



Vectors and Projectile Motion

27. Which of the following is a vector quantity?

- A) Speed
- B) Mass
- C) Temperature
- D) Velocity

Solution: D. Velocity has direction.

28. The horizontal component of a projectile's velocity (ignoring air resistance):

- A) Increases
- B) Decreases
- C) Remains constant
- D) Is zero

Solution: C. No horizontal acceleration.

29. At the top of a projectile's path, the vertical acceleration is:

- A) Zero
- B) g downwards
- C) g upwards
- D) Depends on mass

Solution: B. Gravity always acts downwards.

30. Two vectors of magnitude 3 and 4 can have a maximum resultant of:

- A) 1
- B) 5
- C) 7
- D) 12

Solution: C. Max sum is $3 + 4 = 7$ (aligned).

31. A ball is dropped and another fired horizontally from the same height. Which hits the ground first?

- A) Dropped ball
- B) Fired ball
- C) Both at same time
- D) Depends on mass

Solution: C. Vertical motion is independent of horizontal motion.

32. Find the x-component of a vector with magnitude 10 at 60° to the x-axis.

- A) 5.0
- B) 8.7
- C) 10
- D) 0

Solution: A. $10 \cos(60^\circ) = 5.0$.

33. A vector has components $x = 3, y = 4$. Its magnitude is:

- A) 5
- B) 7
- C) 12
- D) 25

Solution: A. $\sqrt{3^2 + 4^2} = 5$.

34. A ball is thrown horizontally at 10 m/s from a height of 20 m. Time to hit ground? ($g = 10 \text{ m/s}^2$)

- A) 1 s
- B) 2 s
- C) 3 s
- D) 4 s

Solution: B. $y = 0.5gt^2 \implies 20 = 5t^2 \implies t = 2 \text{ s}$.

35. In the previous problem, how far horizontally does it travel?

- A) 10 m
- B) 20 m
- C) 30 m
- D) 40 m

Solution: B. $x = v_x t = 10 \times 2 = 20 \text{ m}$.

36. A projectile is launched at 30° with $v = 40 \text{ m/s}$. Vertical component of velocity?

- A) 20 m/s
- B) 34.6 m/s
- C) 40 m/s
- D) 0 m/s

Solution: A. $40 \sin(30^\circ) = 20 \text{ m/s}$.

37. A quarterback throws a football at a 45° angle. To maximize range, he should throw it:

- A) At 30°
- B) At 45°
- C) At 60°
- D) Horizontally

Solution: B. 45° gives maximum range for projectiles on level ground.

38. A boat heads directly north across a river flowing east. The boat's resultant velocity is:

- A) North
- B) East
- C) Northeast
- D) Northwest

Solution: C. Vector sum of North and East is Northeast.

39. A relief package is dropped from a plane flying horizontally. To an observer on the ground, the package follows a:

- A) Straight line down
- B) Parabolic path
- C) Circular path
- D) Straight line backwards

Solution: B. It has constant horizontal velocity and accelerating vertical motion.

Newton's Laws

40. **Inertia is a measure of an object's:**

- A) Velocity
- B) Force
- C) Mass
- D) Acceleration

Solution: C. Mass is the measure of inertia.

41. **If the net force on an object is zero, it must be:**

- A) At rest
- B) Moving with constant velocity
- C) Accelerating
- D) Falling

Solution: B. Or at rest (velocity=0 is constant). Generally, constant velocity.

42. **Action and reaction forces always act on:**

- A) The same object
- B) Different objects
- C) The ground
- D) Stationary objects

Solution: B. Newton's 3rd Law pairs act on different objects.

43. **The weight of an object depends on:**

- A) Mass only
- B) Gravity only
- C) Mass and Gravity
- D) Volume

Solution: C. $W = mg$.

44. **To keep an object moving at constant velocity on a frictionless surface requires:**

- A) A constant force
- B) A decreasing force
- C) Zero net force
- D) An increasing force

Solution: C. Newton's 1st Law.

