Projectile motion concepts:

- An object projected upward will remain in the air longest if it is projected at 90 degrees
- An object projected sideways will have the largest horizontal velocity if it is projected at 0 degrees
- An object projected at 45 degrees will travel farthest in the air because it remains airborne while moving forward
- Acceleration remains constant and vertical throughout any projectile motion.
- The time for an object to drop a distance in freefall is the same as the time it takes an object to fall when projected horizontally.
- All these assume conditions in a vacuum where the projectile will not be slowed by air.

- Horizontal kinematics parameters are independent of vertical kinematics parameters, except for Time.

A kicked soccer ball has an initial velocity of 25 meters per second at an angle of 40.° above the horizontal, level ground. [Neglect friction.]

Calculate the magnitude of the vertical component of the ball's initial velocity. [Show all work, including the equation and substitution with units.] [2]

Calculate the maximum height the ball reaches above its initial position. [Show all work, including the equation and substitution with units.] [2]

On the diagram sketch the path of the ball's flight from its initial position at point *P* until it returns to level ground. [1]

14 Four projectiles, *A*, *B*, *C*, and *D*, were launched from, and returned to, level ground. The data table below shows the initial horizontal speed, initial vertical speed, and time of flight for each projectile.

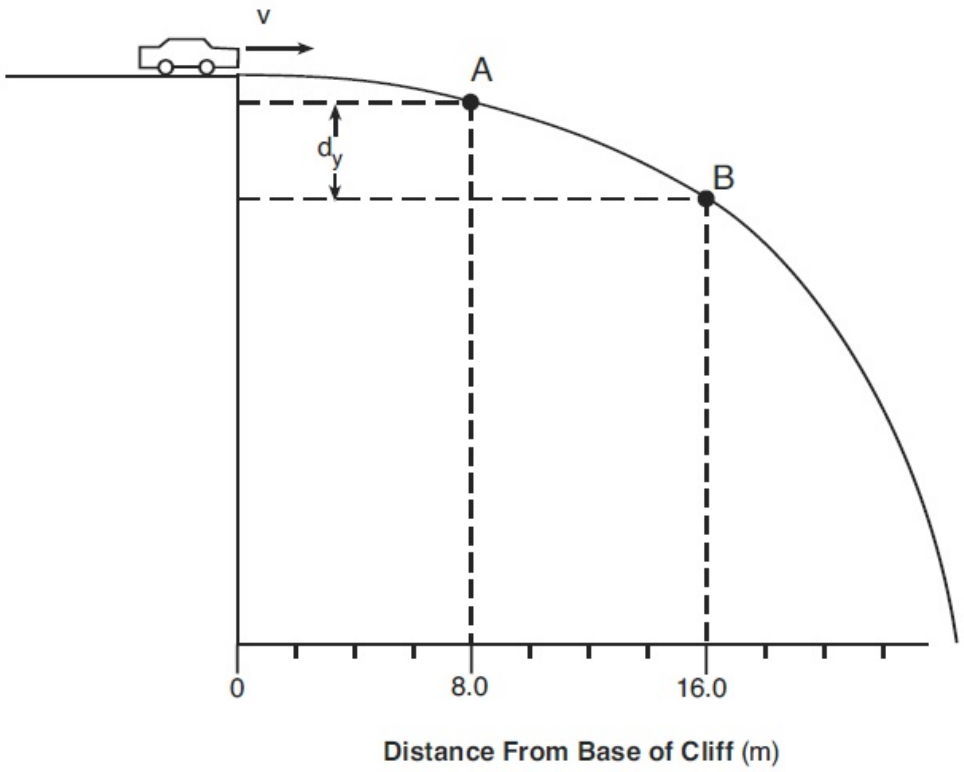
Data Table

Projectile	Initial Horizontal Speed (m/s)	Initial Vertical Speed (m/s)	Time of Flight (s)
A	40.0	29.4	6.00
B	60.0	19.6	4.00
C	50.0	24.5	5.00
D	80.0	19.6	4.00

Which projectile traveled the greatest horizontal distance? [Neglect friction.]

