

NAAHAR PUBLIC SCHOOL CBSE SEMNIOR SECONDARY
ACADEMIC YEAR (2022-2023)
NOVEMBER MONTH PERIODIC TEST

STD: XI
SUBJECT: PHYSICS

TOTAL: 50
DATE: 18.11.2022

I. ANSWER THE FOLLOWING:

10X1=10

1. A body of mass m is moving on a horizontal table with constant velocity. What is the force on the table?

Answer:

mg i.e. equal to the weight of the body.

2. Rocket works on which principle of conservation?

Answer:

Law of conservation of linear momentum.

3. Will a person while firing a bullet from a gun experience a backward jerk? Why?

Answer:

Yes, it is due to the law of conservation of linear momentum.

4. A bomb explodes in mid-air into two equal fragments. What is the relation between the directions of their motion?

Answer:

The two fragments will fly off in two opposite directions.

5. Why does not a heavy gun kick so strongly as a light gun using the same bullets (i.e. cartridges)?

Answer:

The recoil speed of the gun is inversely proportional to its mass. So the recoil speed of the heavy gun is lesser than that of the light gun.

Directions: Each of these questions contains two statements, Assertion and Reason. Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.

(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.

(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion

(c) Assertion is correct, reason is incorrect

(d) Assertion is incorrect, reason is correct.

6. Assertion: On a rainy day, it is difficult to drive a car or bus at high speed.

Reason: The value of coefficient of friction is lowered due to wetting of the surface.

Answer: (a) On a rainy day, the roads are wet. Wetting of roads lowers the coefficient of friction between the tyres and the road. Therefore, grip on a road of car reduces and thus chances of skidding increases.

7. Assertion: A rocket works on the principle of conservation of linear momentum.

Reason: Whenever there is change in momentum of one body, the same change occurs in the momentum of the second body of the same system but in the opposite direction.

Answer: (a)

8. A spherical ball of mass 10^{-6} kg hits a wall 1000 times per second normally with a velocity of 1000 m/s and rebounds with same velocity along the initial direction. The force experienced by the wall is

(a) 1 N

(b) 4 N

(c) 2 N

(d) 8 N

Answer: (c) 2 N

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

(a) One

(b) four

(c) two

(d) three

Answer: (d) three

10. A passenger sitting in a bus moving at uniform speed, feels pushed backward whenever the bus is accelerated forward. This type of force is called

(a) Gravitational force

(b) real force

(c) fictitious force or pseudo force

(d) frictional force

Answer: (c) fictitious force or pseudo force

II. ANSWER THE FOLLOWING QUESTIONS:

5X2=10

11.a. A man is at rest in the middle of a pond on perfectly frictionless ice. How can he get himself to the shore of the pond?

Answer:

He can get himself to the shore if he throws away his shirt or anything in his possession in a direction opposite to the desired direction of motion or by spitting in the forward direction or by blowing air from his mouth.

b. Why do we pull the rope downwards for climbing up?

Answer:

When we pull the rope downwards, an upward reaction helps us to rise up.

12. a. Why is it easier to roll than to pull a barrel along a road?

Answer:

It is due to the fact that rolling friction is less than sliding friction.

b. Why are the lubricants used in machines?

Answer:

Lubricants are used in machines so as to reduce friction.

13. a. Friction is independent of the area, but brakes of a very small contact area are not used. Why?

Answer:

This is done so as to avoid wear and tear.

b. Carts with rubber tires are easier to ply than those with iron tires. Why?

Answer:

The coefficient of friction between the rubber tires and the road is lesser than the coefficient of friction between iron and steel.

14. Determine the maximum acceleration of the train in which a box lying on its floor will remain stationary. It is given that the coefficient of static friction between the box and the floor of the train is 0.13. ($g=9.8\text{m/s}^2$)

Answer:

Given; $\mu_s=0.13$; $g=9.8\text{m/s}^2$; $a_{\text{max}}=?$

The frictional force acting between the floor of the train and the surface of the box will oppose the slipping of the box on the floor of the train.

$\therefore$ Limiting friction force

$$f_s = ma_{\text{max}}$$

$$\text{and } f_s = \mu_s N = \mu_s mg$$

$$\therefore m \cdot a_{\text{max}} = \mu_s mg$$

$$\text{or } a_{\text{max}} = \mu_s g = 0.13 \times 9.8$$

$$\text{or } a_{\text{max}} = 1.274 \text{ ms}^{-2}$$

$$\text{or } a_{\text{max}} = 1.27 \text{ ms}^{-2}$$

15. A pebble of mass 0.05 kg is thrown vertically upwards. Give the direction and magnitude of the net force on the pebble

1. during its upward motion,
2. during its downward motion,
3. at the highest point where it is momentarily at rest. Do your answers change if the pebble was thrown at an angle of say 45° with the horizontal direction? Ignore air resistance.

Answer:

When the pebble is moving upward the force acting on it is a gravitational force in a downward direction.

$$F = mg = 0.05 \times 10 = 0.5 \text{ N}$$

Even in this case $F = mg = 0.5 \text{ N}$ in downward direction.

