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PHYSICS

BOOKS - FULL MARKS PHYSICS (TAMIL ENGLISH)

LAW OF MOTION

Solved Example

1. A book of mass m is at rest on the table.

(1) What are the forces acting on the book?

(2) What are the forces exerted by the book?

(3) Draw the free body diagram for the book

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2. If two objects of masses 25 kg and 100 kg experience the same force 5 N, what is the acceleration experienced by each of them?

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3. Which is the greatest force among the three force $\overrightarrow{F}_1, \overrightarrow{F}_2, \overrightarrow{F}_3$ as shown below?

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4. Apply Newton's second law to a mango hanging from a tree. (Mass of the mango is 400 gm)

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5. A person rides a bike with a constant velocity $\vec{v}$ with respect to ground and another biker accelerates with acceleration ā with respect to ground. Who can apply Newton's second law with respect to a stationary observer on the ground?

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6. The position vector of a particle is given by $\vec{r} = 3t\hat{i} + 5t^2\hat{j} + 7\hat{k}$

Find the direction in which the particle experiences net force?

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7. Consider a bob attached to a string, hanging from a stand. It oscillates as shown in the figure.

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8. The velocity of a particle moving in a plane is given by the following diagram. Find out the direction of force acting on the particle?

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9. Apply Newton's second law for an object at rest on Earth and analyse the result.

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10. A particle of mass 2 kg experiences two forces,

$\overrightarrow{P}_1 = O, \overrightarrow{P}_2 = O$ and $\overrightarrow{F}_2 = 3\hat{i} - 4\hat{j} + 3\hat{k}$

. What is the acceleration of the particle?

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11. Identify the forces acting on blocks A, B and C shown in the figure.

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12. Consider a horse attached to the cart which is initially at rest. If the horse starts walking forward, the cart also accelerates in the forward direction. If the horse pulls the cart with force F_h in forward direction, then according to Newton's third law, the cart also pulls the horse by equivalent opposite force $F_c = F_h$ in backward direction. Then total force on cart+horse' is zero. Why is it then the 'cart+horse'accelerates and moves forward?

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13. The position of the particle is represented by $y = ut - \frac{1}{2}gt^2$

(a) What is the force acting on the particle?

(b) What is the momentum of the particle?

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14. A baby is playing in a swing which is hanging Rigid support with the help of two identical chains is at rest. Identify the forces acting on the baby. Apply Lami's theorem and

find out the tension acting on the chain.

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15. Identify the internal and external forces acting on the following systems. (a) Earth alone as a system (b) Earth and Sun as a system (c) Our body as a system while walking (d) Our body + Earth as a system

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16. An object of mass 10 kg moving with a speed of 15 ms- hits the wall and comes to res within (a) 0.03 second (b) 10 second. Calculate the impulse and average force acting on the object in both the cases

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17. Consider an object of mass 2 kg resting on the floor. The coefficient of static friction between the object and the floor is μ_8 = 0.8.

What force must be applied on the object to move it?

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18. Consider an object of mass 50 kg at rest on the floor. A Force of 5 N is applied on the object but it does not move. What is the frictional force that acts on the object?

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19. Two bodies of masses 7 kg and 5 kg are connected by a light string passing over a smooth pulley at the edge of the table as shown in the figure. The coefficient of static friction between the surfaces (body and table) is 0.9. Will the mass m_1 = 7 kg on the surface move? If not what value of m_2 should be used so that mass 7 kg begins to slide on the table?

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20. A block of mass m slides down the plane inclined at an angle 60° with an acceleration g/2. Find the co-efficient of kinetic friction.

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21. Consider an object moving on a horizontal surface with a constant velocity. Some external force is applied on the object to keep the object moving with a constant velocity. What

is the net force acting on the object?

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22. If a stone of mass 0.25 kg tied to a string executes uniform circular motion with a speed of $2ms^{-1}$ of radius 3 m, what is the magnitude of tensional force acting on the stone?

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23. The Moon orbits the Earth once in 27.3 days in an almost circular orbit. Calculate the centripetal acceleration experienced by the Moon? (Radius of the Earth is $6.4 \times 10^6 m$).

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24. Consider a circular leveled road of radius 10 m having coefficient of static friction 0.81. Three cars (A, B and C) are travelling with speed 7 $ms^{-1}, 8ms^{-1}$ and $10ms^{-1}$

respectively, which car will skid when it moves in the circular level road? $\left(g = 10ms^{-2}\right)$:

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25. Consider a circular road of radius 20 meter banked at an angle of 15 degree. With what speed a car has to move on the turn so that it will have safe turn?

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26. Calculate the centrifugal force experienced by a man of 60 kg standing at Chennai. (Given: Latitude of Chennai is 13°)

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27. A body of mass 100 kg is moving with an acceleration of $50cms^{-2}$. Calculate the force experienced by it.

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28. Draw the free body diagram that represents the particle accelerating in positive x direction

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29. A gun weighing 25 kg fires a bullet weighing 30 g with the speed of $200ms^{-1}$. What is the speed of recoil of the gun?

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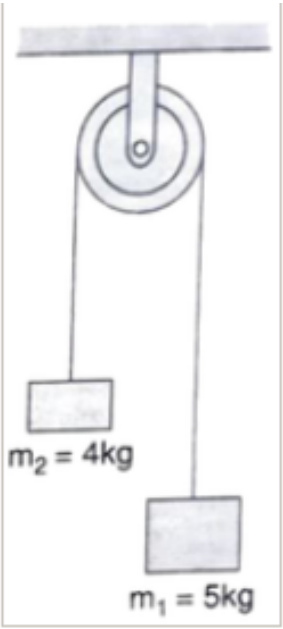
30. A wooden box is lying on an inclined plane. What is the coefficient of friction if the box starts sliding when the angle of inclination is 45°



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31. Two masses m_1 = 5 kg and m_2 = 4 kg tied to a string are hanging over a light frictionless pulley. What is the acceleration of each mass when left free to move? $\left(g = 9.8ms^2\right)$

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32. A block of mass m is pushed momentarily along a horizontal surface with an initial velocity u. If μ_k is the coefficient of kinetic

friction between the object and surface, find the time at which the block comes to rest.

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33. Three blocks of masses 10 kg, 7 kg and 2 kg are placed in contact with each other on a frictionless table. A force of 50 N is applied on the heaviest mass. What is the acceleration of the system?

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34. The coefficient of friction between a block and plane is $\frac{1}{\sqrt{3}}$ If the inclination of the plane gradually increases, at what angle will the object begin to slide?

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35. Find the maximum speed at which a car can turn round a curve of 36 m radius on a level road. Given the coefficient of friction between the tyre and the road is 0.53.

