Law of Motion

1. **Two weights w_1 and w_2 are suspended from the ends of a light string passing over a smooth fixed pulley. If the pulley is pulled at an acceleration g, the tension in the string will be**

(1) $\frac{4w_1w_2}{w_1+w_2}$ (2) $\frac{2w_1w_2}{w_1+w_2}$ (3) $\frac{w_1+w_2}{w_1-w_2}$ (4) $\frac{w_1w_2}{2(w_1+w_2)}$

2. **A rope of length L is pulled by a constant force F. The tension in the rope at a distance x from the end where the force is applied is**

(1) FL/x (2) F (L-x)/L (3) FL/ (L-x) (4) Fx/(L-x)

3. **When a running train stops suddenly, passengers in it feel an instant jerk in the forward direction because**

(1) The back of seat suddenly pushes the passengers forward

(2) Inertia of rest stops the train and takes the body forward

(3) Upper part of the body continues to be in the state of motion whereas the lower part of the body in contact with seat comes to rest

(4) Nothing can be said due to insufficient data

4. **Newton's second law gives the measure of**

(1) Acceleration (2) Force

(3) Momentum (4) Angular Momentum

5. **Inertia of a body has direct dependence on**

(1) Velocity (2) Volume (3) Mass (4) Density

6. A man is at rest in the middle of a pond on perfectly smooth ice. He can get himself to the shore by making use of Newton's

(1) First law (2) Second law (3) Third law (4) All the laws

7. An air-tight cage with a Parrot sitting in it is suspended from the spring balance. The Parrot starts flying. The reading of the spring balance will

(1) Increase (2) Decrease (3) Not change (4) Be zero

8. Newton's first law of motion gives the concept of

(1) Energy (2) Work (3) Inertia (4) Momentum

9. The apparent weight of a man in a lift is less than the real weight when the lift is going

(1) Up with an acceleration (2) Down with an acceleration

(3) Up with uniform speed (4) Down with uniform speed

10. We can derive Newton's

(1) Second and third laws from the first law

(2) First and second laws from the third law

(3) Third and first laws from the second law

(4) All the three laws are independent of each other

11. The apparent weight of a freely falling body is

(1) Increased (2) Decreased (3) Unchanged (4) Zero

12. On a stationary sail boat air is blown at the sails from a fan attached to the boat. The boat will

(1) Remain stationary

(2) Spin around

(3) Move in a direction opposite to that in which air is blown

(4) Move in the direction in which the air is blown

(5) Both the strings will break simultaneously

13. An open knife edge of mass m is dropped from a height h on a wooden floor. If the blade penetrates s into the wood, the average resistance offered by the wood to the blade is (where S is a distance)

(1) mg (2) $mg\left(1+\frac{h}{s}\right)$ (3) $mg\left(1-\frac{h}{s}\right)$ (4) $mg\left(1+\frac{h}{s}\right)^2$

14. A stationary railway platform on earth is

1) An inertial frame of reference for an observer on earth

2) A non inertial frame of reference for an observer on moon

3) Both are true

4) Both are false

15. A rotating platform for a stationary observer outside it is

1) Inertial frame of reference

2) Non inertial frame of reference

3) Both

4) Sometimes inertial (or) Sometimes non inertial

16. Frames moving uniformly with respect to an inertial frame are

1) Inertial frames 2) Non inertial frames 3) Both 4) Accelerated

17. If particle stays at rest as seen from a frame of reference

1) The frame may be inertial and a resultant force acts on it

2) The frame may be non inertial and $F_{real} = -F_{pseudo}$

3) The frame may be non inertial but a resultant force acts on it

4) The frame must always be inertial

18. The acceleration of a particle is found to be non zero while no force acts on the particle. This is possible if the measurement is made from

1) Inertial frame

2) Non - inertial frame

3) Both

4) Sometimes inertial (or) sometimes non inertial

19. A ball hangs from a string inside a rail road car moving along a straight track. The string is observed to be inclined towards the rear of the car making a constant small angle with the vertical. It shows that the car is

1) Moving with a uniform acceleration

2) Moving with a uniform velocity

3) Moving with a uniform retardation

4) Moving with an acceleration which is increasing uniformly

20. A body of mass m has its position x at a time t, expressed by the equation: $x = 3t^{3/2} + 2t - \frac{1}{2}$. The instantaneous force F on the body is proportional to

