LAWS OF MOTION IMP QUESTIONS

Class 11 - Physics

Section A

1. A 1 kg stationary bomb is exploded in three parts having mass 1 : 1 : 3 respectively. Parts having same mass move in perpendicular direction with velocity 30 m/s, then the velocity of bigger part will be **[1]**

   a) $15\sqrt{2}$ m/sec

   b) $\frac{10}{\sqrt{2}}$ m/sec

   c) $10\sqrt{2}$ m/sec

   d) $\frac{15}{\sqrt{2}}$ m/sec

2. The second law of motion is a vector law. It is equivalent to: **[1]**

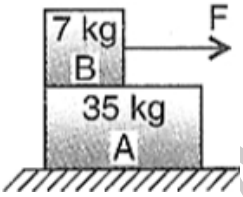
   a) Two equations, one for each component of the vectors

   b) One equation, one for each component of the vectors

   c) Three equations, one for each component of the vectors

   d) Four equations, one for each component of the vectors and one for time

3. Block A of mass 35 kg is resting on a frictionless floor. Another block B of mass 7 kg is resting on it as shown in the figure. The coefficient of friction between the blocks is 0.5 while kinetic friction is 0.4. If m_A = 10 kg, m_B = 40 kg and the applied force are 40 N, the acceleration of the block B with respect to block A will be: (g = 10 ms^{-2}) **[1]**



   a) 0.5 ms^{-2}

   b) zero

   c) 2.5 ms^{-2}

   d) 0.8 ms^{-2}

4. A particle of mass 2 kg is moving on a circular path of radius 10 m with a speed of 5 ms^{-1} and its speed is increasing at rate of 3 ms^{-1}. Find the force acting on the particle. **[1]**

   a) 12 N

   b) 14 N

   c) 5 N

   d) 10 N

5. A man is standing on a spring platform. Reading of spring balance is 60 kg wt. If man jumps outside from the platform, then reading of spring balance will **[1]**

   a) increase

   b) first increase and then become zero

   c) become zero

   d) remain same

6. A 500 kg car takes a round turn of radius 50 m with a velocity of 36 km/h. The centripetal force is **[1]**

a) 1000 N

b) 750 N

c) 1200 N

d) 250 N

7. A person is sitting in a lift accelerating upwards. The measured weight of a person will be **[1]**

a) zero

b) more than actual weight

c) less than the actual weight

d) equal to actual weight

8. If Newton's second law is applied to a rigid body: **[1]**

a) the acceleration is the average of all particles in the body

b) the acceleration is that of any particle in the body

c) the acceleration is that of the centre of mass

d) the acceleration is the higher of all particles in the body

9. The upper half of an inclined plane of inclination θ is perfectly smooth while lower half is rough. A block starting from rest at the top of the plane will again come to rest at the bottom, if the coefficient of friction between the block and lower half of the plane is given by **[1]**

a) $\mu = 2\tan\theta$

b) $\mu = \frac{1}{\tan\theta}$

c) $\mu = \frac{2}{\tan\theta}$

d) $\mu = \tan\theta$

10. A bob of mass 0.1 kg hung from the ceiling of a room by a string 2 m long is set into oscillation. The speed of the bob at its mean position is 1 m s^{-1}. What is the trajectory of the bob if the string is cut when the bob is at one of its extreme positions. **[1]**

a) bob will go upwards

b) bob will go downwards at an angle

c) bob will fall vertically downwards

d) bob will go down in a parabolic path

11. A body of mass 5 kg explodes at rest into three fragments with masses in the ratio 1 : 1 : 3. The fragments with equal masses fly in mutually perpendicular directions with speeds of 21 m/s. The velocity of heaviest fragment in m/s will be **[1]**

a) $5\sqrt{2}$

b) $\sqrt{2}$

c) $3\sqrt{2}$

d) $7\sqrt{2}$

12. A block of mass m is placed on a smooth wedge of inclination θ. The whole system is accelerated horizontally so that the block does not slip on the wedge. The force exerted by the wedge on the block (g is acceleration due to gravity) will be **[1]**

a) mg sinθ

b) mg cosθ

c) $\frac{mg}{\cos\theta}$

d) mg

13. A man of mass 70 kg stands on a weighing scale in a lift which is moving downwards with a uniform acceleration of 5 ms^{-2}. What would be the reading on the scale? **[1]**

a) 350 N

b) 380 N

c) 450 N

d) 530 N

14. According to the first law of motion: **[1]**

a) body acted on by no net force moves with constant velocity (which may be zero) and

b) body acted on by zero net force moves with non zero acceleration

zero acceleration

c) body acted on by no net force moves with increasing velocity and negative acceleration

d) body acted on by net force moves with constant velocity (which may be zero)

