Solution

FORCE AND LAWS OF MOTION

Class 09 - Science

Section A

1.

(d) 6.67 ms^{-2}

Explanation:

$m_1 = \frac{5N}{10ms^{-2}}$ = 0.5 kg, $m_2 = \frac{5N}{20ms^{-2}}$ = 0.25 kg

Total mass = 0.5 + 0.25 = 0.75 kg.

Acceleration produced when both masses are tied together = $\frac{5N}{0.75kg}$ kg

= 6.67 ms^{-2}.

2.

(b) The forces acting on the ball are balanced.

Explanation:

When all the forces are balanced or the net force is zero, objects move with steady speed.

3.

(c) All have equal inertia

Explanation:

Inertia is directly proportional to mass, hence all the above given objects will have equal inertia.

4.

(c) 60000 N

Explanation:

Here, rate of burning fuel, $\frac{dm}{dt}$ = 1 kg s^{-1}

Velocity of fuel ejection, v = 60 km s^{-1} = 60000 m s^{-1}

Thrust = $\frac{dm}{dt}$ .v = 1 $\times$ 60000 = 60000 N

Thus, force exerted on rocket is 60000 N.

5.

(c) force

Explanation:

Fireman holds a hose by exerting a force because equal and opposite force acts on him. To counter that force he needs to hold the hose with force.

6.

(b) N-s

Explanation:

If we multiply the force acting on an object by the time it is acting for this is called the impulse of a force. Impulse is a vector quantity and its unit is the kilogram meter per second ($kgms^{-1}$) or the newton second (Ns).

7.

(d) decrease the rate of change of momentum

Explanation:

The goalkeeper pulls his hands backwards after holding the ball to decrease the rate of change of momentum by increasing the time. By doing this, less force is exerted on his hands (v Force is directly proportional to the rate of change of momentum).

8.

(d) It always goes away from the earth

Explanation:

It always goes away from the earth

9.

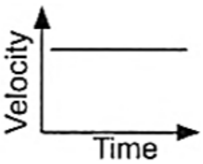
(b) N - s

Explanation:

The Newton second (also newton-second, symbol Ns or N·s)is the derived SI unit of Momentum. It is dimensionally equivalent to the momentum unit kilogram metre per second (kgm/s). One newton second corresponds to a one-newton force applied for one second.

$\vec{F}.t = \Delta m\vec{v}$

10.

(d) 

Explanation:

Net external force is zero, it means, particle is moving with constant velocity. Velocity-time graph of such a particle is represented by a straight line parallel to time axis.

11.

(c) 0 N

Explanation:

According to the first law of motion, an object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced external force

12.

(d) A, B

Explanation:

Newton's first law deals with rest or uniform motion of a body,i.e; An object at rest stays at rest and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force.

13.

(c) 6 m/s^2

Explanation:

For the first body,

F = m_1a_1

So, 5 = $m_1 \times 8$

So, $m_1 = \frac{5}{8}$ kg

For second body,

F = m_2a_2

So, 5 = $m_2 \times 24$

So, $m_2 = \frac{5}{24}$ kg

Combined mass of both bodies, $m_1 + m_2$

$= \frac{5}{8} + \frac{5}{24} = \frac{20}{24}$ kg

Now, m = $\frac{20}{24}$ kg

F = 5N

a = ?

F = ma

So, 5 = $\frac{20}{24} \times$ a

So, a = 5 $\times \frac{24}{20}$

So, a = $6 m/s^2$

14.

(b) zero

Explanation:

No reaction occurs between the ball and the base of the cup.

15. **(a)** 3v

Explanation:

Due to the conservation of momentum a collision between two bodies, the total momentum of the colliding bodies before the collision is equal to the total momentum after the collision.

$m_1v_1 = m_2v_2$

$m_1=1$, $m_2 = 3$, $v_2 = v$

$V_1 = 3v$

16.

(c) two

Explanation:

Force is directly proportional to the acceleration.

17.

(c) three

Explanation:

If two unequal forces are taken then given two vectors of unequal length, adding them will result in a non-zero vector because, in order to have a zero vector sum, the first and second vectors must "cancel out." For example, if you travel left 1 metre you must travel 1 metre right to return to your initial position. So, 3 unequal forces are mandatory for making resultant force zero.