1) $t^{3/2}$ 2) t 3) $t^{-1/2}$ 4) t^0

21 A jet of water with a cross sectional area 'a' is striking against a wall at an angle q to the horizontal and rebounds elastically. If the velocity of water jet is v and the density is ρ, the normal force acting on the wall is

1) $2av^2\rho$ cosq 2) av ρcos q 3) 2 av ρcos q 4) av cos q

22. A constant force (F) is applied on a stationary particle of mass 'm'. The velocity attained by the particle in a certain displacement will be proportional to

1) m 2) 1/m 3) $\sqrt{m}$ 4) $\frac{1}{\sqrt{m}}$

23. A body is moving with acceleration 'a' under the action of a force 'g'. The weight of the body is

1) g/a 2) $-g^2/a$ 3) g^2/a 4) a^2/g

24. A force produces an acceleration of a, in a body and the same force produces an acceleration of a_2 in another body. If the two bodies are combined and the same force is applied on the combination, the acceleration produced in it is

1) $a_1 + a_2$ 2) $\frac{a_1 + a_2}{a_1 a_2}$ 3) $\frac{a_1 a_2}{a_1 + a_2}$ 4) $\sqrt{a_1 a_2}$

25. A rubber ball falls from a height h and rebounds to a height h/2. A rubber ball of double the mass falling from the same height h rebounds to a height

1) h 2) h/2 3) 3h/4 4) 2h

26. A fat hose pipe is held horizontally by a fireman. It delivers water through a constricting nozzle at 1 liter/sec. If by increasing the pressure, the water is delivered at 2 liter/sec, the fireman now has to

1) Push forward twice as hard 2) Push forward four times as hard

3) Push forward eight times as hard 4) Push backward four times as hard

27. A reference frame attached to the earth

a) Is an inertial frame by definition

b) Cannot be an inertial frame because the earth is revolving around the sun

c) Is an inertial frame because Newton's laws are applicable in this frame

d) Cannot be an inertial frame because the earth is rotating about its axis

1) a, b, c are correct 2) b only correct 3) b and d are correct 4) All are correct

28. **a) In a frame of reference S_1 , though the net force is zero, the net acceleration is not zero.**

b) In a frame of reference S_2, though the net force is not zero, the net acceleration is zero.

c) In a frame of reference S_3, the net acceleration is zero whenever the net force is zero.

1) S_1 and S_3 are inertial and S_2 is non-inertial

2) S_1 and S_2 are non-inertial and S_3 is inertial

3) S_1 , S_2 , S_3 are non-inertial

4) S_1 , S_2 , S_3 are inertial

29. **Statement A : If the lift is falling freely then the man on its floor experiences no reaction from the floor.**

Statement B : If the lift moves down with an acceleration a > g, then the normal reaction becomes negative and the man feels floating up in the lift.

1) A and B are correct
2) A and B are false
3) A is true and B is false
4) A is false and B is true

30. **(A): When a moving bus suddenly stops, a passenger in the bus tends to lean forward.**

(R): Newton's first law gives the concept of inertia.

(1) Both (A) and (R) are true and (R) is the correct explanation of (A)

(2) Both (A) and (R) are true and (R) is not the correct explanation of (A)

(3) (A) is true but (R) is false

(4) (A) is false but (R) is true

31. **(A): Newton's law of motion is applicable for particles only.**

(R): During any kind of collision centre of mass of the system of particles will not be accelerated.

(1) Both (A) and (R) are true and (R) is the correct explanation of (A)

(2) Both (A) and (R) are true and (R) is not the correct explanation of (A)

(3) (A) is true but (R) is false

(4) (A) is false but (R) is true

32. (A): A player lowers his hands while catching a cricket ball.

(R): Increase in the time of catch, decreases the impulsive force.

(1) Both (A) and (R) are true and (R) is the correct explanation of (A)

(2) Both (A) and (R) are true and (R) is not the correct explanation of (A)

(3) (A) is true but (R) is false

(4) (A) is false but (R) is true

33. (A): Sportsman runs some distance before taking a long jump.