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36. Calculate the centripetal acceleration of the Earth which orbits around the Sun. The Sun to Earth distance is approximately 150 million km. (Assume the orbit of Earth to be circular)

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37. A block 1 of mass m_1 , constrained to move along a plane inclined at angle θ to the

horizontal, is connected via a frictionless, massless and inextensible string that passes over a massless pulley, to a second block 2 of mass m_2 . Assume the coefficient of static friction between the block and the me inclined plane is μ_s and the coefficient of kinetic friction is μ_k . What is the relation between the masses of block 1 and block 2 such that the system just starts to slip?

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38. Consider two objects of masses 5 kg and 20 kg which are initially at rest. A force 100 N is applied on the two objects for 5 second. (a) What is the momentum gained by each object after 5 s? (b) What is the speed gained by each object after 5 s?

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39. An object of mass 5 kg is initially at rest on the surface. The surface has coefficient kinetic friction μ_s = 0.6. What initial velocity must be

given to the object so that it travels 10 m before coming to rest?

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40. In the section 3.7.3 (Banking of road) we have not included the friction exerted by the road on the car. Suppose the coefficient of static friction between the car tyre and the surface of the road is μ_s, calculate the minimum speed with which the car can take safe turn? When the car takes turn in the

banked road, the following three forces act on the car. (1) The gravitational force mg acting downwards (2) The normal force N acting perpendicular to the surface of the road (3) The static frictional force f acting on the car along the surface.

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Textual Questions Solved Multiple Choice Questions

1. When a car takes a sudden left turn in the curved road passendgers are pushed towards the right due to

A. inertia of direction

B. inertia of motion

C. inertia of rest

D. absence of inertia

Answer: A

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2. An object of mass m held against a vertical wall by applying horizontal force F as shown in the figure . The minimum value of the force F is

A. Less than mg

B. Equal to mg

C. Greater than mg

D. Cannot determine

Answer: C

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3. A vehicle is moving along the positive x direction if sudden brake is applied then

A. frictional force acting on the vehicle is along negative x direction

B. frictional force acting on the vehicle is along positive x direction

C. no frictional force acts on the vehicle

D. frictional force acts in downward direction

Answer: A

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4. A book is at rest on the table which exerts a normal force on the book if this force is considered as reaction force what is the action force according to newton third law ?

A. Gravitational force exerted by Earth on the book

B. Gravitational force exerted by the book on Earth

C. Normal force exerted by the book on the table

D. None of the above

Answer: C

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5. Two masses M_1 and m_2 are experiencing the same force where $m_1 < m_2$ the ratio of their acceleration $\frac{a_1}{a_2}$ is

A. 1

B. less than 1

C. greater than 1

D. all the three cases

Answer: C

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6. Choose appropriate free body diagram for the particle experiencing net acceleration along negative y direction. (Each arrow mark represents the force acting on the system).

A. 

B. 

C. 

D. 

Answer: C

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7. Match the following

(a)	Piezo motors	-	Industrial robots
(b)	Nano solid	-	Less than 100 nm
(c)	Bulk soild	-	Exceeds 100 nm
(d)	Human Robot	-	Delta

A. greater acceleration along the path AB

B. greater acceleration along the path AC

C. same acceleration in both the paths

D. no acceleration in both the paths

Answer: B

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8. Two blocks of masses m and 2m are placed on a smooth horizontal surface as shown in the first case only a force F_1 is applied from the left later only a force F_2 is applied from the right if the force acting at the interface of the two blocks in the two case is same then $F_1 : F_2$ is

A. $1:1$

B. $1:2$

C. $2:1$

D. $1:3$

Answer: C

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9. Force acting on the particle moving with constant speed is

A. always zero

B. need not be zero

C. always nonzero

D. cannot be concluded

Answer: B

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10. An object of mass m begins to move on the plane inclined at an angle θ the coefficient of static friction of inclined surface is μ_s the

maximum static friction experienced by the mass is

A. mg

B. $\mu_s mg$

C. $\mu_s mg \sin\theta$

D. $\mu_s mg \cos\theta$

Answer: D

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11. When the object is moving at constant velocity on the rough surface

A. net force on the object is zero

B. no force acts on the object

C. only external force acts on the object

D. only kinetic friction acts on the object

Answer: A

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12. When the object is at rest on the inclined rough surface

A. static and kinetic frictions acting on the object is zero

B. static friction is zero but kinetic friction is not zero

C. static friction is not zero and kinetic friction is zero

D. static and kinetic frictions are not zero

Answer: C

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13. The centrifugal force appears to exist

A. only in inertial frames

B. only in rotating frames

C. in any accelerated frame

D. both in inertial and non-inertial frames

Answer: B

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14. Choose the correct statement from the following

A. Centrifugal and centripetal forces are action reaction pairs

B. Centripetal forces is a natural force

C. Centrifugal force arises from gravitational force

D. Centripetal force acts towards the center and centrifugal force appears to

act away from the center in a circular motion

Answer: D

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15. If a person moving from pole to equator of the earth then the centrifugal force acting on him is

A. increases

B. decreases

C. remains the same

D. increases and then decreases

Answer: A

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Textual Questions Solved Short Answer Questions

1. Explain the concept of inertia write two examples each inertia of motion inertia of rest and inertia of direction

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2. State Newton's second law .

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3. Define one newton

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4. Show that impulse is the change of momentum

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5. Using free body diagram show that it is easy to pull an object than to push it

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6. Explain various types of friction suggest a few methods to reduce friction

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7. What is the meaning by pseudo force ?

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8. State the empirical laws of static and kinetic friction

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9. State newton's third law

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10. What are interial frames ?

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11. Under what condion will a car skid on a leveled circular road ?

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12. Define Lami's theorem.

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13. Explain the motion of blocks connected by a string in (i) vertical motion (ii) horizontal

motion .

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14. Briefly explain the origin of friction show that in an inclined plane angle of friction is equal to angle of repose

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15. State newton three laws and discus their significance

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16. Explain the similarties and differences of centripetal and centrifugal forces

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17. Briefly explain centrifugal force with suitable examples

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18. What is meant by rolling friction ?

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19. Describe the method of measuring angle of repose

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20. Explain the need for banking of tracks.

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21. Calculate the centripetal acceleration of moon towards the earth

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Textual Questions Solved Long Answer Questions

1. Prove the law of conservation of linear momentum use it to find the recoil velocity of a gun when a bullet is fired from it

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Textual Questions Solved Conceptual Questions

1. Why is not possible to push a car from inside

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2. There is a limit beyong which the polishibng of a surface increases frictional resistance rather than decreasing it why

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3. Can a single isoloated force exist in nature explain your answer

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4. Why does a parachute descend slowly?