18.

(b) always act on different bodies in opposite directions

Explanation:

According to Newton's 3rd law of motion , action and reaction are of equal magnitude and directed in opposite direction.

19. **(a)** Both (i) and (ii) are correct.

Explanation:

For a lift moving downward with acceleration a, Acceleration of body moving = g - a

20.

(d) move forwards

Explanation:

Water moves forward due to inertia of motion. Inertia is an inherent property of an object to resist any change in its state of rest or of uniformmotion.

21. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation:

Both A and R are true and R is the correct explanation of A.

22. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation:

According to Newton’s second law of motion, a = $\frac{F}{m}$ i.e., the magnitude of the acceleration produced by a given force is inversely proportional to the mass of the body. Higher is the mass of the body, lesser will be the acceleration produced i.e., the mass of the body is a measure of the opposition offered by the body to change a state when the force is applied i.e., the mass of a body is the measure of its inertia.

23.

(c) A is true but R is false.

Explanation:

A is true but R is false.

24. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation:

Both A and R are true and R is the correct explanation of A.

25.

(c) A is true but R is false.

Explanation:

Inertia is that property of the body due to which it resists a change in its state of rest or of uniform motion. Heavy objects have more inertia than lighter objects. For example, if we kick a stone it will not move because of high inertia but if we kick a football, it will move a long way.

26.

(b) Both A and R are true but R is not the correct explanation of A.

Explanation:

If the resultant of all the forces acting on a body is zero, then the forces are called balanced forces. Suppose a heavy box is lying on the ground. Let us push this box with our hands but it does not move. Though the box is at rest, four forces are acting on it – the force of the push, the force of friction, the force of gravity, and force of reaction. The forces acting on a stationary box is an example of balanced forces. Thus balanced forces cannot produce motion in a stationary body or stop a moving body.

27. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation:

Both A and R are true and R is the correct explanation of A.

28. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation:

A force can change the direction of a moving body. For example - in a cricket match, when a cricket ball is hit by a bat, then the direction of the cricket ball changes and it goes in another direction.

29. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation:

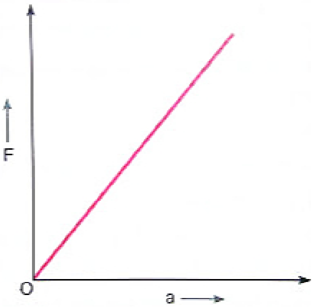
Heavy objects have more inertia than lighter objects. For example, if we kick a stone it will not move because of high inertia but if we kick a football, it will move a long way. Thus the inertia of an object is measured by its mass.

30. **(a)** Both A and R are true and R is the correct explanation of A.

Explanation:

While catching a fast-moving cricket ball, a fielder in the ground gradually pulls his hands backwards. While doing so, the fielder increases the time during which the high velocity of the moving ball decreases to zero. Thus, the acceleration of the ball is decreased and therefore the impact of catching the fast-moving ball is also reduced.

31. Newton’s second law of motion gives the measure of force.
32. This is because of the frictional forces acting opposite to the direction of motion. It is the result of the retarding action of friction.
33. The force of attraction or repulsion of particles or objects because of their electric charge is known as electrostatic force.It is also known as Coulomb force or Coulomb interaction.
34. Dyne
35. We define one newton as that force which when acting on a mass of 1 kg produces in it an acceleration of $1m/s^2$ in its own direction.
    $1N = 1kgm/s^2$
36. No,action and reaction forces act simultaneously but on different bodies.Action and reaction forces occur in pairs only.

37. According to Newton’s second law of motion, the rate of change of momentum of a body is equal to the force acting on it and the change in momentum takes place in the same direction as the force applied.
38. A body continues to move with the same velocity if no unbalanced force acts on it.It stays at rest or moves in a straight line with constant speed, i.e. it will remain unaccelerated.
39. No, If two equal and opposite forces acts on an object, they both cancel out each other. Hence, there will be no motion. The object will remain in the state of rest.
40. 