15. An aircraft executes a horizontal loop at a speed of 720 km/h with its wings banked at 15^o. What is the radius of the loop? **[1]**

a) 11 km

b) 17.24 km

c) 14 km

d) 15.24 km

16. A stone of mass 0.25 kg tied to the end of a string is whirled round in a circle of radius 1.5 m with a speed of 40 rev./min in a horizontal plane. What is the maximum speed with which the stone can be whirled around if the string can withstand a maximum tension of 200 N? **[1]**

a) $35\ ms^{-1}$

b) $37\ ms^{-1}$

c) $38\ ms^{-1}$

d) $33\ ms^{-1}$

17. A rocket is fired upward from the earth surface such that it creates an acceleration of $19.6\ m/s^2$. If after 5 s, its engine is switched off, the maximum height of the rocket from earth's surface would be **[1]**

a) 245 m

b) 980 m

c) 735 m

d) 490 m

18. A shell of mass 0.020 kg is fired by a gun of mass 100 kg. If the muzzle speed of the shell is $80\ ms^{-1}$, what is the recoil speed of the gun? **[1]**

a) 1.7 cm/s

b) 1.6 cm/s

c) 1.9 cm/s

d) 1.8 cm/s

19. A person sitting in an open car moving at constant velocity throws a ball vertically into air, the ball falls **[1]**

a) outside the car

b) in the car ahead of the person

c) in the car behind the person

d) exactly in the hand of thrower

20. A stone is dropped from a height h. It hits the ground with a certain momentum p. If the same stone is dropped from a height 100% more than the previous height, the momentum when it hits the ground will change by **[1]**

a) 68%

b) 41%

c) 200%

d) 100%

21. A helicopter of mass 1000 kg rises with a vertical acceleration of $15\ ms^{-2}$. The crew and the passengers weigh 300 kg. Give the magnitude and direction of the action of the rotor of the helicopter on the surrounding air. **[1]**

a) 3.50×10^4 N downwards

b) 3.70×10^4 N upwards

c) 3.25×10^4 N downwards

d) 3.95×10^4 N upwards

22. A man of mass 60 kg records his weight on a weighing machine placed inside a lift. The ratio of the weights of man recorded when lift is ascending up with a uniform speed of 2 m/s to when it is descending down with a uniform speed of 4 m/s will be **[1]**

a) 4

b) 2

c) 1 d) 0.5

23. A conveyor belt is moving at a constant speed of 2 m/s. A box is gently dropped on it. The coefficient of friction between them is μ = 0.5. The distance that the box will move relative to belt before coming to rest on it, taking g = 10 ms^{-2}, is **[1]**

a) zero b) 1.2 m

c) 0.6 m d) 0.4 m

24. A bomb moving with velocity $(40\hat{i} + 50\hat{j} - 25\hat{k})$ ms^{-1} explodes into two pieces of mass ratio 1 : 4. After the explosion, the smaller piece moves away with velocity $(200\hat{i} + 70\hat{j} + 15\hat{k})$ ms^{-1}. The velocity of larger piece after explosion is **[1]**

a) $45\hat{i} - 35\hat{k}$ b) $-35\hat{i} + 45\hat{k}$

c) $45\hat{k} - 35\hat{j}$ d) $45\hat{i} - 35\hat{j}$

25. A batsman deflects a ball by an angle of 45^{o} without changing its initial speed which is equal to 54 km/h. What is the impulse imparted to the ball? (Mass of the ball is 0.15 kg.) **[1]**

a) 4.4 kg ms^{-1} b) 4.8 kg ms^{-1}

c) 4.6 kg ms^{-1} d) 4.2 kg ms^{-1}

26. For a car not to turn safely on a curved road **[1]**

a) speed is slow b) distance between tyres is large

c) centre of gravity for car is low d) low friction force

27. An object is moving on a plane surface with a uniform velocity 10 ms^{-1} in presence of a force 10 N. The frictional force between the object and the surface is **[1]**