(R): Because of inertia body remains in state of motion or rest.

(1) Both (A) and (R) are true and (R) is the correct explanation of (A)

(2) Both (A) and (R) are true and (R) is not the correct explanation of (A)

(3) (A) is true but (R) is false

(4) (A) is false but (R) is true

34. Assertion (A): According to Newton's third law sum of action and reaction is not equal to zero

Reason (R): The forces action and reaction acts on different bodies

1. A and R are correct and R is the correct explanation of A

2. A and R are correct and R is not the correct explanation A

3. A is true and R is false

4. A is false and R is true

35. Assertion (A): When a ball of mass hits normally a wall with a velocity and rebounds with same velocity, impulse imparted to the wall is.

Reason (R): Impulse = change in linear momentum

1. A and R are correct and R is the correct explanation of A
2. A and R are correct and R is not the correct explanation A
3. A is true and R is false
4. A is false and R is true

36. An object is placed in a lift. Match its apparent weight with the given situation.

Situation	Apparent Weight
(a) Lift moving with uniform velocity	**(e) Zero**
(b) Lift moving up with acceleration a.	**(f)** $W\left(1-\frac{a}{g}\right)$
(c) Lift moving down with acceleration a	**(g)** $W\left(1+\frac{a}{g}\right)$
(d) Lift falling down as the supporting cables are snapped	**(h) W**

(1) a-e, b-h, c-f, d-g (2) a-h, b-g, c-f, d-e

(3) a-h, b-f, c-e, d-g (4) a-e, b-g, c-f, d-h

37. Match list (I) with List (II)

LIST - I	LIST - II
a) Recoil of gun	**e) Newton's first law**
b) Acceleration in one dimension	**f) Newton's second law and motion in two directions**
c) Definition of force	**g) Projectile motion**
d) Measurement of force	**h) Newton's third law**

1) $a \to e, b \to g, c \to h$ and $d \to f$ 2) $a \to h, b \to g, c \to e$ and $d \to f$

3) $a \to e, b \to h, c \to g$ and $d \to f$ 4) $a \to h, b \to e, c \to g$ and $d \to f$

38. A man of mass m is on the floor of a lift then match the following:

LIST – I **LIST – II**

a) Lift is moving up with acceleration 'a' e) Apparent weight is greater than true weight

b) Lift is moving down with acceleration 'a' f) Apparent weight is zero

c) Lift is moving with uniform velocity g) Apparent weight is equal to true weight

d) Lift is freely falling h) Apparent weight is less than true weight

1) a-e, b-h, c-f, d-g 2) a-h, b-e, c-g, d-f

3) a-e, b-h, c-g, d-f 4) a-e, b-f, c-g, d-h

39. Statement A: Shock absorbers reduce the magnitude of change in momentum.

Statement B: Shock absorbers increase the time of action of impulsive force

1) A & B are true 2) A & B are false

3) A is true & B is false 4) A is false & B is true

40. When a force 1N acts on 1kg mass at rest for 1s, its final momentum is P. When 1N force acts on 1kg mass at rest through a distance 1m, its final momentum is $P^{|}$. The ratio of P to $P^{|}$ is

1) 1 : 1 2) $1:\sqrt{2}$ 3) 1 : 2 4) 2 : 1

41. A player caught a cricket ball of mass 150g moving at a rate of 20 m/s. If the catching process is completed in 0.1s, the force of the blow exerted by the ball on the hand of the player is equal to:

1) 150N 2) 3N 3) 30N 4) 300N

41. A body of mass 3 kg is moving along a straight line with a velocity of 24 ms^{-1}. When it is at a point 'P' a force of 9 N acts on the body in a direction opposite to its motion. The time after which it will be at 'P' again is,

1) 8s 2) 16s 3) 12s 4) 24s

43. A balloon with its contents weighing 160 N is moving down with an acceleration of g/2 ms^{-2}. The mass to be removed from it so that the balloon moves up with an acceleration of g/3 ms^{-2} is

1) 5kg 2) 10 kg 3) 6 kg 4) 3 kg

44. A body of mass 2kg is moving along positive X – direction with a velocity of 5 ms^{-1}. Now a force of $10\sqrt{2}$ N is applied at an angle 45^0 with X – axis. Its velocity after 3s is,

1) 20 ms^{-1} 2) 15 ms^{-1} 3) 25 ms^{-1} 4) 5 ms^{-1}

45. A machine gun fires a bullet of mass 40 g with a velocity 1200 ms^{-1}. The man holding it can exert a maximum force of 144N on the gun. How many bullets can he fire per second at the most?