Section B

41. Mass of bullet (m) = 10 g = 0.01 kg

Initial velocity of bullet (u) = 150 ms^{-1}

Final velocity of bullet (V) = 0

Time (t) = 0.03 sec

Acceleration on bullet (a) = ?

Force acting on wooden block (F) =?

Distance penetrated by bullet (s) =?

We know:

v = u + at

0 = 150 + a × 0.3

$\Rightarrow$ -a $\times$ 0.03 = 150

$\Rightarrow a = \frac{-150}{0.03}$ = -5000 ms^{-2}

We know; S = ut + 1/2 at 2

= 150 $\times$ 0.03 + $\frac{1}{2}$ $\times$ (-5000) $\times$ $(0.03)^2$

= 4.5 - 2.25 = 2.25 m

We know, F = ma

Force acting on bullet (F)

= 0.01 $\times$ (-5000)

= -50 N

Negative sign denotes that wooden block exerts force in the direction, opposite to the direction of motion of the bullet.

42. Mass of ball (m) = 200 g = 0.2 kg

Initial velocity of ball (u_1) = 10 ms^{-1}

Final velocity of ball (u_2) = -5ms^{-1}

(Negative sign denotes that ball is moving in opposite direction)

Initial momentum of ball = mu_1

= 0.2 × 10 = 2 Ns

Final momentum of ball = mu_2

= 0.2 × (-5) = -1Ns

Change in Momentum = Final Momentum - Initial Momentum

= -1 - 2 = -3Ns

Negative sign denotes that change in momentum is in the direction opposite to the direction of initial momentum of the ball.

43. Here,

Mass of the automobile,m = 1,500 kg

Negative acceleration,a = -1.7 ms^{-2}

Force needed to stop the vehicle,F =?

Using the relation, F=ma

=1500 kg × (-1.7 ms^{-2}) = -2,550 kg ms^{-2} = -2550 N

The negative value of the force indicates that it is acting in the direction opposite to the direction of motion.So,the retarding force needed to stop the vehicle is 2550 N.

44. Mass of the body (m) = 5 kg

Force acting on the body (F) = 200 N

∴ Acceleration acting on the body = $a = \frac{F}{M} = \frac{200}{5} = 40ms^{-2}$

45. Let, Mass of the first block = m_1

Acceleration of the first block = a_1

Mass of the second block = m_2

Acceleration of the second block = a_2

Also, a_2 = 5 a_1

If the force acting on each block be F.

Then, F = m_1a_1 and F = m_2a_2 = m_2 × 5a_2

or m_1a_1 = m_2a_2 = m_2 × 5a_1

or m_1 = 5m_2

This gives, $\frac{m_2}{m_1} = \frac{1}{5}$ Thus, the mass of the second block is one-fifth that of the first block.

46. We have m_1 = $\frac{F}{a\ 1}$, and m_2 = $\frac{F}{a\ 2}$.

Here we have given that, a = 1 = 10 ms^{-2}, a_2 = 20 ms^{-2} and F = 5 N

Thus m_1 = $\frac{5N}{10}$ ms^{-2} = 0.50 kg; and m_2 = $\frac{5N}{20}$ ms^{-2} = 0.25 kg

If the two masses were tied together, the total mass, m would be m = 0.50 kg + 0.25 kg = 0.75 kg

The acceleration, a produced in the combined mass by the 5 N force would be, a = $\frac{F}{m}$ = $\frac{5N}{0.75kg}$ = 6.67 ms^{-2}.

47. It is given that u = 3 ms^{-1} and v = 7 ms^{-1}, t = 2 s and m = 5 kg

Now according to Newton's 2nd Law of motion

$F = \frac{m(v-u)}{t}$

Substitution of values in this relation gives

F = 5 kg $\frac{(7\text{ms}^{-1} - 3\text{ms}^{-1})}{2s}$ = 10 N

Now, if this force is applied for a duration of 5 s (t = 5 s), then the final velocity can be calculated as

v = u + $\frac{Ft}{m}$

On substituting the values of u, F, m, and t, we get the final velocity, v = 13 ms^{-1}.

