? b) 154 m
   c. What will be the velocity of this ball when it reaches the ground again? c) −55 m/s

2. A marble, which has a mass of 24 grams, is dropped from a height of 94 cm. How long will it take for this marble to reach the floor?

3. A marble is rolling along a horizontal tabletop, which is 94.0 cm above the floor, when the marble reaches the edge of the table and then falls to the floor. How long will it take for the marble to strike the floor? 0.44 s

4. A rifle bullet, which has a mass of 57.0 grams, is fired horizontally from a rifle which is held 94.0 cm above the floor, with a velocity of 385 m/s. How long will it take for the bullet to strike the floor?

5. A marble is fired horizontally from a launching device attached to the edge of a tabletop which is 94.0 cm above the floor. The marble then strikes the floor 2.35 meters from the edge of the table.
   a. How long will it take for the marble to reach the floor? a) 0.44 s
   b. What is the initial velocity of the marble as it leaves the launching device? b) 5.3 m/s
   c. What will be the horizontal velocity of the marble as it reaches the floor? c) 5.3 m/s
   d. What will be the vertical velocity of the marble as it reaches the floor? d) −4.3 m/s
   e. What will be the direction and magnitude of the velocity of the marble as it reaches the floor? e) 6.8 m/s 39° downward

6. A projectile is fired from the ground with a velocity of 96.0 m/s at an angle of 35.0° above the horizontal;
   a. What will be the vertical and horizontal components of the initial velocity of this projectile?
   b. How long will it take for this projectile to reach the highest point of its trajectory?
   c. How long will this projectile be in the air?
   d. What will be the velocity of this projectile at the highest point?
   e. What will be the velocity of this projectile as it again reaches the ground?
   f. How high will this projectile be at the highest point of its trajectory?
   g. What will be the range [the horizontal displacement] of this projectile?

Remember to set up TWO data tables, one for the vertical and one for the horizontal!

7. A projectile, which has a mass of 5.5 kg., is fired from the ground with a an initial velocity of 169 m/s at an angle of 23.0° above the horizontal;
   a. What will be the velocity of this projectile at the highest point of its trajectory? a) 156 m/s
   b. What will be the total flight time of this projectile? b) 13.5 s
   c. What will be the height of this projectile at the highest point of its trajectory? c) 222 m
   d. What will be the range of this projectile? d) 2100 m
   e. What will be the vertical velocity of this projectile 3.50 seconds after it has been fired? e) 31.7 m/s
   f. What will be the horizontal velocity of this projectile 3.50 seconds after it has been fired? f) 156 m/s
   g. What will be the direction and magnitude of the projectile's velocity 3.50 seconds after it has been fired? g) 159 m/s @ 11.5° up
   h. What will be the height of this projectile 3.50 seconds after it has been fired? h) 171 m
   i. How far downrange will the projectile be 3.50 seconds after it has been fired? i) 545 m
   j. What will be the final displacement of the projectile 3.50 seconds after the projectile has been fired? j) 571 m @ 17.4°

Answers to opposite side: 8. 40.0 s b. 1960 m c. 8280 m d. 221 m/s at 21.0° down
8e. 6030 m at 16° upward f. 29.7 s & 10.3 s g. 207 m/s 9a. 20.3 s b. 8440 m
9c. 430 m/s at 14.8° downward 10. 9090 m 11a. 2.1 s b. 75 m c. 8.3 m 12a. 0.43 s
12b. 3.8 ft c. 3.0 ft 13a. 60.6 ft 13b. 2.04 s

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PHYSICS HOMEWORK #14 — KINEMATICS

TWO DIMENSIONAL PROJECTILES

8. A projectile is fired from the ground with an initial velocity of 285 m/s at an angle of 43.5° above the horizontal;
   a. How long will this projectile be in the air?
   b. How high will this projectile be at the highest point of its trajectory?
   c. What will be the range of this projectile?
   d. What will be the velocity of this projectile 28.0 seconds after it has been fired?
   e. What will be the displacement of the projectile 28.0 seconds after it has been fired?
   f. When will this projectile be 1500 meters above the ground?
   g. What will be the velocity of this projectile at the highest point of its trajectory?

Remember to set up TWO data tables, one for the vertical and one for the horizontal!