a) 1 N b) 10 N

c) 100 N d) -10 N

28. A body of mass 2 kg moves with an acceleration 3 ms^{-2}. The change in momentum in one second is **[1]**

a) $\frac{3}{2}$ kg ms^{-1} b) 6 kg ms^{-1}

c) $\frac{2}{3}$ kg ms^{-1} d) 4 kg ms^{-1}

29. A heavy uniform chain lies on horizontal table top. If the coefficient of friction between the chain and the table surface is 0.25, then the maximum fraction of the length of the chain that can hang over one edge of the table is **[1]**

a) 20% b) 15%

c) 25% d) 35%

30. Two iron blocks of equal masses but with different surface areas slide down an inclined plane with friction coefficient μ. If the first block with the surface area. A experiences a friction force f, then the second block with surface area 2 A will experience a frictional force **[1]**

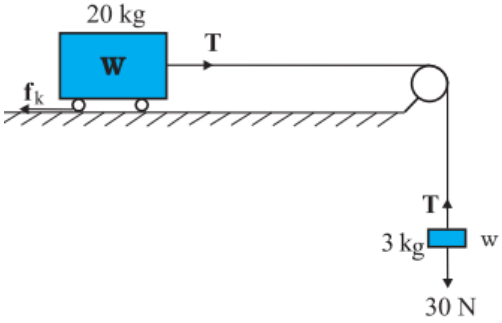
a) $\frac{f}{2}$ b) 4 f

c) f d) 2 f

Section B

31. What is static friction? Is it self adjusting in nature? **[2]**

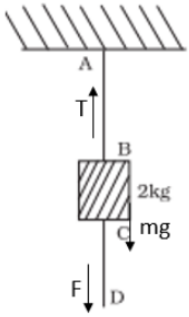
32. What is the acceleration of the block and trolley system shown in a Figure? if the coefficient of kinetic friction between the trolley and the surface is 0.04? What is the tension in the string? (Take g = 10 ms^{-2}). Neglect the mass of the string. **[2]**



33. A stone of mass 5 kg falls from top of a cliff 50 m high and buries 1 m in the sand. Find the average resistance offered by the sand and the time it takes to penetrate. **[2]**

34. A cyclist speeding at 18 km/h on a level road takes a sharp circular turn of radius 3 m without reducing the speed. The coefficient of static friction between the tyres and the road is 0.1. Will the cyclist slip while taking the turn? **[2]**

35. A mass of 2kg is suspended with thread AB (Fig.). Thread CD of the same type is attached to the other end of 2 kg mass. Lower thread is pulled gradually, harder and harder in the downward directon so as to apply force on AB. Which of the threads will break and why? **[2]**



36. 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 is μ and the acceleration due to gravity is g, calculate the minimum force required to be applied by the finger to hold the block against the wall? **[2]**

37. Give the magnitude and direction of the net force acting on **[2]**

a. A drop of rain falling down with constant speed.

b. A kite skillfully held stationary in the sky.

38. A nucleus is at rest in the laboratory frame of reference. Show that if it disintegrates into two smaller nuclei, the products must be emitted in opposite directions. **[2]**

39. A rocket motor consumes 100 kg of fuel per second, exhausting it with a speed of 6×10^3 ms^{-1}. **[2]**

i. What thrust is exerted on the rocket?

ii. What will be the velocity of the rocket at the instant its mass is reduced to $(\frac{1}{40})$th of its initial mass, its initial velocity being zero? Neglect gravity.

40. A passenger of mass 72.2 kg is standing on a weighing scale in an elevator. What does the scale read when the elevator cab is **[2]**

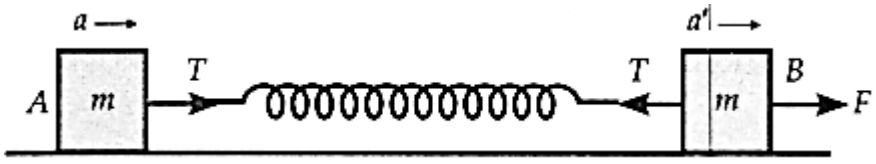
1. descending with constant velocity?

2. ascending with constant acceleration, 3.5 m /s^2?