48. Initial velocity (u) = 0, Final velocity (v) =?

Height (S) = 0.8 m, Acceleration (g) = 10 ms^{-2}

Using, v^2 - u^2 = 2 gS we have

v^2 - $(0)^2$ = 2 × 10 × 0.8

v^2 = 16 or v = 4 ms^{-1}

Therefore, Momentum of dumbbell = m × v

= 10 kg × 4 ms^{-1} = 40 N.

49. Here, Initial velocity of sphere, u = 0

h=10 m

Acceleration of sphere, a = 9.8 ms^{-2}

Final velocity of sphere when it just reaches the ground can be calculated using

$v^2 - u^2 = 2gh$

$\implies v^2 - 0 = 2 \times 9.8ms^{-2} \times 10m = 196m^2s^{-2}$

$\implies v = \sqrt{196\,m^2s^{-2}} = 14\,ms^{-1}$

Momentum of the sphere just before it touches the ground = mv

= 1 kg $\times 14ms^{-1} = 14kgms^{-1}$

On reaching the ground, the iron sphere comes to rest, so its final momentum is equal to zero according to the law of conservation of momentum.

Momentum transferred to the ground = Momentum of the sphere just before it comes to rest = 14 $kgms^{-1}$

50. Mass of bullet (m) = 10 g = 0.01 kg

Initial velocity of the bullet (u) = 0

Final velocity of the bullet (v) = 300 ms^{-1}

Time (t) = 0.003 s

Now acceleration of the bullet $a = \frac{v-u}{t} = \frac{300-0}{0.003} = 100,000 ms^{-2}$

Hence force on the bullet F = ma

F = 0.01 $\times$ 100,000 = 1000 N

51. Initial velocity of car = 45 km h^{-1}

= 45 $\times$ $\frac{5}{18}$ = $\frac{225}{18}$ ms^{-1}

Final velocity of the car (v) = 0

Time (t) = 5 s

Mass of the car (m) = 1000 kg

Force exerted by the tree on the car

F = $\frac{m(v-u)}{t}$ = $\frac{1000\times\left(0-\frac{225}{18}\right)}{5}$

= $\frac{-1000\times225}{90}$ = -2500 N

Hence force exerted by the car on tree

= -(F) = -(-2500 N) = 2500 N

52. Mass of the vehicle (m) = 1500 kg

Negative acceleration (a) = -1.7 ms^{-2}

$\therefore$ Force of friction between the road and vehicle

F = ma

F = 1500 $\times$ (-1.7)

= -2550 N

Negative sign means force is acting in the direction opposite to the direction of motion of the vehicle.

53. m = 500 g = 0.5 kg, t = 10 s, F = 10^{-2} N = 0.01 N and u = 0

From F = m a we have s = $\frac{F}{m}$ = $\frac{0.01}{0.5}$ = 0.02ms^{-2}

S = ut + $\frac{1}{2}at^2$

We have S = 0 + $\frac{1}{2}$ $\times$ 0.02 $\times$ $(10)^2$ = 1 m

54. $Here, the\ mass\ of\ the\ hammer = 500\,g = \frac{500}{1000}\,kg = 0.5\,kg,$

Initial velocity, u = 50 ms^{-1}

Final velocity, v =0

Time taken, t = 0.01 s

From Newton's second law of motion, we have

$F = ma = \frac{m(v-u)}{t} = \frac{0.5\,kg(0\,ms^{-1}-50\,ms^{-1})}{0.01\ \ s}$

$= \frac{-25\,kg\,ms^{-1}}{0.01\,s}$

= -2500 kg ms^{-2} = -2500 N

So, the force of the nail on the hammer is 2500 N. Negative sign indicates that the force is acting opposite to the motion.

55. We have given that,

The initial velocity of the motorcar u = 108 km/h

$= \frac{108\times1000m}{(60\times60s)}$

= 30 ms^{-1}

and the final velocity of the motorcar v = 0 ms^{-1}

The total mass of the motorcar along with its passengers = 1000 kg and the time taken to stop the motorcar, t = 4 s.