9. A rifle is fired from the top of a building 220 meters high with an initial velocity of 425 m/s at an angle of 12.0° above the horizontal;
   a. How long will it take for the bullet to reach the ground? a) 20.3 s
   b. How far from the base of the building will the bullet strike the ground? b) 8440 m
   c. What will be the velocity of the bullet just as it reaches the ground? c) 430 m/s @ 14.8° down

10. A Spanish Galleon enters a harbor defended by cannon placed on top of a castle wall which is 135 meters above the water level. The cannon have a known muzzle velocity of 323 m/s and are aimed 28.0° above the horizontal. How far from the base of the castle wall will the Galleon be within the range of the cannon?

11. A motor cycle is moving with a velocity of 36.0 m/s when it encounters a ramp which is 22.0 meters long and meets the horizontal at an angle of 13.0°. The motorcycle goes up the incline without losing speed and flies off the end of the incline.
   a. How long after the motorcycle leaves the end of the ramp will the motorcycle land on the ground? a) 2.1 s
   b. How far from the end of the ramp will the motorcycle land on the ground? b) 75 m
   c. How high above the ground will the motorcycle be at its highest point? c) 8.3 m

12. Suppose that a baseball is thrown horizontally from a pitcher's mound, which is 1.50 feet above the ground level, to home plate located 60.0 feet away. The ball is released from the pitchers hand with a velocity of 139 feet second when the pitcher's hand is 5.30 feet above the mound. Ignoring the effects of air friction and given that the acceleration of gravity is g = -32.2 feet second^2;
   a. How long will it take for the ball to reach home plate?
   b. What will be the height of the ball above the ground when it reaches home plate?
   c. How far did the ball drop on its way to home plate?

13. Suppose that a shotputter throws a 16 pound shot with a velocity of 43 ft/s at an angle of 45°. At the time the shot is released the shotputter's hand is 6.5 feet above the ground.
   a. What will be the final horizontal displacement of this shot? [World men's record 74 ft 4¼ in 1989, women's record 73 ft 10 in 1977] a) 60.6 ft
   b. How long will it take for this shotput to strike the ground? b) 2.04 s

Answers to opposite side: 1. 5.61 s b. 154 m c. -55.0 m/s 2. 0.44 s 3. 0.44 s 4. 0.44 s
5a. 0.44 s b 5.3 m/s c. 5.3 m/s d. -4.3 m/s e. 6.8 m/s at 39° downward 6a. 55 m/s, 79 m/s
6b. 5.60 s c. 11.2 s d. 79 m/s e. 96 m/s at 35° downward f. 154 m g. 887 m 7a. 156 m/s
7b. 13.5 s c. 222 m d. 2100 m e. 31.7 m/s f. 156 m/s g. 159 m/s at 11.5° up h. 171 m
7i. 545 m j. 571 m at 17.4° upward

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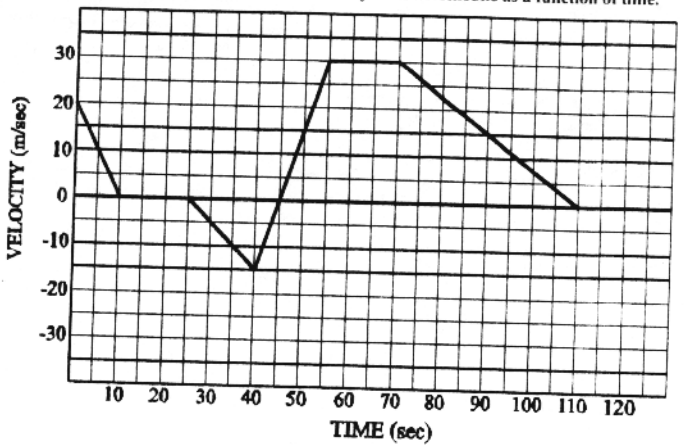
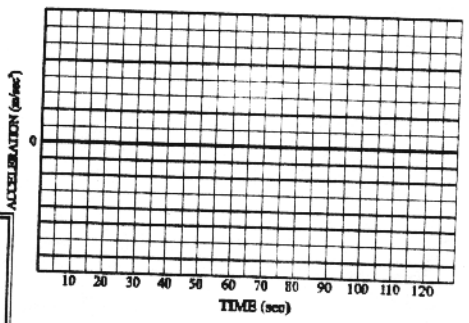
PHYSICS HOMEWORK #5 — KINEMATICS

GRAPHICAL ANALYSIS

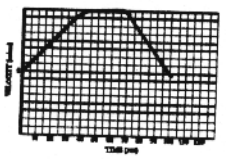
The following graph describes the velocity of an automobile as a function of time.