(1) *A*
(2) *B*
(3) *C*
(4) *D*

The path of a stunt car driven horizontally off a cliff is represented in the diagram below. After leaving the cliff, the car falls freely to point *A* in 0.50 second and to point *B* in 1.00 second.

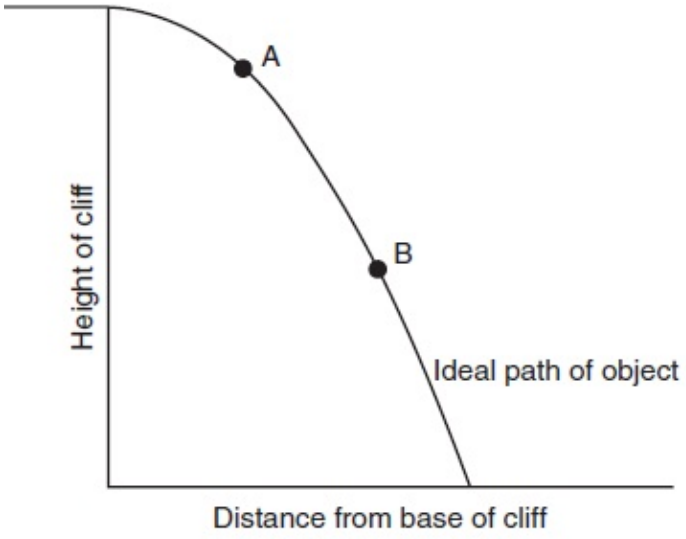


60 Determine the magnitude of the horizontal component of the velocity of the car at point *B*. [I friction.] [1]

61 Determine the magnitude of the vertical velocity of the car at point *A*. [1]

62 Calculate the magnitude of the vertical displacement, d_y, of the car from point *A* to point *B*. [Neg friction.] [Show all work, including the equation and substitution with units.] [2]

An object was projected horizontally from a tall cliff. The diagram below represents the path of the object, neglecting friction.

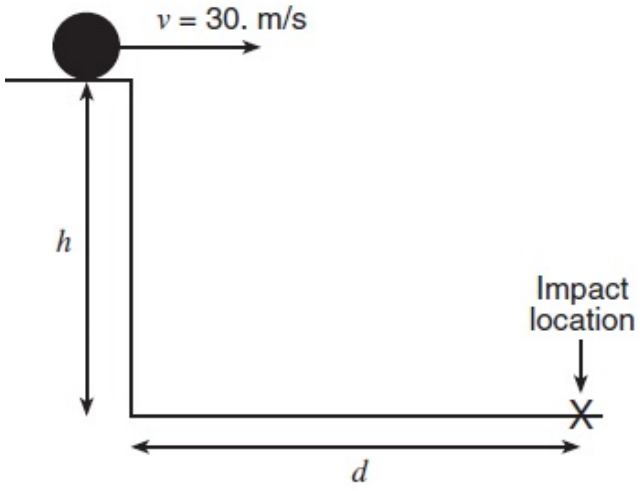


How does the magnitude of the horizontal component of the object's velocity at point *A* compare with the magnitude of the horizontal component of the object's velocity at point *B*? [1]

How does the magnitude of the vertical component of the object's velocity at point *A* compare with the magnitude of the vertical component of the object's velocity at point *B*? [1]

On the diagram *in your answer booklet*, sketch a likely path of the horizontally projected object, assuming that it was subject to air resistance. [1]

A projectile is launched horizontally at a speed of 30. meters per second from a platform located a vertical distance h above the ground. The projectile strikes the ground after time t at horizontal distance d from the base of the platform. [Neglect friction.]



On the diagram *in your answer booklet*, sketch the theoretical path of the projectile. [1]

Calculate the horizontal distance, d, if the projectile's total time of flight is 2.5 seconds. [Show all work, including the equation and substitution with units.] [2]

Express the projectile's total time of flight, t, in terms of the vertical distance, h, and the acceleration due to gravity, g. [Write an appropriate equation and solve it for t.] [2]