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5. When walking on ice one should take short steps why ?

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6. When a person walks on surface the frictional force exerted by the surface on the person is opposite to the direction of motion true or false

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7. Can the coefficent of friction be more than one

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8. Can we predict the direction of motion of a body from the direction of force on it

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9. The momentum of a system of particles is always conserved true or false

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Textual Questions Solved Numerical Problems

1. A force of 50 N act on the object of mass 20 kg calculate the acceleration of the object in x and y direction

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2. A spider of mass 50 g is hanging on a string of a cob web as what is the tension in the string

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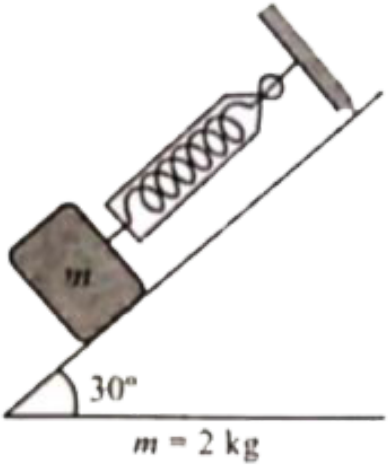
3. What is the reading shown in spring balance



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4. The physics books are stacked on each other in the sequence +1 and 2, +2 volumes 1 and 2 on a table identify the forces acting on each book and draw the free body diagram (b) Identify the forces exerted by each book on the other

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5. A bob attached to the string oscillates back and forth resolve the forces acting on the bob

in to compents what is the acceleration experience by the bob at an angle θ

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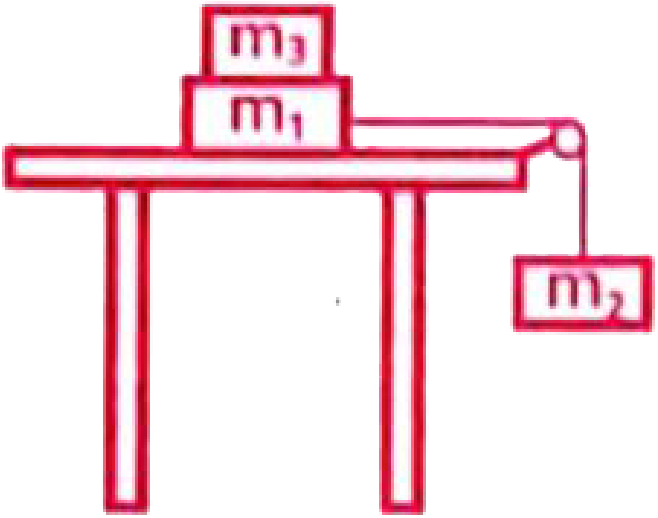
6. Two masses m_1 and m_2 are connected with a string passing over a frictionless pulley fixed at the corner of the table as shown in the the coefficent of static friction of mass m_1 with the table is μ_s calculate the minium mass m_3 that may be placed on m_1 to prevent it from sliding check if

$m_1 = 15kgm_2 = 10kg, mm_3 = 25$ and

$\mu_s = 0.2$



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7. Calculate the acceleration of the bicycle of mass 25 kg as

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8. Apply Lami's theorem on sling shot and calculate the tension in each string?

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9. A football player kicks a 0.8 kg ball and imparts it a velocity $12ms^{-1}$ the contact between the foot and ball is only for one sixtieth of a second find the average kicking force

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10. A stone of mass 2kg is attached to a string of length 1 meter the sting can withstand maximum tension 200 N what is the m

maximum speed that stone can have during the whirling motion ?

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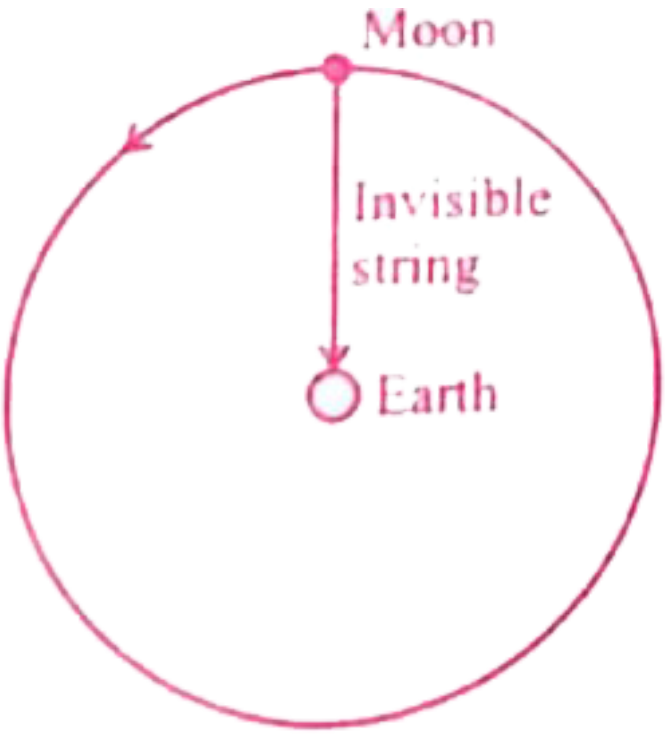
11. Imagine that the gravitational force between earth and moon is provided by an invisible string that exist between the moon and earth what is the tension that exists in this invisible string due to earth centripetal force

(Mass of the moon =$7.34 \times 10^{22} kg$ distance

between moon and earth =3.84×10^8m)



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12. Two bodies of masses 15kg and 10 kg are connected with light string kept on a smooth

surface a horizontal force F=500 N is applied to a 15 kg as calculate the tension acting in the sting

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13. People often say for every action there is an equuivalent opposite reaction here they meant action of a human is it correct to apply newton third law to human action ? What is

meant by action in newton third law given your argument based on newton 's laws

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14. A car takes a turn with velocity 50 ms^{-1} on the circular road of radius of curvature 10 m. Calculate the centrifugal force experienced by a person of mass 60 kg inside the car?

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15. A long stick rests on the surface a person standing 10 m away the stick with what minimum speed an object of masss 0.5 kg should he throuwn so that it hits the stick (Assume the coefficient of kinetic friction is 0.7)

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Additional Questions Solved Multiple Choice Questions

1. The concept " force causes motion" was given by

A. Galileo

B. Aristotle

C. Newton

D. Joule

Answer: B

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2. Who decoupled the motion and force?