We have the magnitude of the force (F) applied by the brakes as

$\frac{m(v-u)}{t}$

On putting the values in the above equation, we get

F = 1000 kg $\times$ (0 - 30) $ms^{-1} = \frac{1000kg \times (0-30)ms^{-1}}{4s}$

= - 7500 kg ms^{-2} or - 7500 N

The negative sign tells us that the force exerted by the brakes is opposite to the direction of motion of the motorcar.

56. Mass of stone (m) = 1 kg

Initial velocity of stone (u) = 20 ms^{-1}

Final velocity of stone (v) = 0

Distance covered by the stone (s) = 50 m

Acceleration of stone (a) = ?

Force acting on the stone due to friction (F) =?

We know;

$v^2 - u^2 = 2as$

$(0)^2 - (20)^2 = 2a \times 50$

- 400 = 100 a

$a = \frac{-400}{100}$ = -4

a = - 4 ms^{-2}

Force of friction (F) = ma

= 1 $\times$ (-4)

= - 4 N

Negative sign signifies that force of friction is acting in the direction opposite to the direction of motion of the stone.

57. Here, m = 0.4 kg, u = 10 m/s

Initial momentum of the ball = mu = 0.4 $\times$ 10 = 4 kg m/s

At the highest point, velocity of ball is zero,

Therefore,the momentum of the ball at the highest point of flight = 0 $\times$ 4 = 0.

58. Given: m = 80 kg, u = 5 ms^{-1} v = 25 ms^{-1} and t = 2s

Now acceleration a = $\frac{\text{change in velocity}}{\text{time taken}} = \frac{v-u}{t} = \frac{25-5}{2}$ = 10 ms^{-2}

Force = mass $\times$ acceleration or F = ma

Therefore, F = 80 $\times$ 10 = 800N

59. We are given,

Acceleration, a = 8 ms^{-2}

Initial velocity, u = 0

Time interval, t = 1 s

Distance travelled, S = ?

Using the equation of motion, S = ut + $\frac{1}{2}at^2$, one gets

S = 0 $\times$ 1 + $\frac{1}{2} \times 8 \times 1^2$

The object travels a distance of 4 m.

60. We are given,

Initial velocity u = 0 ms^{-1}

Distance travelled, S = 400 m

Time interval, t = 20 s

Mass of the truck, m = 7 m ton = 7000 kg

a) To find the acceleration of the truck

Using the equation of motion, S = ut + $\frac{1}{2}at^2$ we have

400 = 0 + $\frac{1}{2}$ $a(20)^2 \Rightarrow a = \frac{2\times400}{20\times20}$ = 2ms^{-2}

b) To find the force acting on the truck

Using Newton's second law of motion,

F = m $\times$ a = 7000 $\times$ 2 ms^{-2} = 14000 N

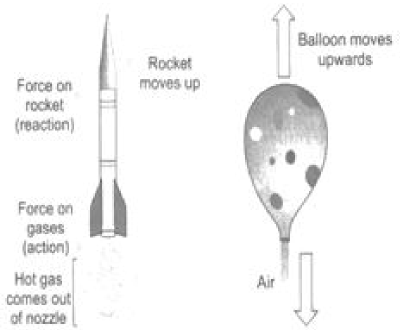
61. Quantum of inertia depends on mass of the object. For same volume, the mass of steel would be highest; compared to aluminium or wood. Hence, the solid of steel would have the highest inertia.

62. According to the second law of motion, F = ma--------(i)

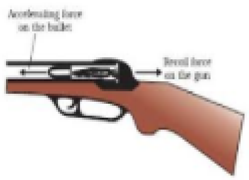
If no external force is acting on the object at rest,we can write,
F = 0-------(ii)
From (i) and (ii),we get
$m \times a = 0$
Since, m cant be zero,a=0.
According to Newton's second law of motion
F= rate of change of momentum
$F = \frac{mv-mu}{t}$
If F=0, then

$\frac{mv-mu}{t} = 0$
or, $v - u$=0 ('m' cant be 0)
so, $v = u$ (for whatever time t is taken.)
This means that if no external force is applied on the moving object,then its initial and final velocities are equal. It means that the body will continue to be in the state of uniform motion along a straight line if no external force acts on it.

