

## KINEMATICS

1. CHARLOTTE WAS TRAVELING AT 25 m/s IN HER BMW WHEN SHE BEGAN ACCELERATING. AFTER ZOOMING 450 m, HER VELOCITY WAS 65 m/s. FOR THAT INTERVAL, FIND HER:  $\bar{v} = \underline{\hspace{2cm}}$  m/s,  $t = \underline{\hspace{2cm}}$  SEC AND  $a = \underline{\hspace{2cm}}$  m/s<sup>2</sup>.

SHE CONTINUE WITH THE SAME ACCELERATION UNTIL HER VELOCITY IS 85 m/s. FIND THE TOTAL TIME TO ACHIEVE THAT VELOCITY,  $t = \underline{\hspace{2cm}}$  SEC. FIND HER AVERAGE VELOCITY FOR THE ENTIRE ACTIVITY,  $\bar{v} = \underline{\hspace{2cm}}$  m/s. FIND HER TOTAL DISPLACEMENT WHILE ACCELERATING,  $x = \underline{\hspace{2cm}}$  m.

2. CINDY RELEASES A TEDDY BEAR FROM REST FROM ATOP THE EMPIRE STATE BUILDING. BEING FURRY WITH LOTS OF AIR FRICTION, THE *URSUS ARCTOS* FALLS -54 m AT WHICH POINT ITS VELOCITY IS -18 m/s. FIND:  $\bar{v} = \underline{\hspace{2cm}}$  m/s  $t = \underline{\hspace{2cm}}$  s  $a = \underline{\hspace{2cm}}$  m/s<sup>2</sup>. FIND ITS VELOCITY WHEN IT HAS FALLEN FOR A TOTAL OF TWENTY-FOUR SECONDS,  $v = \underline{\hspace{2cm}}$  m/s. FOR THE TOTAL FALL, FIND  $\bar{v} = \underline{\hspace{2cm}}$  m/s AND  $y = \underline{\hspace{2cm}}$  m.

3. JAMES BOND IS ZOOMING OVER HORIZONTAL SNOW AT 120 m/s WHEN HE SPIES A HUGE SNOWMAN 750m AHEAD. BRAKING WITH HIS SKIS, BOND REDUCES HIS VELOCITY TO 80 m/s WHILE TRAVELING 400 m. FOR THIS INITIAL INTERVAL, FIND:  $\bar{v} = \underline{\hspace{2cm}}$  m/s  $t = \underline{\hspace{2cm}}$  s  $a = \underline{\hspace{2cm}}$  m/s<sup>2</sup>. BOND CONTINUES BRAKING TO A STOP. FOR THE ENTIRE ACTIVITY, FIND:  $\bar{v} = \underline{\hspace{2cm}}$  m/s  $t = \underline{\hspace{2cm}}$  s  $x = \underline{\hspace{2cm}}$  m. IS BOND SAFE OR IS HE IMPALED ON THE CARROT NOSE OF THE SNOWMAN?


ANSWERS: 45, 10, 4, 15, 55, 825; -9, 6, -3, -72, -36, -864; 100, 4, -10, 60, 12, 720, SAFE BY 30 m.

2. ALAN, BOUNCING ON A POGO STICK, LEAVES THE GROUND WITH A VELOCITY OF 30 m/s.

- DETERMINE THE TOTAL TIME THAT HE IS AIRBORNE. (6)
- FIND HIS MAXIMUM ELEVATION. (45 m)
- TIME TO REACH THE ZENITH. (3 SEC)
- WITH WHAT VELOCITY DOES HE STRIKE THE GROUND? (-30)
- AFTER HOW MANY SECONDS IS HIS SPEED 5 m/s? (2.5+3.5)

3. KEVIN, ATOP A 30 m HIGH TOWER, THROWS A WATERMELON DOWN WITH AN INITIAL VELOCITY OF -20 m/s.

- FIND THE TOTAL TIME AIRBORNE. (1.16 SEC)
- WITH WHAT VELOCITY DOES THE GREEN ELLIPSOID KISS THE CONCRETE? (-31.6 m/s)
- FIND ITS ELEVATION WHEN ITS VELOCITY IS -25 m/s (18.75 m)

4. ANNA STANDS ATOP A BUILDING WHICH IS 50 m HIGH. SHE FLINGS AN ORANGE STRAIGHT UPWARDS. WHEN THE IRISH FRUIT IS 8 m ABOVE THE TOP OF THE BUILDING, ITS VELOCITY IS 40 m/s. THE PATH: 

- FIND THE INITIAL VELOCITY OF THE CITRUS. (42 m/s)
- THE TOTAL TIME AIRBORNE. (9.46 SEC)
- WHAT IS ITS VELOCITY FIVE SECONDS AFTER ANNA FIRES IT UPWARD? (-8)
- DETERMINE ITS ELEVATION ABOVE THE GROUND WHEN ITS SPEED IS 25 m/s. (107 m)
- AT WHAT TIME IS ITS ELEVATION 105 m ABOVE THE GROUND? (6.78, 1.62 SEC)
- TIME TO REACH ITS ZENITH. (4.2 SEC)
- TIME FROM THE APEX TO THE GROUND. (5.26 SEC)