A. Galileo

B. Aristotle

C. Newton

D. Joule

Answer: A

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3. The inability of objects to move on its own or change its state of motion is called as

A. force

B. momentum

C. inertia

D. impulse

Answer: C

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4. Inertia means

A. inability

B. resistance to change its state

C. movement

D. inertial frame

Answer: B

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5. When a bus starts to move from rest, the passengers experience a sudden backward push is an example for

A. Inertia of motion

B. Inertia of direction

C. Inertia of rest

D. back pull

Answer: C

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6. If the brake is applied in the moving bus suddenly, passengers move forward is an example for

A. Inertia of motion

B. Inertia of direction

C. Inertia of rest

D. back pull

Answer: A

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7. In whirling motion, if the string is cut suddenly, the stone moves tangential to circle is an example for

A. Inertia of motion

B. Inertia of direction

C. Inertia of rest

D. back pull

Answer: B

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8. Newton's laws are applicable in

A. Inertial frame

B. non-inertial frame

C. in any frame

D. none

Answer: A

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9. The accelerated train is an example for

A. inertial frame

B. non-inertial frame

C. both (a) and (b)

D. none of the above

Answer: B

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10. Rate of change of momentum of an object is equal to

A. acceleration

B. work done

C. force

D. impulse

Answer: C

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11. The product of mass and velocity of a particle is

A. force

B. impulse

C. momentum

D. acceleration

Answer: C

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12. The unit of momentum in SI system is _____.

A. $kgms^{-2}$

B. $kgms^{-1}$

C. MLT^{-2}

D. MLT^{-1}

Answer: B

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13. According to Newton's third law,

A. $F_{12} = F_{21}$

B. $F_{12} = -F_{21}$

C. $F_{12} + F_{21} = 0$

D. $F_{12} \times F_{21} = 0$

Answer: A

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14. According to Newton's third law,

A. $\vec{F}_{12} = -\vec{F}_{21}$

B. $\vec{F}_{12} = -F_{21}$

C. $\vec{F}_{12} + \vec{F}_{21} = 1$

D. $\vec{F}_{12} \times F_{21} = 0$

Answer: B

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15. The law which is valid in both inertial and non-inertial frame is

A. Newton's first law

B. Newton's second law

C. Newton's third law

D. none

Answer: C

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16. When a force is applied on a body, it can change

A. velocity

B. momentum

C. direction of motion

D. all the above

Answer: D

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17. The rate of change of velocity is $1ms^{-2}$ when a force is applied on the body of mass 75 gm the force is

A. 75 N

B. 0.75 N

C. 0.075 N

D. $0.75 \times 10^{-3} N$

Answer: C

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18. The action and reaction forces acting on

A. same body

B. different bodies

C. either same or different bodies

D. none of the above

Answer: B

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19. Newton 's first law of motion describes the following

A. velocity

B. energy

C. momentum

D. Inertia

Answer: D

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20. Inertia of the body depends on

A. velocity

B. area

C. mass

D. volume

Answer: C

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21. If a car and a scooter have the same momentum, then which one is having greater speed?

A. scooter

B. car

C. both have same velocity

D. data insufficient

Answer: A

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22. Newton's second law gives

A. $\vec{F} \propto \frac{d\vec{P}}{dt}$

B. $\vec{F} = \frac{d\vec{P}}{dt}$

C. $\vec{F} = m\vec{a}$

D. all the above

Answer: D

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23. 1 dyne is

A. $10^5 N$

B. $10^{-5} N$

C. $1N$

D. $10^{-3}N$

Answer: B

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24. If same force is acting on two masses m_1 and m_2 and the accelerations of two bodies are a_1 and a_2 respectively, then

A. $\frac{a_2}{a_1} = \frac{m_2}{m_1}$

B. $\frac{a_1}{a_2} = \frac{m_1}{m_2}$

C. $\frac{a_1}{a_2} = \frac{m_2}{m_1}$

D. $m_1 a_1 + m_2 a_2 = 0$

Answer: C

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25. If a force $\vec{F} = 3\hat{i} - 4\hat{j}N$ produces an acceleration of $10ms^{-2}$ on a body, then the mass of a body is

A. 10 kg

B. 9 kg

C. 0.9 kg

D. 0.5 kg

Answer: D

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26. A constant retarding force of 50 N is applied to a body of mass 20 kg moving initially with a speed of $15ms^{-1}$. How long does the body take to stop?

A. 0.75 s

B. 1.33 s

C. 6 s

D. 35 s

Answer: C

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27. Rain drops come down with

A. zero acceleration and non-zero velocity

B. zero velocity with non-zero acceleration

C. zero acceleration and non-zero net force

D. none

Answer: A

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28. If force is the cause then the effect is

A. mass

B. potential energy

C. acceleration

D. Inertia

Answer: C

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29. In free body diagram, the object is represented by a

A. line

B. arrow

C. circle

D. point

Answer: D

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30. When an object of mass m slides on a friction less surface inclined at an angle θ then normal force exerted by the surface is

A. $g\cos\theta$

B. $mg\cos\theta$

C. $g\sin\theta$

D. $mg\tan\theta$

Answer: B

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31. The acceleration of the sliding object in an inclined plane

A. $g\cos\theta$

B. $mg\cos\theta$

C. $g\sin\theta$

D. $mg\tan\theta$

Answer: C

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32. The speed of an object sliding in an inclined plane at the bottom is

A. $mg\cos\theta$

B. $\sqrt{2sg\sin\theta}$

C. $\sqrt{sg\cos\theta}$

D. $\sqrt{2sg\sin\theta}$

Answer: B

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33. The acceleration of two bodies of mass m_1 and m_2 in contact on a horizontal surface is

A. $a = \frac{F}{m}$

B. $a = \frac{F}{m_2}$

C. $a = \frac{F}{m_1 + m_2}$

D. $a = \frac{F}{m_1 m_2}$

Answer: A

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34. Two blocks of masses m_1 and $m_2 (m_1 > m_2)$ in contact with each other on frictionless, horizontal surface. If a horizontal force F is given on m_1 set into motion with

acceleration a, then reaction force on mass m_1 by m_2 is

A. $\frac{Fm_1}{m_1 + m_2}$

B. $\frac{m_1 m_2}{Fm_1}$

C. $\frac{m_1 m_2}{Fm_2}$

D. $\frac{Fm_2}{m_1 + m_2}$

Answer: D

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35. If two masses m_1 and $m_2(m_1 > m_2)$ tied to string moving over a frictionless pulley, then acceleration of masses

A. $\frac{m_1 - m_2}{g}$

B. $\frac{m_1 + m_2}{m_1 - m_2}g$

C. $\frac{2m_1m_2}{m_1 + m_2}g$

D. $\frac{m_1m_2}{2m_1m_2}g$

Answer: A

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36. Three masses is in contact as shown. If force F is applied to mass m_1 the acceleration of three masses is