1. What was the velocity of this car when t = 35 seconds?
2. What was the rate of acceleration of this car when t = 20 seconds?
3. What was the rate of acceleration of this car when t = 5 seconds?
4. What was the rate of acceleration of this car when t = 40 seconds?
5. What was the displacement of this car between t = 0 and t = 10 seconds?
6. What was the displacement of this car between t = 10 and t = 25 seconds?
7. What was the displacement of this car between t = 25 and t = 35 seconds?
8. What was the total displacement of this car between t = 0 and t = 110 seconds?
9. What was the total distance traveled by this car between t = 0 and t = 110 seconds?
10. During which time interval/intervals was the car at rest?
11. During which interval intervals was the car moving in reverse?
12. On the graph at the right sketch the acceleration of this car as a function of time.
13. At what times t [other than at t= 0] was the displacement of the car again exactly zero?



Answers to opposite side:
1. 2.0 m/sec 2. 1.0 m sec^2
3. 0.0 m/sec 4. -3.0 m sec^2
5. 20 m sec 6. 60 m sec
7. 80 m sec 8. -2.5 m sec
10. 900 m 9. Graph at right



↖ These are the answers to #6

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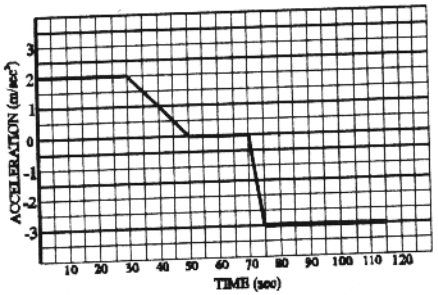
PHYSICS HOMEWORK #6

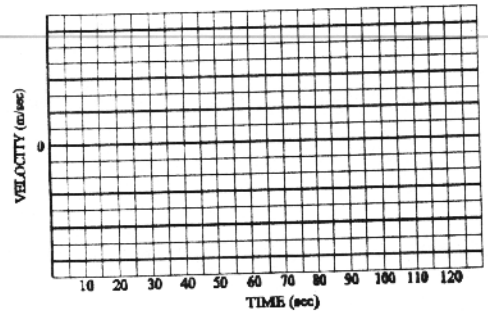
KINEMATICS

GRAPHICAL ANALYSIS

The following graph describes the acceleration of an automobile as a function of time.
For each of the following questions assume that this car is at rest at t = 0 seconds.

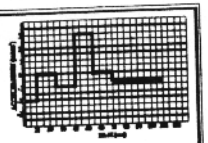
1. What was the rate of acceleration of this car when t = 10 seconds?
2. What was the rate of acceleration of this car when t = 40 seconds?
3. What was the rate of acceleration of this car when t = 50 seconds?
4. What was the rate of acceleration of this car when t = 85 seconds?
5. What was the velocity of this car when t = 10 seconds?
6. What was the velocity of this car when t = 30 seconds?
7. What was the velocity of this car when t = 50 seconds?
8. What was the velocity of this car when t = 100 seconds?
9. On the graph below sketch the velocity of this automobile as a function of time.
10. What was the total distance traveled by this car between t = 0 and t = 30 seconds?





These are the answers to #5

Answers to opposite side: 1. -10.0 m/sec 2. zero 3. -2.0 m/sec² 4 cannot be determined because this point lies on two different lines with two different slopes! 5. 100 m 6. zero 7. -50 m 8. 1150 m 9. 1450 m 10. between t = 10 s and t = 25 s, at 45 s and at 110 s 11. between t = 25 s and t = 45 s 13. t = ~39 sec & t = ~ 51 sec 12. sketch a vs t to the right



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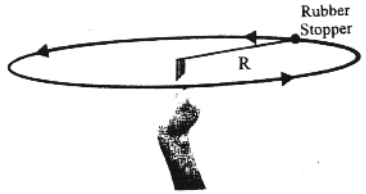
PHYSICS HOMEWORK #15

KINEMATICS

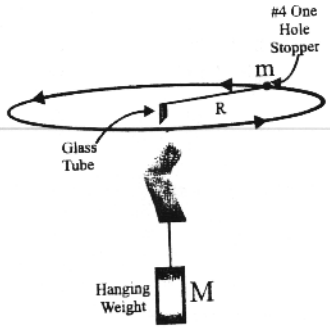
CENTRIPETAL ACCELERATION

1. You are spinning a rubber stopper over your head as shown in the diagram at the right. The rubber stopper has a mass m and is moving in a circle which has a radius R.



   a. In what direction must you apply force to the string in order to keep the stopper moving in a circular path?
   b. What will happen to the stopper if you let go of the string? Describe precisely!
   c. What is the direction of the force acting on the stopper to keep the stopper moving in a circular path?
   d. How would the force being applied to the string by your hand be different if you were to spin the stopper faster?
   e. How would the force being applied to the string by your hand be different if you were to spin the stopper at the same speed, but if you significantly increased the mass of the stopper?
   f. How would the force being applied to the string by your hand be different if you were to spin the stopper in a larger radius circle?