Since there is no force other than gravitational force acting on a pebble, during the whole process $F = mg = 0.5 \text{ N}$. Note that the pebble moves in opposite direction because of its initial velocity. The situation remains the same for pebble thrown at an angle.

16. Why a horse has to apply more force to start a cart than to keep it moving? Explain.

Answer:

Static friction comes into play when the horse applies force to start the motion in the cart. On the other hand, kinetic friction comes into play when the cart is moving.

Also, we know that the static friction is greater than the kinetic friction, so the horse has to apply more force to start a cart than to keep it moving.

III. ANSWER THE FOLLOWING:

5X3=15

17. a. Write the S.I. units of force, momentum, and impulse.

Answer:

S.I. units of force, momentum, and impulse are Newton (N), kg ms^{-1} , and Ns (Newton-second).

(b) Why should the hammer be heavier to push the nail deeper into the wooden blocks?

Answer:

It should be heavier so as to increase the impact of force i.e. more force applied for a shorter time.

c. Why rockets are given conical shapes?

Answer:

The rockets are given conical shapes so as to reduce atmospheric friction.

18. a. How does air friction affect the maximum height of a projectile?

Answer:

The maximum height of a projectile is reduced due to air friction.

b. Explain why jet planes cannot move in air-free space but rockets can move?

Answer:

Jet planes use atmospheric oxygen to foil their fuel but rockets carry their own fuel and don't depend on atmospheric oxygen.

c. Is it correct to state that a body always moves in the direction of the net force acting on it?

Answer:

The statement is true only for bodies at rest before the application of force.

19. a. A constant retarding force of 50 N is applied to a body of mass 20 kg moving initially with a speed of 15 ms⁻¹. How long does the body take to stop?

Answer:

Here $M = 20 \text{ kg}$, $F = -50 \text{ N}$ [retarding force]

As $F = Ma$

$$\therefore a = \frac{F}{M} = \frac{-50}{20} = -2.5 \text{ ms}^{-2}$$

Also, $v = u + at$

Here, $u = 15 \text{ ms}^{-1}$, $v = 0$

$$\therefore 0 = 15 + (-2.5)t$$

$$\Rightarrow t = 6 \text{ s.}$$

b. At which place on Earth, the centripetal force is maximum?

Answer:

The centripetal force is maximum at the equator.

20. a. A cyclist speeding at 18km/h on a level road takes a sharp circular turn of radius 3m without reducing the speed and without bending towards the centre of the circular path. The coefficient of static friction between the tyres and the road is 0.1. Will the cyclist slip while taking the turn?

Answer:

Given that $v = 18\text{km/h} = 5\text{m/s}$, $\mu = 0.1$ and $R = 3\text{m}$

assume that mass of vehicle is m

as the diagram(FBD) shows, if centrifugal force F applying on cycle is more than static friction f then the cyclist will slip down while taking turn

$$N = mg \dots (1)$$

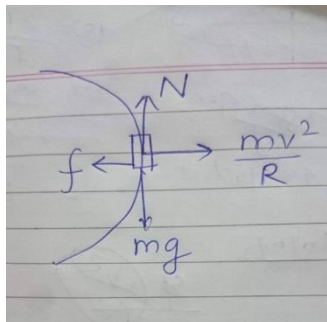
$$f = \mu N \dots (2)$$

from above two equations

$$\Rightarrow f = \mu mg = 0.1 \times m \times 10 = m$$

$$\text{and } \Rightarrow F = m \frac{v^2}{R} = m \frac{5^2}{3} = 8.33 \times m$$

we can see $F \geq f$ so the cyclist will slip down



b. What provides the centripetal force in the following cases?

(i) Electron revolving around the nucleus.

Answer:

It is provided by

the electrostatic force of attraction between the electron and the nucleus.

21. a. Why chinaware crockery is wrapped in paper or straws?

Answer:

Paper or straw provides a cushion between the pieces of crockery.

In case of any jerk (impulse), these will prolong the time of impact and reduce its effect; the crockery will thus be saved.

b. A body falls from a single-story building roof on a muddy floor and another boy falls from the same height on a stone, who is likely to survive out of them and why?

Answer:

The boy who falls on a muddy floor will survive due to the reduction of the impact of force by prolonging the time of reduction of force from maximum to zero.

c. What is the effect on the direction of centripetal force when the revolving body reverses its direction of motion?

Answer:

The centripetal force will be directed towards the center of the circle. This fact does not depend upon the sense of the rotation of the circle.

22. a. Explain how proper inflation of tires saves fuel?

Answer:

When the tires are properly inflated, the area of contact between the tires and the ground is reduced which in turn reduces the rolling friction. As a result of this, there is less dissipation of energy against friction. So the cover of the automobile/eater distance for the same quantity of fuel consumed. Hence proper inflation of tires leads to saving fuel.

b. Why is it more dangerous to fall on frozen ice than on fresh snow?