63. The working of the rotation of sprinkler is based on third law of motion. As the water comes out of the nozzle of the sprinkler, an equal and opposite reaction force comes into play. So, the sprinkler starts rotating.
64. When the branch is suddenly set in motion, the leaves attached to it tend to continue in their state of rest because of inertia of rest. It generates a lot of strain at the junction of leaves and the branch. Because of this strain some leaves get detached from the branch.
65. a. Jet airplanes and rockets work on the principle of Newton's third law of motion.
In this case, the hot gases come out of a nozzle (a fine opening) with a great force, i.e., action and the rocket moves with high speed upwards as a reaction.
b. If we fill a balloon with air and hold it with its mouth downwards, then when we release the balloon, the air rushes out vertically downwards (action). *The balloon moves vertically upwards (reaction).

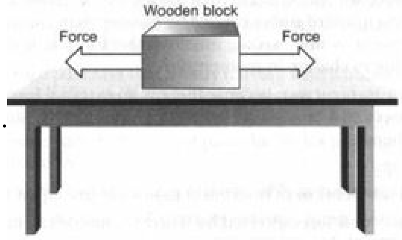


c. When a gun is fired, the bullet goes out (action) due to the force applied on it. According to Newton's third law of motion, the gun recoils backward due to the reaction acting on it in the opposite direction.



66. Yes, the balls will start rolling in the direction in which the train was moving. Due to the application of the brakes, the train comes to rest but due to inertia the balls try to remain in motion.Therefore, they begin to roll. Since the masses of the balls are not the same, therefore, the inertial forces are not same on both the balls. Thus, the balls will move with different speeds.
67. Initially, the carpet and dust-particles are at rest. When the carpet is beaten, it is suddenly set into motion. The dust particles tend to remain at rest due to the inertia of rest, therefore, dust comes out of it.
68. If the resultant of various forces acting on a body is zero, the forces are said to be ‘balanced forces’. These forces do not change the speed but usually change the shape of an object. Examples:
a. Consider a wooden block lying on a table, the strings tied to its two opposite faces, as shown in the figure.
If we pull at point P, it begins to move towards left. If we pull at point Q, it begins to move towards the right. But if we pull

from both the sides with equal force, the block does not move. The two forces have now balanced each other



.

b. In a tug-of-war, the two teams pull the rope with equal effort; the rope is not moved in any direction. This is clearly because the forces exerted by the two teams are equal and opposite and thus get balanced.

69. The player does so as to decrease the rate of change of momentum by increasing the time.In doing so,the entire momentum of the ball is reduced to zero in a long time interval.In other words,the rate of change of momentum is small.As a result,according to Newton's second law of motion,the player has to apply a small force on the ball.In reaction,the ball also applies less force and the palms of the player are not injured.If the ball is stopped suddenly,then the entire momentum of the ball will be reduced to zero in a very short time which will cause a larger rate of change of momentum resulting in greater action and reaction forces.Thus the palms of the player will be hurt.

70. In the course of walking on the hard ground, as we push the earth backward with out feet, the earth applies a reaction and pushes us in the forward direction. However, when the reaction is missing we tend to fall. This often happens when we step on a banana peel. The peel slips under our feet and hence does not apply any reaction. Thus, we lose our balance and fall.

Section C

71. i. The inertia of an object depends on the mass it has, therefore the greater the mass, the more will be the inertia.hence , inertia of 50 kg mass is more.
ii. It is defined as a property of matter by which it remains at the state of rest or in uniform motion in the same straight line unless acted upon by some external force.
iii. According to Newton's first law of motion, the dust particles stay in a state of rest, while the carpet moves. Hence, the dust particle comes out of the carpet due to inertia.
OR
Due to inertia of motion, an object do not stop all of a sudden rather it continues to move over some distance.that's why an athlete doesn't come to rest immediately after crossing the finish line.

Section D

72. **Newton's Second Law of Motion:** The rate of change of momentum is directly proportional to the force applied in the direction of force.
According to the question:
Initial velocity (u) = 0, final velocity (v) = 10m/s, time (t) = 20 second, Mass (m) = 10000 kg,
Therefore, force (F) = ?
We know that force (F) $= m\frac{(v-u)}{t}$
F = $(10000)\frac{(10-0)}{20}$
= $\frac{100000}{20}$
= 5000 N
Thus the required force is 5000 N.