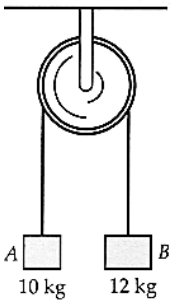
41. A neutron having a mass 1.67×10^{-27} kg and moving at 10^8 ms^{-1} collides with a deutron at rest and sticks to it. If the mass of duetron is 3.34×10^{-27} kg, find the speed of the combination. **[2]**

42. Why does a cyclist lean to one side, while going along curve? In what direction does he lean? **[2]**

43. Two bodies A and B, each of mass m, are connected together by a massless spring. A force F acts on the mass B as shown in figure. At the instant shown, the body A has an acceleration a, what is the acceleration of B? **[2]**



44. In the Atwood's machine (figure), the system starts from rest. What is the speed and distance moved by each mass at t = 3s? **[2]**



45. A hunter has a machine gun that can fire 50 g bullets with a velocity of 150 ms^{-1}. A 60 kg tiger springs at him with a velocity of 10 ms^{-1}. How many bullets must the hunter fire into the tiger in order to stop him in track? **[2]**

46. Explain why it is easier to pull a lawn mower than to push it. **[2]**

47. A bus starts from rest accelerating uniformly with 4 ms^{-2}. At t = 10 s, a stone is dropped out of a window of the bus 2 m high. What are the (i) magnitude of velocity and (ii) acceleration of the stone at 10.2 s? Take g = 10 ms^{-2}. **[2]**

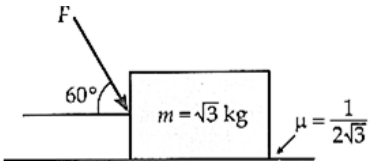
48. An elevator weighs 4000 kg. When the upward tension in the supporting cable is 48000 N, what is the upward acceleration? Starting from rest, how far does it rise in 3 s? **[2]**

49. What are concurrent forces? Obtain a condition for the equilibrium of three concurrent forces. **[2]**

50. An aeroplane travelling at a speed of 500 km h^{-1} tilts at an angle of 30° as it makes a turn. What is the radius of the curve? **[2]**

51. One often comes across the following type of statement concerning circular motion: 'A particle moving uniformly along a circle experiences a force directed towards the centre (centripetal force) and an equal and opposite force directed away from the centre (centrifugal force). The two forces together keep the particle in equilibrium'. Explain what is wrong with this statement. **[2]**

52. What is the maximum value of the force F such that the block shown in the arrangement of the figure does not move? **[2]**



53. Find the force required to move a train of 2000 quintals up an incline of 1 in 50, with an acceleration of 2 ms^{-2}, the force of friction being 0.5 newton per quintal. **[2]**

54. An aeroplane requires for take off a speed of 80 kmh^{-1}, the run on the ground being 100 m. The mass of the aeroplane is 10^4 kg and the coefficient of friction between the plane and the ground is 0.2. Assume that the plane **[2]**

accelerates uniformly during the take off. What is the maximum force required by the engine of the plane for take off?

55. A stone when thrown on a glass window smashes the windowpane to pieces, but a bullet from the gun passes through making a clean hole. Why? **[2]**

Section C

56. Ten one rupee coins are put on top of one another on a table. Each coin has a mass m kg. Give the magnitude and direction of **[3]**

a. The force on the 7^{th} coin (counted from the bottom) due to all coins above it.

b. The force on the 7^{th} coin by the eighth coin (counted from the bottom) and

c. The reaction of the 6^{th} coin on the 7^{th} coin (counted from the bottom).

57. A bird is sitting on the floor of a closed glass cage and the cage is in the hand of a girl. Will the girl experience any change in the weight of the cage when the bird **[3]**

i. starts flying in the cage with a constant velocity

ii. flies upwards with acceleration

iii. flies downwards with acceleration?

58. A block of mass 15 kg is placed on a long trolley. The coefficient of static friction between the block and the trolley is 0.18. The trolley accelerates from rest with 0.5 m/s^2 for 20 s and then moves with uniform velocity. Discuss the motion of the block as viewed by **[3]**

a. a stationary observer on the ground,

b. an observer moving with the trolley.

59. Explain, why **[3]**

i. The passengers are thrown forward from their seats, when a speeding bus stops suddenly.

ii. Does a cricketer move his hand backwards while holding a catch?

iii. Is the boat pushed away when a man jumps out of the boat?