Answer:

The fresh snow is softer and frozen ice is harder. So the impulse caused by falling on fresh snow is much lesser than frozen snow. Thus, falling on frozen ice may cause serious injury or maybe fatal (the reaction will be much greater in this case).

c. One end of a string of length l is connected to a particle of mass m and the other to a small peg on a smooth horizontal table. If the particle moves in a circle with speed v the net force on the particle (directed towards the centre) is:

(i) T , (ii) $T - mv^2/l$, (iii) $T + mv^2/l$, (iv) 0

T is the tension in the string. [Choose the correct alternative].

Answer: (i) T

The net force T on the particle is directed towards the centre. It provides the centripetal force required by the particle to move along a circle.

IV. ANSWER THE FOLLOWING:

3X5=15

23. (i) An astronaut accidentally gets separated out of his small spaceship accelerating in inter-stellar space at a constant rate of 100 ms^{-2} . What is the acceleration of the astronaut at the instant after he is outside the spaceship?

Answer:

According to Newton's first law of motion, the moment he is out of the spaceship, there is no external force on the astronaut, and thus his acceleration is zero. Here we are assuming that he is out of the gravitational field of heavenly bodies i.e. there are no nearby stars to exert a gravitational force on him and the small spaceship exerts a negligible gravitational attraction on him.

(ii) How is it that a stone dropped from a certain height falls much more rapidly as compared to a parachute under similar conditions?

Answer:

As the surface area of a parachute is much larger as compared to the surface area of a stone, so the air resistance, i. e. fluid friction in the case of the parachute is much larger than in the case of stone. Hence the parachute falls slowly.

(iii) Explain how lubricants reduce friction?

Answer:

The lubricants spread as a thin layer between the two surfaces. The motion now is between the surface and the lubricant layer which changes the dry friction into wet friction. As wet friction is less than dry friction, hence lubricants reduce friction.

(iv) When a man jumps out of a boat, then it is pushed away. Why?

Answer:

This is due to Newton's third law of motion. When the man jumps out of the boat, he applies a force on it in the backward direction, and in turn, the reaction of the boat on the man pushes him out of the boat.

24. (i) 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?

Answer:

Here $u = 2 \text{ ms}^{-1}$, $v = 3.5 \text{ ms}^{-1}$, and $t = 25 \text{ s}$

As $v = u + at$

$\therefore 3.5 = 2 + a \times 25$

$\Rightarrow a = \frac{3.5 - 2}{25} = 0.06 \text{ ms}^{-2}$

Mass of body, $M = 3 \text{ kg}$

$\therefore$ Force acting on the body, $F = Ma = 3 \times 0.06 = 0.18 \text{ N}$

Mass of body, $M = 3 \text{ kg}$

Force acting on the body, $F = Ma = 3 \times 0.06 = 0.18 \text{ N}$

Since the applied force increases the speed of the body; it acts in the direction of motion.

(ii) Explain why ball bearings are used in machinery?

Answer:

We know that rolling friction is much lesser than sliding friction, so we convert the sliding friction into rolling

friction which is done using ball bearings that are placed in between the axle and the hub of the wheel. The ball bearings tend to roll around the axle as the wheel turns and as such the frictional force is reduced.

(iii) Why a horse has to apply more force to start a cart than to keep it moving? Explain.

Answer:

Static friction comes into play when the horse applies force to start the motion in the cart. On the other hand, kinetic friction comes into play when the cart is moving.

Also, we know that the static friction is greater than the kinetic friction, so the horse has to apply more force to start a cart than to keep it moving.

25. a. A rocket with a lift-off mass 20,000 kg is blasted upwards with an initial acceleration of 5.0 ms^{-2} .

Calculate the initial thrust (force) of the blast.

Answer: Here, $m = 20000 \text{ kg} = 2 \times 10^4 \text{ kg}$

Initial acceleration = 5 ms^{-2}

clearly, the thrust should be such that it overcomes the force of gravity besides giving it an upward acceleration of 5 ms^{-2} .

Thus the force should produce a net acceleration of $9.8 + 5.0 = 14.8 \text{ ms}^{-2}$.

Since, thrust = force = mass $\times$ acceleration

$$F = 2 \times 10^4 \times 14.8 = 2.96 \times 10^5 \text{ N}.$$

b. The driver of a three-wheeler moving with a speed of 36 km/h sees a child standing in the middle of the road and brings his vehicle to rest in 4.0 s just in time to save the child. What is the average retarding force on the vehicle? The mass of the three-wheeler is 400 kg and the mass of the driver is 65 kg.

Answer: Here mass of three-wheeler $m_1 = 400 \text{ kg}$, mass of driver = $m_2 = 65 \text{ kg}$, initial speed of auto, $u = 36 \text{ km/h} = 36 \times \frac{1000}{3600} \text{ m/s} = 10 \text{ ms}^{-1}$, final speed, $v = 0$ and $t = 4 \text{ s}$.

As acceleration,
$$a = \frac{v - u}{t} = \frac{0 - 10}{4} = -2.5 \text{ ms}^{-2}$$

Now
$$F = (m_1 + m_2) a = (400 + 65) \times (-2.5) \\ = -1162.5 \text{ N} = -1.2 \times 10^3 \text{ N}.$$

The $-ve$ sign shows that the force is retarding force.