73. Mass of player 1 = m_1 = 60 kg
Mass of player 2 = m_2 = 55 kg
If v is the velocity of the two entangled players after the collision, the total momentum then
= $(m_1 + m_2) \times v$
= (60 + 55) kg $\times$ v ms^{-1}
= 115 $\times$ v kg ms^{-1}
Equating the momenta of the system before and after the collision, in accordance with the law of conservation of momentum, we get
v = $\frac{-30}{115}$
= -0.26 ms^{-1}
Thus, the two entangled players would move with velocity 0.26 m s^{-1} from right to left, that is, in the direction the second player was moving before the collision.

Let the first player be moving from left to right. By convention left to right is taken as a positive direction and thus right to left is the negative direction. If symbols m and u represent the mass and initial velocity of the two players, respectively. Subscripts 1 and 2 in these physical quantities refer to the two hockey players. Thus,

m_1 = 60 kg; u_1 = + 5 ms^{-1}; and

m_2 = 55 kg; u_2 = - 6 ms^{-1}.

The total momentum of the two players before the collision

= 60 kg $\times$ (+ 5 m s^{-1}) + 55 kg $\times$ (-6 ms^{-1})

= - 30 kg ms^{-1}

74. Force exerted by the engine,F' = 40,000 N

Frictional force offered by the track in the direction opposite of the motion,F" = -5,000 N

(a) The net accelerating force, F = F'+F"= 40,000 N + (-5,000 N) = 35,000 N

(b) Mass of each wagon of the train = 2000 kg

Number of wagons = 5

Therefore, Mass of the train,m= 2,000 kg $\times$ 5= 10,000 kg.

Net accelerating force acting on the train,F= 35000 N

From Newton's second law of motion, acceleration

$a = \frac{F}{m} = \frac{35{,}000\ N}{10{,}000\ kg} = 3.5\ ms^{-2}$

(c)Mass of 1 wagon= 2000 kg

acceleration of the train= 3.5 ms^{-2}

From the relation,F =ma,we get

F= 2000 kg $\times$ 3.5 ms^{-2}

F= 7000 N

Force exerted by wagon 1 on wagon 2

=Net accelerating force - Force acting on wagon 1= 35000 N - 7000 N= 28000 N

Therefore,the required answer is 28000 N

75. Force,F = 5N

Mass,m = 2 kg

i. $F = m \times a$

$\implies 5 = 2 \times a$

$\implies a = 2.5\ m/s^2$

Therefore,acceleration produced by the body is 2.5 ms^{-2}

ii. Final velocity,v = 0

Initial velocity ,u = 0 (body starts from Rest)

Time,t = 4 s

From the relation,

$v = u + at$

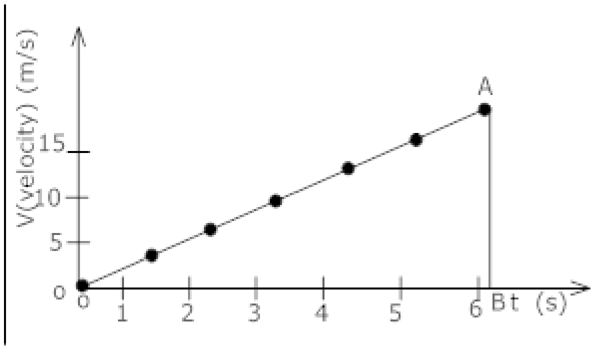
$\implies v = 2.5 \times 4$

$\implies v = 10\ m/s$

Therefore,the velocity at t=4 s is $10ms^{-1}$

iii.

For t = 0	1	2	3	4	5	6
V = 0	2.5	5	7.5	10	12.5	15



iv. Distance Travelled = Area under v/t curve = Area of ΔAOB

$= \frac{1}{2} \times \text{Base} \times \text{Height}$

$= \frac{1}{2} \times OB \times AB$

$= \frac{1}{2} \times 6 \times 15$

$= 45\, m$

Therefore, distance travelled in 6 s is 45 m.