



1. For a long time it was the dream of many runners to break the "4-minute mile." Now quite a few runners have achieved what once seemed an impossible goal. On July 2, 1988, *Steve Cram* of Great Britain ran a mile in 3.81 min. During this amazing run, what was Steve Cram's average speed in mi/hour?. **Resp.: 15.75 mi/min**

2. Two buses leave Houston at the same time and travel in opposite directions. One bus averages 50 mi/hour and the other bus averages 45 mi/hour. In how many hours will they be 570 miles apart? **Resp.: 6 h.**

3. A train leaves Little Rock and travels north at 85 km/h. Another train leaves one hour later and travels north at 95 km/h. How long after the first train leaves do the trains meet? How far did the trains travel? **Resp.: 9.5 h; 807.5 mi..**

4. Two planes leave at 9 AM from airports that are 2700 miles apart and fly towards each other at speeds of 200 mph (plane A) and 250 mph (plane B). At what time will they pass each other? How far will the plane A travel? **Resp.: 3 P.M., 1200 mi.**

5. A car is cruising at 100 km/h when it slams on the breaks. It stops in 4.5 seconds. If the acceleration is constant, find the acceleration and the distance it took to stop the car. **Resp: 6.17 m/s², 62.5 m.**

6. You are driving at 30 m/s when you pass a police car at rest. If it speeds up from rest with a uniform 2.44 m/s² how much time does it take for the police to pass you, how far have you traveled?. **Resp: 24.6 s, 738 m.**

7. The Road Runner, traveling at 55 meters per second, is cruising down the road, *Wili E. Coyote* sees our fine-feathered friend and starts out from rest to catch him just as the road runner passes him. In 10 seconds, he reaches for the Runner (just before he smashes into a rock.) What was his acceleration? How far did W. E. Coyote travel? **Resp: 550 m, 11 m/s²**

8. A rock is dropped from the *Empire State Building*. If the building is 300 m tall, how long will it take for the rock to hit the ground? How fast will it be moving when it hits the ground? **Resp: 7.8 s, 76.7 m/s.**

9. A ball is thrown vertically upward with an initial velocity of 20 meters per second. Calculate: a) The maximum height reached by the ball. b) The total time for which the ball is in the air. **Resp: a) 20.4 m b)3.9 s**

10. A ball is thrown upwards at 18 m/s from a point that is 12 m above the ground. a) What is the maximum height above the ground that this ball will rise to? b) How long was required to reach this point? c) What will be the velocity of the ball three seconds after release. d) How long will this ball be in the air?. e) With what velocity will the ball impact the ground? **Resp: a) 28.5 m. b) 1.84 s. c) - 11.4 m/s. d) 4.25 s. e) - 23.65 m/s.**

11. A boy throws a ball straight up from 10 m above the ground. The ball reaches a max height of 30 m . a) Find the ball's *initial velocity* and the *total flight time* of the ball if it then proceeds to land on the ground (since the boy misses catching it). **Resp.: 19.8 m/s ; 4.49 s .**

12. A man throws a ball straight upward. The ball leaves his hand at a height of 1.5 m above the ground and its initial velocity is 8 m/s . a) *How high* above the ground will the ball reach? b) *How long* will the ball take to reach its *maximum height*?. **Resp.: a) 4.8 m . b) 0.81 s , c) 0.42 s ; 0.21 s .**

13. A rifle bullet is shot *vertically upward*. *Twenty three seconds later* the bullet has a velocity of 72.0 m/s , *downward*. What is the *velocity* of the bullet when it *left the rifle*? What was the *maximum elevation*? *How long* was required to reach *this point*? **Resp: 153 m/s , 1190 m , 15.6 s .**

14. A ball thrown vertically upward is caught 5 seconds by the person who threw it at exactly the same height it left her hand. Find the *initial velocity* of the ball and the *max height*. **Resp.: 25 m/s , 31 m .**

15. A man *drops* a penny off the top of a 100 m tall cliff. Another man, lying on the ground below the cliff, throws another penny *straight up* at with an *initial velocity* of 50 m/s . Find the *time at which both penny's are at the same height* above the ground. At this time, *how high* above the ground will they be. **Resp.: 2 s , 80.4 m .**