A. $\frac{F}{m_1+m_2+m_3}$

B. $\frac{m_1F}{m_1+m_2+m_3}$

C. $\frac{(m_2+m_3)F}{m_1+m_2+m_3}$

D. $\frac{m_3F}{m_1+m_2+m_3}$

Answer: A

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37. Three masses in contact is as shown above. If force F is applied to mass m_1 , then the contact force acting on mass m_2 is

A. $\dfrac{F}{m_1 + m_2 + m_3}$

B. $\dfrac{m_1 F}{m_1 + m_2 + m_3}$

C. $\dfrac{(m_2 + m_3)F}{m_1 + m_2 + m_3}$

D. $\dfrac{m_3 F}{m_1 + m_2 + m_3}$

Answer: C

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38. Three masses in contact is as shown above. If force F is applied to mass m_1 , then the contact force acting on mass m_2 is

A. $\frac{F}{m_1+m_2+m_3}$

B. $\frac{m_1F}{m_1+m_2+m_3}$

C. $\frac{(m_2+m_3)F}{m_1+m_2+m_3}$

D. $\frac{m_3F}{m_1+m_2+m_3}$

Answer: D

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39. Two masses connected with a string. When a force F is applied on mass m_2 . The acceleration produced is

A. $\frac{F}{m_1 + m_2}$

B. $\frac{F}{m_1 - m_2}$

C. $\frac{m_1 + m_2}{F}$

D. $\frac{m_1 - m_2}{F}$

Answer: A

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40. Two masses connected with a string. When a force F is applied on mass m_1 . The force acting on m_1 is

A. $\frac{m_1 F}{m_1 + m_2}$

B. $\frac{m_2 F}{m_1 + m_2}$

C. $\frac{m_1 + m_2}{m_1} F$

D. $\frac{m_1 + m_2}{m_2} F$

Answer: B

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41. If a block of mass m lying on a frictionless inclined plane of length L height h and angle of inclination θ , then the velocity at its bottom is

A. $g \sin \theta$

B. $g \cos \theta$

C. $\sqrt{2gh}$

D. $\sqrt{2a\sin\theta}$

Answer: C

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42. If a block of mass m lying on a frictionless inclined plane of length L height h and angle of inclination θ , then the time taken to reach the bottom is

A. $g\sin\theta$

B. $\sin\theta\sqrt{\frac{2h}{g}}$

C. $\sin\theta\sqrt{\frac{g}{2h}}$

D. $\frac{1}{\sin\theta}\sqrt{\frac{2h}{g}}$

Answer: D

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43. A rocket works on the principle of conservation of

A. energy

B. mass

C. angular momentum

D. linear momentum

Answer: B

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44. A bomb at rest explodes. The total momentum of all its fragments is

A. zero

B. infinity

C. always 1

D. always greater than 1

Answer: A

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45. A block of mass m_1 is pulled along a horizontal frictionless surface by a rope of mass m_2 . If a force F is given at its free end. The net force acting on the block is

A. $\frac{m_1 F}{m_1 - m_2}$

B. F

C. $\frac{m_2 F}{m_1 + m_2}$

D. $\frac{m_1 F}{m_1 + m_2}$

Answer: B

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46. A block of mass m is pulled along a horizontal surface by a rope. The tension in the rope will be same at all the points

A. if the rope is accelerated

B. if the rope is massless

C. always

D. none of the above

Answer: B

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47. The lines of forces act at a common point is called as

A. concurrent forces

B. coplanar forces

C. equilibrant

D. resultant

Answer: A

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48. If the lines of forces act in the same plane, they can be

A. concurrent forces

B. coplanar forces

C. either concurrent force or coplanar forces

D. Lami's force

Answer: A

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49. Lami's theorem is applicable only when the system of forces are in

A. same plane

B. different plane

C. equilibrium

D. none of the above

Answer: C

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50. Due to the action of internal forces of the system, the total linear momentum of the system is

A. a variable

B. a constant

C. always zero

D. always infinity

Answer: C

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51. The velocity with which a gun suddenly moves backward after firing is

A. linear velocity

B. positive velocity

C. recoil velocity

D. $v_1 + v_2$

Answer: C

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52. A large force acting for a very short interval of time is called as .....

A. Newtonian force

B. impulsive force

C. concurrent force

D. coplanar force

Answer: B

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53. SI unit of impulse is _____

A. Nm

B. Ns

C. Nm^2

D. Ns^{-2}

Answer: B

Watch Video Solution

54. The force which always opposes the relative motion between an object and the surface where it is placed is

A. concurrent force

B. frictional force

C. impulsive force

D. coplanar force

Answer: B

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55. The force Which acts in order to oppose the relative motion of the layer is known as _____ force.

A. static friction

B. kinetic friction

C. friction

D. zero

Answer: A

Watch Video Solution

56. When the object is at rest, the resultant of gravitational force and upward normal force is

A. Static force

B. zero

C. one

D. infinity

Answer: B

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57. The magnitude of static frictional force f_s lies between

A. $0 \leq f \leq \mu_s N$

B. $0 \geq f \geq \mu_s N$

C. 0 and 1

D. 0 and minimal static frictional force

Answer: A

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58. The unit of coefficient of static friction is

A. N

B. Nm

C. Ns

D. no unit

Answer: D

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59. If the object is at rest and no external force is applied on the object, the static friction acting on the object is

A. $\mu_s N$

B. zero

C. one

D. infinity

Answer: D

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60. When object begins to slide, the static friction acting on the object attains

A. zero

B. minimum

C. maximum

D. infinity

Answer: C

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61. The static friction does not depend upon

A. the area of contact

B. normal force

C. the magnitude of applied force

D. none of the above

Answer: A

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62. Which of the following pairs of materials has minimum amount of coefficient of static friction?