45. **If you push a wall, the wall pushes back with:**

- A) Less force
- B) More force
- C) Equal force
- D) Zero force

Solution: C. Newton's 3rd Law.

46. **An object in deep space (no gravity) has:**

- A) No mass
- B) No weight
- C) No inertia
- D) No volume

Solution: B. Weight depends on gravity; mass is intrinsic.

47. **The normal force on a book resting on a flat table is equal to:**

- A) Its mass
- B) Its weight
- C) Friction
- D) Zero

Solution: B. Balances weight (if no other vertical forces).

48. **Doubling the net force on an object will:**

- A) Double the acceleration
- B) Halve the acceleration
- C) Quadruple the acceleration
- D) Not change acceleration

Solution: A. $a \propto F$.

49. Which law explains why passengers lurch forward when a bus stops?

- A) 1st Law
- B) 2nd Law
- C) 3rd Law
- D) Law of Gravity

Solution: A. Law of Inertia.

50. A 5 kg box on a frictionless surface is pushed to accelerate at 3 m/s². What force is applied?

- A) 1.6 N
- B) 8 N
- C) 15 N
- D) 0.6 N

Solution: C. $F = ma = 5 \times 3 = 15$ N.

51. You push a 2 kg object with a force of 10 N. What is the acceleration?

- A) 0.2 m/s²
- B) 5 m/s²
- C) 20 m/s²
- D) 8 m/s²

Solution: B. $a = F/m = 10/2 = 5$.

52. What is the weight of a 10 kg mass on Earth? ($g = 9.8$ m/s²)

- A) 10 N
- B) 98 N
- C) 1.02 N
- D) 980 N

Solution: B. $W = mg = 10 \times 9.8 = 98$ N.

53. An object weighs 50 N. What is its mass? ($g = 10$ m/s²)

- A) 5 kg
- B) 50 kg
- C) 500 kg
- D) 0.5 kg

Solution: A. $m = W/g = 50/10 = 5$ kg.

54. Two forces, 3 N and 4 N, act in the same direction. Net force is:

- A) 1 N
- B) 5 N
- C) 7 N
- D) 12 N

Solution: C. $3 + 4 = 7$ N.

55. Two forces, 10 N right and 4 N left, act on a 2 kg box. Acceleration?

- A) 3 m/s²
- B) 7 m/s²
- C) 14 m/s²
- D) 2 m/s²

Solution: A. $F_{net} = 10 - 4 = 6$ N. $a = 6/2 = 3$.

56. A 1000 kg car stops from 20 m/s in 5 s. Average force?

- A) 2000 N
- B) 4000 N
- C) 5000 N

D) 10000 N

Solution: B. $a = \Delta v/t = 20/5 = 4$. $F = ma = 1000 \times 4 = 4000$ N.

57. **If mass is doubled while force is constant, acceleration becomes:**

- A) Double
- B) Half
- C) Quadruple
- D) Unchanged

Solution: B. $a = F/m$. Inverse relationship.

58. **A 50 kg person pushes a 5000 kg wall with 100 N. Force on person?**

- A) 0 N
- B) 100 N
- C) 5000 N
- D) 50 N

Solution: B. Equal and opposite reaction.

59. **Net force on a 2 kg object moving at constant 5 m/s is:**

- A) 0 N
- B) 2.5 N
- C) 10 N
- D) 5 N

Solution: A. Constant velocity $\implies a = 0 \implies F = 0$.

60. **When a car turns a corner sharply, passengers slide to the outside. This is due to:**

- A) Centrifugal force
- B) Inertia
- C) Gravity
- D) Friction

Solution: B. Inertia (tendency to keep moving straight).

61. **An elevator accelerates upward. The normal force (apparent weight) on a passenger is:**

- A) Less than actual weight
- B) Greater than actual weight
- C) Equal to actual weight
- D) Zero

Solution: B. Floor pushes harder to accelerate you up.