2. You are spinning a rubber stopper over your head as shown in the diagram at the right. The rubber stopper has a mass of 18.5 grams and is moving in a circle which has a radius of R = 110 cm. You measure that the rubber stopper moves 10 times around your head every 9.0 seconds.



   a. What is the distance once around this circular path?
   b. What is the distance 10 times around this circular path?
   c. What is the average speed of this rubber stopper as it circles above your head?
   d. What is the direction of the centripetal acceleration of the stopper as it circles above your head? Show the direction on the diagram with a clearly labeled vector.
   e. What is the magnitude of the centripetal acceleration of the stopper as it circles over your head?
   f. What is the direction of the velocity of this stopper when in the position shown in the diagram? Show the direction on the diagram with a clearly labeled vector.
   g. How much force would be required to keep this stopper moving in the given circular path?
   h. How much mass M must be hung on the lower end of the string to keep the stopper moving in the given circular path?

Answers to opposite side: 3. 15.0 m/s² 4. 4.98 m/s² 5a. 7.23 m/s b. 12.4 m/s² 6a. 13.6 m/s² b. towards center, left 6c. 1.84 N d. towards center, left e. in a straight line towards top of the page 7a. $q = k$ b. $V \propto q$ c. $F \propto 1/r$ d. $T \propto L$

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PHYSICS HOMEWORK #16 **KINEMATICS**
DISPLACEMENT & VELOCITY

3. A ball, whose mass is 0.650 kg, is moving in a circular path. The radius is 135 meters and the linear speed is 4.50 m/sec. What is the magnitude of the centripetal acceleration of this ball?

4. A car, whose mass is 1200 kg is moving with a speed of 18.0 m/sec as it passes through a curve in the road whose radius of curvature is 65.0 meters. What is the magnitude of the centripetal acceleration of the car?

5. There is an amusement park ride called the "ROTOR" where you enter a cylindrical room. room begins to spin very fast until at some point the floor beneath you "falls out". Suppose that this room has a radius of 4.20 meters and the room rotates such the you make one complete revolution in 3.65 seconds.
   a. What will be your linear speed as the room spins?

   b. What is the magnitude of your centripetal acceleration?

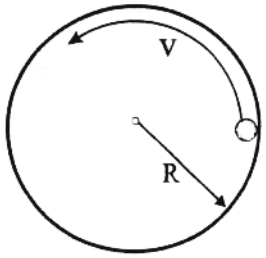
6. Consider a roulette wheel as shown to the right. The radius of the wheel is R = 0.850 meters. A ball whose mass is m = 135 grams is thrown into the roulette wheel after which it rotates counter-clockwise with a speed of v = 3.40 m/sec.
   a. What will be the magnitude of the centripetal acceleration of this ball?

   b. What will be the direction of the centripetal acceleration of this ball while in the position shown?

   c. What will be the magnitude of the centripetal force acting on this ball?

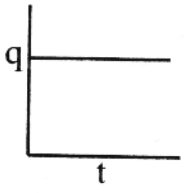
   d. What will be the direction of the centripetal force acting on this ball?

   e. Suppose that this ball escaped from the roulette wheel while in the position shown, what will be the direction of the motion of the ball as it exits the wheel?

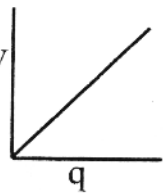


7. For each of the following graphs indicate the most likely relationship between the plotted variables.

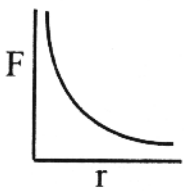
a.



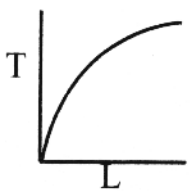
b.



c.



d.



Answers to opposite side: 1a. toward your hand b. it moves off in a straight line c. toward your hand d. you would need more force 1e. you would need more force f. you would need less force 2a. 6.9 m b. 69.1 m 2c. 7.68 m/sec d. toward your hand e. 53.6 m/sec^2 f. straight ahead [up and to the left] g. 0.992 N h. 101 gm

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