A. Glass and glass

B. wood and wood

C. ice and ice

D. steel and steel

Answer: C

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63. Kinetic friction is also called as

A. sliding friction

B. dynamic friction

C. both (a) and (b)

D. static friction

Answer: C

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64. The unit of coefficient of kinetic friction is/has

A. Nm

B. Ns

C. Nm^2

D. no unit

Answer: D

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65. The nature of materials in mutual contact decides

A. μs

B. μk

C. $\mu s \quad \text{or} \quad \mu k$

D. none

Answer: C

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66. Coefficient of kinetic friction is less than

A. 0

B. one

C. μs

D. $\mu s N$

Answer: C

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67. The static friction

A. increases linearly

B. is constant

C. zero

D. varies parabolically

Answer: A

 Watch Video Solution

68. The kinetic friction

A. increases linearly

B. is constant

C. zero

D. varies parabolically

Answer: B

 Watch Video Solution

69. Kinetic friction is independent of

A. nature of materials

B. temperature of the surface

C. applied force

D. none of the above

Answer: C

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70. The angle between the normal force and the resultant force of normal force and maximum frictional force is

A. angle of friction

B. angle of repose

C. angle of inclination

D. none of the above

Answer: A

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71. The angle friction θ is given by

A. $\tan \mu_s$

B. $\tan^{-1} \mu_s$

C. $\frac{fs^{\max}}{N}$

D. $\sin^{-1} \mu_s$

Answer: B

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72. The angle of inclined plane with the horizontal such that an object placed on it begins to slide is

A. angle of friction

B. angle of repose

C. angle of response

D. angle of retardation

Answer: B

Watch Video Solution

73. Comparatively, which of the following has lesser value than others?

A. static friction

B. kinetic friction

C. rolling friction

D. skiping friction

Answer: C

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74. The origin of friction is

A. electrostatic interaction

B. electromagnetic interaction

C. photon interaction

D. magnetic interaction

Answer: B

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75. Friction can be reduced by

A. polishing

B. lubricating

C. using ball bearings

D. all the above

Answer: C

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76. For a particle revolving in a circular path, the acceleration of the particle is

A. along the tangent

B. along the radius

C. along the circumference of the circle

D. zero

Answer: B

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77. A particle moves along a circular path under the action of a force. The work done by the force is

A. Positive and non-zero

B. zero

C. Negative and non-zero

D. none of the above

Answer: B

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78. A bullet hits and gets embedded in a solid block resting on a frictionless surface. In this process which is correct ?

A. Momentum and kinetic energy

B. kinetic energy alone

C. Momentum alone

D. potential energy alone

Answer: C

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79. The origin of the centripetal force can be

A. gravitational force

B. frictional force

C. coulomb force

D. all the above

Answer: D

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80. Centripetal acceleration is given by

A. $\frac{mv^2}{r}$

B. $\frac{v^2}{r}$

C. rv^2

D. $r\omega$

Answer: A

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81. The centripetal force is

A. $\frac{mv^2}{r}$

B. $r\omega^2$

C. both (a) and (b)

D. none

Answer: C

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82. When a car is moving on a circular track the centripetal force is due to

A. gravitational force

B. frictional force

C. magnetic force

D. elastic force

Answer: B

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83. If the road is horizontal then the normal force and gravitational force are

A. equal and along the same direction

B. equal and opposite

C. unequal and along the same direction

D. unequal and opposite

Answer: B

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84. The velocity of a car for safe turn on leveled circular road

A. $v \leq \sqrt{\mu_s r g}$

B. $v \geq \sqrt{\mu_s r g}$

C. $v = \sqrt{\mu_s r g}$

D. $v \leq \mu_s r g$

Answer: A

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85. In a leveled circular road, skidding mainly depends on

A. μ_s

B. μ_k

C. acceleration

D. none

Answer: A

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86. The speed of a car to move on the banked road so that it will have safe turn is

A. $\mu_s rg$

B. $\sqrt{rg\tan\theta}$

C. $rg\tan\theta$

D. $r^2 g \tan\theta$

Answer: B

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87. Centrifugal force is a

A. pseudo force

B. real force

C. force acting towards centre

D. none of the above

Answer: A

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88. Centrifugal force is a

A. intereaction between force is due to

B. inertia

C. electromagnetic interation

D. inertial frame

Answer: B

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89. Centripetal force

A. Inertial frame

B. non-inertial frame

C. both (a) and (b)

D. linear motion

Answer: C

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90. Centrifugal force acts in

A. Inertial frame

B. non-inertial frame

C. both (a) and (b)

D. linear motion

Answer: B

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91. A cricket ball of mass 100 g moving with a speed of 20 ms^{-1} is brought to rest by a player . Find the change in momentum of ball.

A. $0.5Ns$

B. $-2Ns$

C. $-2.5Ns$

D. zero

Answer: B

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92. If a stone tied at the one end of a string of length 0.5 m is whirled in a horizontal circle with a constant speed $6ms^{-1}$, then the acceleration of the stone is

A. $12ms^{-2}$

B. $36ms^{-2}$

C. $2\pi^2 ms^{-2}$

D. $72ms^{-2}$

Answer: D

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93. A block of mass 3 kg is at rest on a rough inclined plane with angle of inclination 30° with horizontal. If μ_s = 0.7, then the frictional force is

A. 17.82 N

B. 1.81 N

C. 3.63 N

D. 2.1 N

Answer: A

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94. Two masses 2 kg and 4 kg are tied at the ends of a massless string and which is passing over a frictionless pulley. The tension in the string is

A. 3.68 N

B. 78.4N

C. 26N

D. 13.26 N

Answer: C

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95. A bomb of 10 kg at rest explodes into two pieces of mass 4 kg and 6 kg. If the velocity of 4 kg mass is $6ms^{-1}$ then the velocity of 6 kg is

A. $4ms^{-1}$

B. $6ms^{-1}$

C. $24ms^{-1}$

D. $2.2ms^{-1}$

Answer: A

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96. A body is subjected under three concurrent forces and it is in equilibrium . The resultant of any two forces is

A. (a) coplanar with the third force

B. (b) is equal and opposite to third force

C. (c) both (a) and (b)

D. (d) none of the above

Answer: C

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97. An impulse is applied to a moving object with the force at an angle of 20° with respect to velocity vector. The angle between the

impulse vector and the change in momentum vector is

A. 0°

B. 30°

C. 60°

D. 120°

Answer: A

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98. A bullet of mass m and velocity v_1 is fired into a large block of wood of mass M. The final velocity of the system is

A. $\frac{v_1}{m+M}$

B. $\frac{mv_1}{m+M}$

C. $\frac{m+m}{m}v_1$

D. $\frac{m+m_1}{m-M}v_1$

Answer: B

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99. A block of mass 2 kg is placed on the floor. The co-efficient of static friction is 0.4. The force of friction between the block and floor is

A. 2.8 N

B. 7.8 N

C. 2N

D. zero

Answer: B

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100. A truck weighing 1000 kg is moving with velocity of 50 km/h on smooth horizontal roads. A mass of 250 kg is dropped into it. The velocity with which it moves now is

A. 12.5 km/h

B. 20 km/h

C. 40 km/h

D. 50 km/h

Answer: B

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101. A body of mass 100 g is sliding from an inclined plane of inclination 30° . If μ = 1.7, then the frictional force experienced is

A. $\frac{3.4}{\sqrt{3}}N$

B. $1.47N$

C. $\frac{\sqrt{3}}{3.4}N$

D. $1.38N$

Answer: B

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Additional Questions Solved Short Answer Questions

1. A passenger sitting in a car at rest, pushes the car from within. The car doesn't move, why?

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2. Give the magnitude and directions of the net force acting on a rain drop falling with a constant speed.