16. A projectile is fired with a speed of 31 m/s at an angle of 30° . a) What are the *initial x- and y- components of velocity*? b) *How high* will it rise, *how much time* will it spend in the air? c) *How far* will it travel downfield? d) What are the *x and y components of velocity as it returns to the ground*? **Resp: a) $V_{ox}= 26.8\text{ m/s}$; $V_{oy}=15.5\text{ m/s}$. b) 12.3 m ; 3.16 s . c) 84.8 m .**

17. A body is projected with a velocity of 200 m/s at an angle of 30° above the horizontal. Calculate: a) The *time* taken to reach the *maximum height*. b) Its *velocity after 16 s*. **Resp.: a) 10 s . b) $173\vec{i} - 60\vec{j}\text{ m/s}$.**

18. A particle is projected with a velocity of 30 m/s at an *angle of 40°* above the horizontal plane. Find: a) The *time* for which the particle is *in the air*. b) The *horizontal distance* it travels. c) *Maximum height*. d) *Velocity after 3 s*. **Resp: a) 3.9 s . b) 89 m . c) 19 m . d) $23\vec{i} - 10.1\vec{j}$.**

19. A mortar shell is fired at an angle of 53° with a speed of 98 m/s . *How long* is the shell in air? *How far* does it travel before hitting the ground? *How high* does it reach? **Resp.: 16 s ; 943 m ; 313 m .**

20. A bouncing ball leaves the ground with a velocity of 4.36 m/s at an angle of 81 degrees above the horizontal. a) *How long* did it take the ball to land? b) *How high* did the ball bounce? c) What was the ball's *range*? **Resp.: a) 0.88 s ; b) 0.95 s . c) 0.60 m .**

21. A projectile is launched and spends 3.0 seconds total time in the air and travels 75 meters in the horizontal direction. Determine: a) The horizontal and vertical components of launch velocity. b) The initial velocity (launch speed and angle). **Resp.:** a) $V_{ox} = 25.0$ m/s; $V_{oy} = 14.7$ m/s. b) 29 m/s; 30.4° above x-axis

22. Starting 2 m from the wall 0.55 m tall if you jumped at an angle of 32 degrees what must your minimum speed be? **Resp.:** 6.2 m/s

23. A biker jumps a canyon that is 12 m wide. He uses an 15 degree incline to approach the jump. What speed must he achieve to clear the canyon? **Resp.:** 15.3 m/s.

24. On level ground, a football is thrown up at a certain angle. The ball is in the air 2 s and strikes the ground 30 m from the thrower. What was the ball's total initial velocity? **Resp.:** $v = 18$ m/s 33° above horizontal

25. A ball is thrown horizontally at a speed of 24 meters per second from the top of a cliff. If the ball hits the ground 4.0 seconds later, approximately how high is the cliff? **Resp.:** 78.4 m.

26. A rescue plane wants to drop supplies to an adventurer 210 m below in a remote region in Central Australia. The plane travels horizontally towards the adventurer with a speed of 252 km/h. Ignore air resistance to simplify the calculations. a) How long will it take the supplies to hit the ground? b) How far (horizontal distance) in advance of the adventurer must the supplies be dropped in order to land next to the adventurer? c) With what speed do the supplies land on the ground?. **Resp.:** a) 6.54 s. b) 458 m. c) $70 \vec{i} - 64 \vec{j}$ m/s

27. Divers at Acapulco dive from a cliff that is 61 m high. If the rocks below the cliff extend outward for 23 m, what is the minimum horizontal velocity a diver must have to clear the rocks safely? **Resp.:** 6.5 m/s.

28. A movie stunt driver on a motorcycle speeds horizontally off a 50 m high cliff. How fast (in km/h) must the motorcycle leave the cliff-top if it's to land on the level ground below at a distance of 90 m from the base of the cliff? **Resp.:** 101 km/h.

29. A pebble is thrown from the top of a cliff at a speed of 10 m/s and at 30° above the horizontal. It hits the sea below the cliff 6 s later. Find a) The height of the cliff. b) The distance from the base of the cliff at which the pebble falls into the sea. **Resp:** a) 150 m. b) 52 m.

30. An airplane is climbing from take-off at a velocity of 65 m/s at an angle of 22.6° above the horizontal. At an altitude of 88.8 m above the ground a bolt drops from the plane. How long does the bolt rise before it begins to fall? What is the maximum height of the bolt above the ground? What is the total time of flight for the bolt? What is the impact velocity of the bolt? **Resp.:** a) 2.4 s b) 120 m c) 7.4 s d) 77.5 m/s; 39.2° below the horizontal.