1) One 2) Four 3) Two 4) Three

46. The apparent weight of man inside a lift moving up with certain acceleration is 900N. When the lift is coming down with the same acceleration apparent weight is found to be 300N. The mass of the man is (g = 10 ms^{-2})

1) 45 kg 2) 60 kg 3) 75 kg 4) 80 kg

47. When an empty lift is moving down with an acceleration of $\frac{g}{4}ms^{-2}$, the tension in the cable is 9000N. When the lift is moving up with an acceleration of $\frac{g}{3}ms^{-2}$, the tension in the cable is,

1) 16,000N 2) 18,000N 3) 12,000N 4) 15,000N

48. A 50kg man is standing at one end of a 25m long boat. He starts running towards the other end. On reaching the other end his velocity is 2ms^{-1}. If the mass of the boat is 200 kg, final velocity of the boat is (in ms^{-1}

1) $\frac{2}{5}$ 2) $\frac{2}{3}$ 3) $\frac{8}{5}$ 4) $\frac{8}{3}$

49. A gun mounted on the top of a moving truck is aimed in the backward direction at an angle of 30^{0} to the vertical. If the muzzle velocity of the gun is 4 ms^{-1}, the value of speed of the truck that will make the bullet come of out vertically is

1) 1 ms^{-1} 2) $\frac{\sqrt{3}}{2}ms^{-1}$ 3) 0.5ms^{-1} 4) 2ms^{-1}

50. A rocket of mass 20kg has 180 kg of fuel. The exhaust velocity of fuel is 1.6 km/sec. Calculate the ultimate velocity of the rocket gained, when the rate of consumption of the fuel is 2kg/sec. (Neglect gravity)

1) 3.7 km/sec 2) 2 km/sec 3) 10 km/sec 4) 5 km/sec

51. A 5000 kg rocket is set for vertical firing. The exhaust speed is $800ms^{-1}$. To give an upward acceleration of $20ms^{-2}$, the amount of gas ejected per second to supply the needed thrust is $\left(g=10ms^{-2}\right)$

1) $127.5\,kg\ s^{-1}$ 2) $137.5\,kg\ s^{-1}$ 3) $187.5\,kg\ s^{-1}$ 4) $185.5\,kg\ s^{-1}$

52. Three forces $\overline{F}_1, \overline{F}_2$ and $\overline{F}_3$ are simultaneously acting on a particle of mass 'm' and keep it in equilibrium. If $\overline{F}_1$ force were reversed in direction only, the acceleration of the particle will be.

1) $\overline{F}_1/m$ 2) $2\overline{F}_1/m$ 3) $-\overline{F}_1/m$ 4) $-2\overline{F}_1/m$

53. A block of metal weighing 2kg is resting on a frictionless plane. It is struck by a jet releasing water at a rate of 1 kg/s and at a speed of 5 m/s. The initial acceleration of the block will be

1. 2.5 m/s^2 2. 5 m/s^2 3. 10 m/s^2 4. 20 m/s^2

54. An object of mass 10 kg moves at a constant speed of 10ms^{-1}. A constant force that acts for 4 sec on the object gives it a speed of 2ms^{-1} in opposite direction. The force acting on the object is

1. –3N 2. –30 N 3. 3N 4. 30 N

55. A ball is suspended by a thread from the ceiling of a tram car. The brakes are applied and the speed of the car changes uniformly from 36 kmh^{-1} to zero in 5 s. The angle by which the ball deviates from the vertical (g = 10 ms^{-2}) is

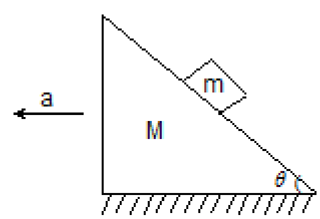
1. $\tan^{-1}\left(\frac{1}{3}\right)$ 2. $\sin^{-1}\left(\frac{1}{5}\right)$ 3. $\tan^{-1}\left(\frac{1}{5}\right)$ 4. $\cot^{-1}\left(\frac{1}{3}\right)$