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3. Why the passengers in a moving car are thrown outwards when it suddenly takes a turn?

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4. You accelerate your car forward. What is the direction of the frictional force on a package resting on the floor of the car?

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5. What is the purpose of using shockers in a car?

Watch Video Solution

6. Why are tyres made of rubber not of steel?

Watch Video Solution

7. Wheels are made circular. Why?

Watch Video Solution

8. If a ball is thrown up in a moving train, it comes back to the thrower's hands. Why?

Watch Video Solution

9. Calculate the force acting on a body which changes the momentum of the body at the rate of $1kg - m/s^2$

Watch Video Solution

10. On a rainy day skidding takes place along a curved path. Why?

Watch Video Solution

11. Why does a gun recoils when a bullet is being fired?

Watch Video Solution

12. Why is it difficult to catch a cricket ball than a tennis ball even when both are moving with the same velocity?

Watch Video Solution

13. The distance travelled by a moving body is directly proportional to time. Is any external force acting on it?

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14. Calculate the impulse necessary to stop a 1500 kg car moving at a speed of $25ms^{-1}$

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15. Lubricants are used between the two parts of a machine. Why?

Watch Video Solution

16. What provides the centripetal force to a car taking a turn on a level road?

Watch Video Solution

17. A body is acted upon by a number of external forces can it remain at rest

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18. Bodies of larger mass need greater effort to put them in motion. Why ?

Watch Video Solution

19. An athlete runs a certain distance before taking a long jump . Why ?

Watch Video Solution

20. Action and reaction forces do not balance each other . Why ?

Watch Video Solution

21. The wheels of vehicles are provided with mudguards. Why?

Watch Video Solution

22. China wares are wrapped in straw paper before packing. Why?

Watch Video Solution

23. Why is it difficult to walk on a sand?

Watch Video Solution

24. The outer edge of a curved road is generally raised over the inner edge. Why?

Watch Video Solution

25. Explain why the water doesn't fall even at the top of the circle when the bucket full of water is upside down rotating in a vertical circle?

Watch Video Solution

26. Why does a speedy motor cyclist bends towards the centre of a circular path while taking a turn on it?

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27. An impulse is applied to a moving object with the force at an angle of 20° with respect to velocity vector. The angle between the

impulse vector and the change in momentum vector is

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Additional Questions Solved Short Answer Questions 2 Marks

1. A man getting down a runnning bus falls forward

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2. Show that if the force acting on the particle is zero its momentum remains unchaged

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3. A force of 36 dynes is inclined to the horizontal at an angle of 60° . Find the acceleration in a mass of 18 g that moves in a horizontal direction.

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4. The motion of a particle of mass m is described by $h = ut + 1/2gt^2$. Find the force acting on particle.

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5. A particle of mass 0.3 kg is subjected to a force of F = -kx with $k = 15Nm^{-1}$. What will be its initial acceleration if it is released from a point 20 cm away from the origin?

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6. A 50 g bullet is fired from a 10 kg gun with a speed of $500ms^{-1}$. What is the speed of the recoil of the gun?

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7. Smooth block is released at rest on a 45° incline and then slides a distance d. If the time taken of slide on rough incline is n times as large as that to slide than on a smooth incline. Show that coefficient of friction. $\mu = \left(1 - \frac{1}{n^2}\right)$

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8. A spring balance is attached to the ceiling of a lift. When the lift is at rest spring balance reads 49 N of a body hang on it. If the lift moves:

(i) Downward (ii) upward, with an acceleration of $5ms^{-2}$ (iii) with a constant velocity.

What will be the reading of the balance in each case?

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9. A bob of mass 0.1 kg hung from the ceiling of room by a string 2 m long is oscillating. At its mean position the speed of a bob is $1ms^{-1}$. What is the trajectory of the oscillating bob if the string is cut when the bob is (i) At the mean position (ii) At its extreme position.

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10. A block placed on a rough horizontal surface is pulled by a horizontal force F. Let f be the force applied by the rough surface on the block. Plot a graph of f versus F.

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11. A mass of 2 kg is suspended with thread AB. Thread CD of the same type is attached to the other end of 2 kg mass. (i) Lower end of the lower thread is pulled gradually, hander and

hander is the downward direction so as to apply force on AB. Which of the thread will break & why? (ii) If the lower thread is pulled with a jerk, what happens?

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12. A block of mass M is held against a rough vertical wall by pressing it with a finger. If the coefficient of friction between the block and the wall Wall is u and the acceleration due to gravity is g, calculate the minimum force

required to be applied by the finger to held the block against the wall?

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Additional Questions Solved Short Answer Questions 3 Marks Numericals

1. A block of mass 500 g is at rest on a horizontal table. What steady force is required

to give the block a velocity of $200 cm s^{-1}$ in 4 s?

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2. A force of 98 N is just required to move a mass of 45 kg on a rough horizontal surface. Find the coefficient of friction and angle of friction?

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3. Calculate the force required to move a train of 2000 quintal up on an incline plane of 1 in 50 with an acceleration of $2ms^{-2}$. The force of friction per quintal is 0.5 N.

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4. A force of 100 N gives a mass m_1, an acceleration of 10 ms-2 and of $20ms^{-2}$ to a mass m_2. What acceleration must be given to it if both the masses are tied together?

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5. The pulley arrangement of figure are identical. The mass of the rope is negligible. In (a) mass m is lifted up by attaching a mass (2m) to the other end of the rope. In (b), m is lifted up by pulling the other end of the rope with a constant downward force F = 2 mg. In which case, the acceleration of m is more?