Kinematics: One-dimensional motion with Constant Acceleration

1. With what vertical velocity does a kangaroo take off if he reaches a height of 2.4 meters? (6.93)
2. We dropped a pumpkin into a well. We hear the splash 4 seconds later. Neglecting the speed of sound, calculate the depth of the well. (-80)
3. If we drop an OSTRICH egg off the cliffs at Torrey Pines, which are 30 meters high, how long does it take for the egg to reach the sands of FRANK'S Beach? (2.45)
4. Sound travels at 330 m/s through air. How many seconds elapse from dropping the egg to the instant we hear the splat? (2.54)
5. A troll catches the egg after it has fallen the 30 m. Saved! But no! He throws the egg back up at us with an initial speed of 35 m/s.
  - a) How fast is the egg going as it zooms past our face? (25)
  - b) How high does it go? (61.25)
  - c) How long will the egg be in the air? (7)
  - d) How fast is the egg moving just before it strikes the troll? (-35)
6. MR HARVIE DOES AN EXPERIMENT TO CHECK THE SEAT BELTS IN HIS CAR. a) FROM AN INITIAL VELOCITY OF 20 m/s, MR. H. BRAKES TO A STOP IN 50 m. DETERMINE HIS ACCELERATION. (-4 m/s<sup>2</sup>)  
b) MR. H. NOW, FROM 20 m/s, BRAKES TO A STOP OVER A DISTANCE OF 25 m. FIND HIS ACCELERATION. (-8)  
c) LASTLY, MR. H, FROM 40 m/s, BRAKES TO A STOP OVER A DISTANCE OF 25 m. FIND a. (-32 m/s<sup>2</sup>)  
WARNING. BE CAREFUL, HIGH ACCELERATIONS ARE UNHEALTHFUL
7. ZORRO, THE FOX, leaps off a 15 m high building and lands on TORINADO. ZORRO started from rest on top of the roof.
  - a) How long does it take him to fall that distance? (1.73)
  - b) How fast is he going when he hits the saddle? (-17.3)
  - c) If the Masked Man comes to rest .2 seconds after he hits the saddle, what is his acceleration? (86.5, OUCH!)

8. HALLOWEEN! HERR HARVIE, DISGUISED AS HUMPTY DUMPTY STEPS OF THE TOP OF THE WALL. DUE TO AIR FRICTION, MR. EGG HEAD PICKS UP SPEED VERY SLOWLY. AFTER FALLING -98 m, MR. H'S VELOCITY METER READS -28 m/s. FIND HIS:
  - A) ACCELERATION
  - B) TOTAL TIME AIRBORNE
  - C) TIME AT WHICH HIS VELOCITY IS -92 m/s.
  - D) POSITION AT  $t = 18$  SECONDS.  
(-4 m/s<sup>2</sup>, 7 sec, 23 sec, -648 m)
9. THE GREAT PUMPKIN LANDS AT LINDBERGH FIELD WITH VELOCITY 90 m/s. AFTER A DISPLACEMENT OF 243 m, THE SQUASH'S VELOCITY IS 72 m/s. FIND THE:
  - A) ACCELERATION
  - B) TOTAL DISTANCE TO STOP
  - C) TOTAL TIME TO STOP
  - D) POSITION AT  $t = 5$ .
  - E) TIME AT WHICH HER VELOCITY IS 36 m/s.  
(-6 m/s<sup>2</sup>, 675 m, 15 sec, 375 m, 9 sec)
10. OLYMPIC GAMES! CARL LEWIS ACCELERATES FROM REST TO 12 m/s OVER A DISTANCE OF 15 m. FIND:
  - A) HIS ACCELERATION
  - B) TIME
  - C) AVERAGE VELOCITY  
(4.8 m/s<sup>2</sup>, 2.5 sec, 6 m/s)
11. SKIING AT 120 m/s, CRAIG SPIES A SNOWMAN AHEAD AND THROWS ON THE BRAKES. AFTER TRAVELING 210 m, HIS VELOCITY IS 90 m/s. FIND THE TOTAL DISTANCE AND TIME TO STOP. (480 m, 8 SECONDS)
12. DALE LEAPS OUT OF A HELICOPTER AND FALLS FREELY FOR FIVE SECONDS. AFTER OPENING HIS PARACHUTE, HE FALLS AN ADDITIONAL -42 m WHILE THE CHUTE ARRESTS HIS FALL. AT THAT POINT, HIS VELOCITY IS -34 m/s. FIND HIS:
  - A) VELOCITY WHEN HE OPENED HIS CHUTE.
  - B) ACCELERATION WHILE THE CHUTE WAS PULLING UPWARD ON HIM.  
(-50 m/s, 16 m/s<sup>2</sup>)