1. 2 N 2. 4 N 3. 6 N 4. 8 N

56. A hammer of mass M strikes a nail of mass m with velocity of and drives it a meter into fixed block of wood. The average resistance of the wood to the penetration of the nail is

1. $\left(\frac{M}{M+m}\right)\frac{u^2}{2a}$ 2. $\left(\frac{M}{(M+m)^2}\right)\frac{u^2}{2a}$ 3. $\left(\frac{M+m}{M}\right)\frac{u^2}{2a}$ 4. $\left(\frac{M^2}{M+m}\right)\frac{u^2}{2a}$

57. A body is lying on the wedge as shown in figure. The necessary horizontal acceleration 'a' that must be given to the wedge towards right such that the body falls freely is



1. $a = g$ 2. $a = g\sin\theta$

3. $a = g\cos\theta$ 4. $a = g\cot\theta$

58. A ball of mass m is thrown upward with a velocity v. If air exerts an average resisting force F, the velocity with which the ball returns back to the thrower is

1. $v\sqrt{\frac{mg}{mg+F}}$ 2. $v\sqrt{\frac{F}{mg+F}}$ 3. $v\sqrt{\frac{mg-F}{mg+F}}$ 4. $\sqrt{\frac{VF}{mg+F}}$

59. A particle is acted upon by a force of constant magnitude which is always perpendicular to the velocity of the particle; the motion of the particle takes place in a place. It follows that

1. Its velocity is constant
2. It moves in a straight line
3. Its kinetic energy is constant
4. Its acceleration is constant

60. A small sphere of mass $m = 2kg$ moving with a velocity $\bar{u} = 4\hat{i} - 7\hat{j}\ m/s$ collides with a smooth wall and returns with a velocity $\bar{v} = \hat{i} - 3\hat{j}\ m/s$. The magnitude of the impulse received by the ball is

1) $5\,kg\,ms^{-1}$ 2) $10\,kg\,ms^{-1}$ 3) $20\,kg\,ms^{-1}$ 4) $15\,kg\,ms^{-1}$

61. A ball of mass 'm' is thrown at an angle of ' θ ' with the horizontal with an initial velocity 'u'. The change in its momentum during its flight in a time interval of't' is

1) mgt 2) $mgt\cos\theta$ 3) $mgt\sin\theta$ 4) $1/2\ mgt$

62. A bomb of mass 6 kg initially at rest explodes in to three identical fragments. One of the fragments moves with a velocity of $10\sqrt{3}\hat{i}\ m/s$, another fragment moves with a velocity if $10\hat{j}$ m/s, then the third fragment moves with a velocity of magnitude.

1) 30 m/s 2) 20 m/s 3) 15 m/s 4) 5 m/s

63. Three forces $20\sqrt{2}\,N$, $20\sqrt{2}\,N$ and 40N are acting along X, Y and Z – axis respectively on $5\sqrt{2}\,kg$ a mass at rest at origin. The magnitude of its displacement after 5s is,

1) 50m 2) 25m 3) 60m 4) 100m

64. The momentum of a body in two perpendicular direction at any time't' are given by $P_x = 2t^2 + 6$ and $P_y = \frac{3t^2}{2} + 3$. The force acting on the body at t = 2 sec is

1) 5 units 2) 2 units 3) 10 units 4) 15 units

65. A 15Kg mass is accelerated from rest with a force of 100N. As it moves faster, friction and air resistance create an oppositely directed retarding force given by F_R=A+BV. Where A=25 N and B=0.5Ns/miter At what velocity does the acceleration equal to one half of the initial acceleration?