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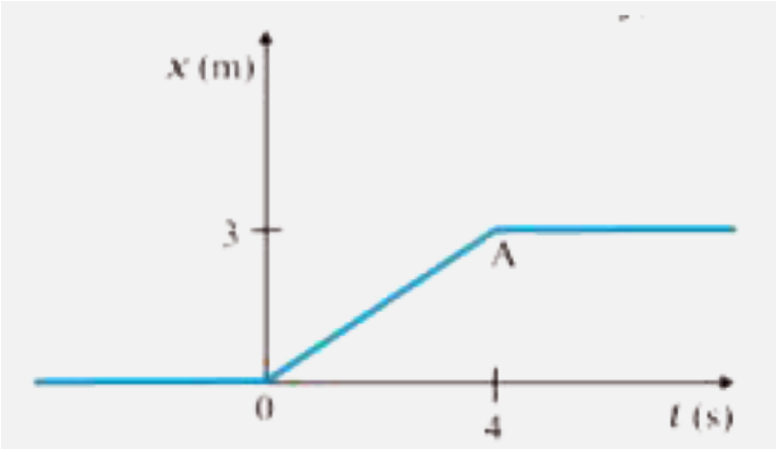
6. Figure shows the position-time graph of a particle of mass 4 kg. What is the (a) force on the particle for $t < 0$, $t > 4$ s, $0 < t < 4$ s? (b) impulse at $t = 0$ and $t = 4$ s ? (Consider one-dimensional motion only).



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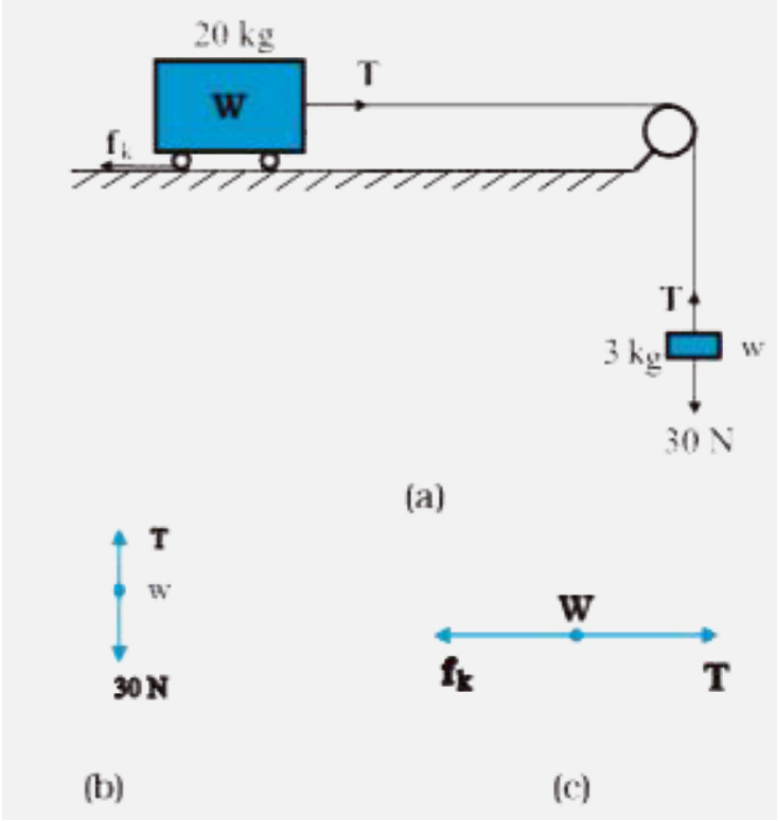
7. What is the acceleration of the block and trolley system shown in a Fig.(a), if the coefficient of kinetic friction between the trolley and the surface is 0.04? What is the tension in the string? (Take g =$10ms^{-2}$).

Neglect the mass of the string.



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8. Solve and fill in the blanks

Sr. No.	Velocity of light in the first medium v_1	Velocity of light in the second medium v_2	Refractive Index ${}_2n_1$	Refractive Index ${}_1n_2$
(1)	3×10^8 m/s	1.2×10^8 m/s		
(2)		2.25×10^8 m/s	$\frac{4}{3}$	
(3)	2×10^8 m/s			1.5

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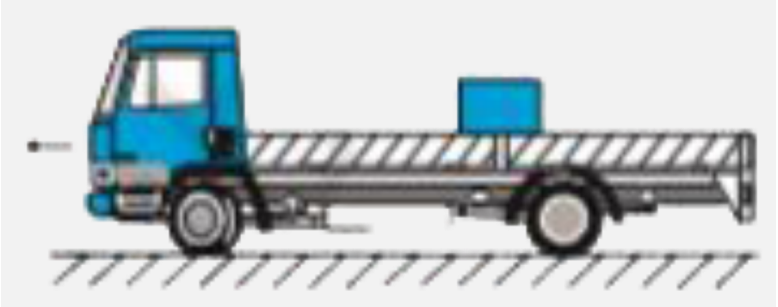
9. The rear side of a truck is open and a box of 40 kg mass is placed 5 m away from the open end as shown in Fig. The coefficient of friction between the box and the surface below it is

0.15. On a straight road, the truck starts from rest and accelerates with $2ms^{-2}$. At what distance from the starting point does the box fall off the truck? (Ignore the size of the box).



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10. A block slides down as incline of 30° with the horizontal. Starting from rest, it covers 8

m in the first 2 seconds. Find the coefficient of static friction.

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11. A helicopter of mass 2000 kg rises with a vertical acceleration of $15m/s^2$. The total mass of the crew and passengers is 500 kg. Give the magnitude and direction of the :

(i) Force on the floor of the helicopter by the crew and passenger. (ii) Action of the rotor of the helicopter on the surrounding air (iii)

Force on the helicopter due to the surrounding air $\left(g = 10m/s^2\right)$

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12. A rectangular box lies on a rough inclined surface. The coefficient of friction between the surface and the box is μ . Let the mass of the box be m.

(a) At what angle of inclination θ of the plane to the horizontal will the box just start to slide down the plane?

(b) What is the force acting on the box down the plane, if the angle of inclination of the plane is increased to $a > \theta$.

(c) What is the force needed to be applied upwards along the plane to make the box either remain stationary or just move up with uniform speed?

(d) What is the force needed to be applied upwards along the plane to μ_k kgf make the box move up the plane with acceleration a?

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13. Calculate the acceleration of the bicycle of mass 25 kg as

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14. Match the following :

Column I	Column II
1. Atto	*(i)* 10^{-15}
2. Fermi	*(ii)* 10^{18}
3. Femto	*(iii)* 10^{6}
4. Micro	*(iv)* 10^{-13}
	(v) 10^{-18}
	(vi) 10^{-6}

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15. A hunter has a machine gun that can fire 50 g bullets with a velocity of $150ms^{-1}$. A 60 kg tiger springs at him with a velocity $10ms^{-1}$

how many bullets must the hunter fire in to the tiger in order to stop him in his track

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16. Two blocks of mass 2 kg and 5 kg are connected by an ideal string passing over a pulley. The block of mass 2 kg is free to slide on a surface inclined at an angle of 30° with the horizontal whereas 5 kg block hangs freely. Find the acceleration of the system and the tension in the string.

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