62. **In a tug-of-war, Team A pulls with 1000 N and Team B pulls with 1000 N. The tension in the rope is:**

- A) 0 N
- B) 1000 N
- C) 2000 N
- D) 500 N

Solution: B. Tension transmits the force; it is 1000 N throughout.

Momentum

63. **Momentum is the product of:**

- A) Mass and acceleration
- B) Mass and velocity
- C) Force and time
- D) Force and distance

Solution: B. $p = mv$.

64. **Impulse is equal to:**

- A) Change in energy

- B) Change in momentum
- C) Force \times distance
- D) Mass \times acceleration

Solution: B. Impulse-Momentum Theorem.

65. **In an inelastic collision, which is conserved?**

- A) Kinetic Energy
- B) Momentum
- C) Both
- D) Neither

Solution: B. Momentum is conserved; KE is not.

66. **A rubber ball bounces; a clay ball sticks. Which receives a larger impulse?**

- A) Rubber ball
- B) Clay ball
- C) Same
- D) Depends on mass

Solution: A. Bouncing involves a larger change in velocity (reversal).

67. **For momentum to be conserved, the system must be:**

- A) Isolated (no external forces)
- B) Moving constant speed
- C) At rest
- D) Massless

Solution: A. No external net force.

71. **A soccer ball with mass 2 kg is moving at 3 m/s. What is its momentum?**

- A) 1.5 kg m/s
- B) 5 kg m/s
- C) 6 kg m/s
- D) 0.6 kg m/s

Solution: C. $p = mv = 2 \times 3 = 6$.

72. **During a collision, a 10 N force acts on an object for 2 s. What is the impulse?**

- A) 5 Ns
- B) 12 Ns
- C) 20 Ns
- D) 0.2 Ns

Solution: C. $J = F\Delta t = 10 \times 2 = 20$.

73. **A 2 kg object changes speed from 2 m/s to 5 m/s. Change in momentum?**

- A) 3 kg m/s
- B) 6 kg m/s
- C) 10 kg m/s
- D) 14 kg m/s

Solution: B. $\Delta p = m(v_f - v_i) = 2(5 - 2) = 6$.

74. **A 1 kg cart ($v=4$) hits a 1 kg stationary cart and sticks. Final velocity?**

- A) 1 m/s
- B) 2 m/s
- C) 4 m/s
- D) 0 m/s

Solution: B. $1(4) + 0 = (1 + 1)v \implies 4 = 2v \implies v = 2$.

75. **A 3 kg object slides at 2 m/s and then comes to rest. What is the impulse magnitude?**

- A) 2 Ns
- B) 3 Ns
- C) 5 Ns
- D) 6 Ns

Solution: D. $\Delta p = 3(0 - 2) = -6$. Magnitude 6.

76. **A 50 kg skater throws a 5 kg ball at 2 m/s. Skater's recoil speed?**

- A) 0.1 m/s
- B) 0.2 m/s
- C) 2 m/s
- D) 10 m/s

Solution: B. $50v = 5(2) \implies 50v = 10 \implies v = 0.2$.

77. **What force is needed to stop an object with momentum 10 kg m/s in 2 seconds?**

- A) 5 N
- B) 10 N
- C) 20 N
- D) 2 N

Solution: A. $F = \Delta p/t = 10/2 = 5$.

78. **Airbags reduce injury in a crash by:**

- A) Reducing the change in momentum
- B) Increasing the time of impact
- C) Decreasing the impulse
- D) Increasing the force

Solution: B. Increasing time reduces the average force for the same impulse.

79. **An astronaut floating in space throws a wrench forward. The astronaut moves:**

- A) Forward
- B) Backward
- C) Stays still
- D) Upward

Solution: B. Conservation of momentum (recoil).

80. **A bug hits a windshield. Which force is greater?**

- A) Force on bug
- B) Force on windshield
- C) They are equal
- D) Depends on speed

Solution: C. Newton's 3rd Law: forces are equal and opposite.