1) $25ms^{-1}$ 2) $50ms^{-1}$ 3) $75ms^{-1}$ 4) $100ms^{-1}$

66. A railway flat car, whose mass together with the artillery gun is M, moves at a speed V. The gun barrel makes an angle with the horizontal. A shell of mass m leaves the barrel at a speed v, relative to the barrel. The speed of the flat car in order that it may stop after the firing is

1) $\frac{mv\cos\alpha}{M-m}$ 2) $\frac{mv}{M+m}$ 3) (M + m) v cos α 4) $\frac{Mv\cos\alpha}{M+m}$

67. A small mass is suspended by a string from the ceiling of a car. As the car accelerates at a rate 'a' the string makes an angle with the vertical. Then the tension in the string

1) $mg\cos\theta$ 2) $ma\sin\theta$

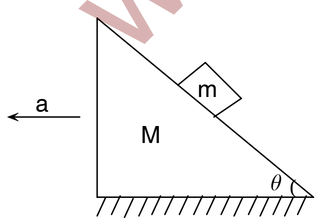
3) $m\sqrt{a^2+g^2}$ 4) $ma\sqrt{a^2+g^2}$

68. A pendulum of mass m hangs from a support fixed to a trolley. The direction of the string (i.e.., angle) when the trolley rolls up a plane of inclination with acceleration 'a' is

1) Zero 2) $\tan^{-1}\alpha$

3) $\tan^{-1}\frac{a+g\sin\alpha}{g\cos\alpha}$ 4) $\tan^{-1}\frac{a}{g}$

69. **All surfaces are smooth. The acceleration of mass m relative to wedge is**



1) $g\sin\theta$ 2) $g\sin\theta+a\cos\theta$ 3) $g\sin\theta-a\cos\theta$ 4) $a\cos\theta$

,

Key

1) 2	**2) 2**	**3) 3**	**4) 2**	**5) 2**	**6) 3**	**7) 3**	**8) 3**	**9) 3**
10) 2	**11) 3**	**12) 4**	**13) 2**	**14) 3**	**15) 2**	**16) 1**	**17) 2**	**18)2**
19) 1	**20) 3**	**21) 1**	**22) 4**	**23) 3**	**24) 3**	**25) 2**	**26) 2**	**27)3**
28) 2	**29) 1**	**30) 1**	**31) 2**	**32) 1**	**33) 1**	**34) 1**	**35) 1**	**36)2**
37) 4	**38) 3**	**39) 4**	**40) 2**	**41) 3**	**42) 2**	**43) 2**	**44) 4**	**45)4**
46) 2	**47) 1**	**48) 1**	**49) 4**	**50) 1**	**51) 3**	**52) 4**	**53) 1**	**54)2**
55) 3	**56) 4**	**57) 4**	**58) 3**	**59) 3**	**60) 2**	**61) 1**	**62) 2**	**63)4**
64) 3	**65) 3**	**66) 4**	**67) 3**	**68) 3**	**69) 2**			

Hints

40. $F = \frac{mu}{t} = \frac{p}{t} \rightarrow p = F \times t$

P = 1 x 1 = 1

$P^1 = \sqrt{2m(k\varepsilon)} = \sqrt{2m(F.s)}$

$= \sqrt{2(1)(1)(1)} = \sqrt{2}$

$\therefore \frac{P}{P^1} = \frac{1}{\sqrt{2}}$

41. $F = \frac{mv}{t} = \frac{0.15 \times 20}{0.1}$

F = 30N

42. $F_{stop} = F_{acc}$

$t_{stop} = \frac{mu}{F} = \frac{3 \times 24}{9} = 8\sec$

$t_{ace} = 8$

To reach again 8 + 8 = 16 sec

43. Mg – BF = M (g/2), BF – (M-x)g = (M-x) g/3

Adding $x = \frac{5M}{8}$,

$x = \frac{5}{8} \times 16 = 10kg$ Removed.