60. Define angle of repose. Show that coefficient of limiting friction is equal to the tangent of angle of repose. **[3]**

61. You may have seen in a circus a motorcyclist driving in vertical loops inside a 'death-well' (a hollow spherical chamber with holes, so the spectators can watch from outside). Explain clearly why the motorcyclist does not drop down when he is at the uppermost point, with no support from below. What is the minimum speed required at the uppermost position to perform a vertical loop if the radius of the chamber is 25 m? **[3]**

62. What is meant by coefficient of static friction and angle of friction? Establish the relation between the two. **[3]**

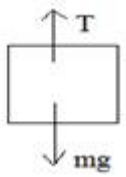
63. How is centripetal force provided in case of the following? **[3]**

i. Motion of planet around the sun,

ii. Motion of moon around the earth.

iii. Motion of an electron around the nucleus in an atom.

64. An elevator weighs 3000kg. What is its acceleration when the in the tension supporting cable is 33000 N. Given that g = 9.8m/s^2. **[3]**



65. Briefly explain the cause of friction. **[3]**

66. A constant force acting on a body of mass 3.0 kg changes its speed from 2.0 ms^{-1} to 3.5 ms^{-1} in 25 s. The direction of the motion of the body remains unchanged. What is the magnitude and direction of the force? **[3]**

67. A stone of mass m tied to the end of a string revolves in a vertical circle of radius R. The net forces at the lowest and highest points of the circle directed vertically downwards are: [Choose the correct alternative] **[3]**

	Lowest Point	**Highest Point**
(a)	T - mg	T + mg
(b)	T + mg	T - mg
(c)	$mg + T - \left(mv_1^2\right)/R$	$mg - T + \left(mv_1^2\right)/R$
(d)	$mg - T - \left(mv_1^2\right)/R$	$mg + T + \left(mv_1^2\right)/R$

68. A monkey of mass 40 kg climbs on a rope which can stand a maximum tension 600 N. In which of the following cases will the rope break? **[3]**

The monkey

a. climbs up with an acceleration of 6m/s^2

b. climbs down with an acceleration of 4m/s^2

c. climbs up with a uniform speed of 5m/s

d. falls down the rope freely under gravity. Take g = 10m/s^2 and ignore the mass of the rope.

69. Explain: **[3]**

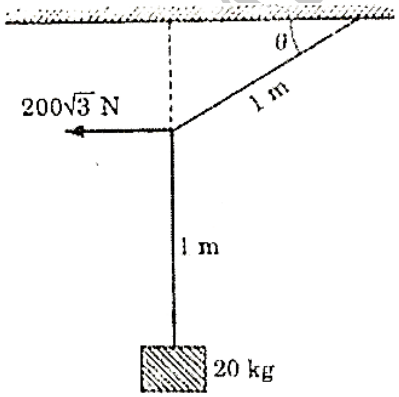
i. Why are ball bearings used in machinery?

ii. Why does a horse have to apply more force to start a cart than to keep it moving?

iii. What is the need for banking the tracks?

70. For traffic moving at 40 kmh^{-1}, if the radius of the curve is 100 m, what is the correct angle of banking of the road? If the road is 20 m wide then what is the height of outer edge of the road as compared to the inner edge? **[3]**

71. A mass of 20 kg is suspended by a rope of length 2 m from a ceiling. A force of 173.2 N in the horizontal direction is applied at the midpoint of the rope as shown in Figure. What is the angle the rope makes with the horizontal in equilibrium? Take g = 10 ms^{-2}. Neglect mass of the rope. **[3]**



72. Give the magnitude and direction of the net force acting on a stone of mass 0.1 kg, **[3]**

a. just after it is dropped from the window of a stationary train,

b. just after it is dropped from the window of a train running at a constant velocity of 36 km/h.

c. just after it is dropped from the window of a train accelerating with1 ms^{-2},

d. lying on the floor of a train which is accelerating with 1 ms^{-2}, the stone being at rest relative to the train.

Neglect air resistance throughout.

73. State the laws of limiting friction. Hence define coefficient of static friction. **[3]**

74. Briefly explain static friction, limiting friction and kinetic friction. How do they vary with the applied force? **[3]**

75. A pebble of mass 0.05 kg is thrown vertically upwards. Give the direction and magnitude of the net force on the pebble, **[3]**

a. during its upward motion,

b. during its downward motion,

c. at the highest point where it is momentarily at rest. Do your answers change if the pebble was thrown at an angle of 45° with the horizontal direction? Ignore air resistance.