44. $u_x = 5$ $a_x = \frac{F\cos\theta}{m} = \frac{10}{2} = 5$

$V_x = u_x + a_x t = 5 + 5(3) = 20ms^{-1}$

$V_y = a_y.t = 5 \times 3 = 15ms^{-1}$

$V = \sqrt{V_x^2 + V_y^2} = \sqrt{20^2 + 15^2} = 25ms^{-1}$

45. F = n. m. u

144 = n. 40 x 10^{-3} x 1200

$n = \frac{144}{4 \times 12} = 3$

46. $W^1 = m(g+a)$ and $W^{11} = m(g-a)$

$\frac{900}{300} = \frac{g+a}{g-a} \Rightarrow a = \frac{g}{2}$, $W^1 = m(g+a)$

900 = m (10 + 5) $\Rightarrow$ m = 60 kg

47. T = m (g – a) T^1 = m (g +a)

$900 = m\left(g - \frac{g}{4}\right)$ $T^1 = m\left(g + \frac{g}{3}\right)$

$9000 \times \frac{4}{3} = mg$ $\qquad$ $T^1 = \frac{4}{3}(mg)$

$T^1 = \frac{4}{3} \times 9000 \times \frac{4}{3}$ $\qquad$ $T^1 = 16,000N$

48. $m_1v_1 + (m_1+m_2)\, v_2 = 0,$ $\qquad$ $v_2 = m_1v_1 / (m_1+m_2)$

$v_2 = 50\,(2) / (50 + 200) = 2/5\ ms^{-1}$

49. Bullet comes out vertically so, momentum along horizontal is zero

$m.\upsilon_t + m\upsilon \sin\theta = 0$

$\upsilon_t = -\upsilon \sin\theta = 4 \times \frac{1}{2} = 2ms^{-1}$

50. $V = V_0 + u \log_e\left(\frac{m_0}{m}\right)$

$= 0 + 1.6 \times \log_e\left(\frac{200}{20}\right) = 3.6816\ kms^{-1}$

51. $m(g+a) = \frac{dm}{dt}v$

52. $\vec{F}_1 = \vec{F}_2 + \vec{F}_3$

$a = \frac{-\vec{F}_1 + \vec{F}_2 + \vec{F}_3}{M}$

53. $F = v\frac{dm}{dt}$

54. $F = \frac{dp}{dt}$

55. $v = u + at,\ \tan\theta = \frac{a}{g}$

56. $v = \frac{Mu}{M+m},\ Fs = \frac{1}{2}(M+m)v^2$

57. $a\sin\theta + N = g\cos\theta$ for freely falling body

N = 0

58. Use conservation of energy in both the cases

60. $J = M\Delta V$

61. $J = Ft = \Delta P$

62. $\vec{P}_3 = -(\vec{P}_1 - \vec{P}_2)$

63. $\overline{F} = 20\sqrt{2}\,\overline{i} + 20\sqrt{2}\,\overline{j} + 40\overline{k}$

$F = 40\sqrt{2}$ $\quad a = \frac{F}{m} = \frac{40\sqrt{2}}{5\sqrt{2}} = 8ms^{-2}$

$\therefore S = \frac{1}{2}at^2 = \frac{1}{2}\times 8\times 5^2 = 100m$

64. Px = $2t^2 + 6$ $\quad Py = \frac{3t^2}{2} + 3$

Fx = 4t and Fy = 3t

$\overline{F} = 4t\overline{i} + 3t\overline{j}$

$|F| = 5t$

F = 5 x 2 = 10N

65. $a_i = \frac{F_{app} - F_R}{m} = \frac{100-(25+0)}{15}$

$a_i = 5\ ms^{-2}$

$a_f = \frac{a_i}{2} \rightarrow 2.5 = \frac{100-(25+0.5V)}{15}$

V = 75 ms^{-1}

66. $0 = M(V_{bGr}) + M(V_{gGr})$

$V_{bg} = V_{bGr} - V_{gGr}$

$0 = m(V_{bg} + V_{gGr}) + MV_{gGr}$

$0 = mV\cos\alpha + (M+m)V_{gGr}$

$V_{gGr} = \frac{mV\cos\alpha}{(M+m)}$

67. $T = \sqrt{F^2 + (mg)^2}$

$T = \sqrt{(ma)^2 + (mg)^2}$

$T = m\sqrt{a^2 + g^2}$

68. $T\cos\theta = mg\cos\alpha$

$T\sin\theta = mg\sin\alpha + ma$

$Tan\theta = \dfrac{g\sin\alpha + a}{g\cos\alpha}$

$\theta = Tan^{-1}\left[\dfrac{g\sin\alpha + a}{g}\right]$

69. F_{net} parallel to the inclined plane

$= ma\cos\theta + mg\sin\theta$

$ma_{net} = m(a\cos\theta + g\sin\theta)$

$a_{net} = a\cos\theta + g\sin\theta$