Sample Paper

Class 9 CBSE 2020-21

General Instructions

(i) The question paper comprises four sections A, B, C, and D. There are 36 questions in the question paper. All questions are compulsory.

(ii) (Section–A - question no. 1 to 20 - all questions and parts thereof are of one mark each. These questions contain multiple-choice questions (MCQs), very short answer questions, and assertion - reason type questions. Answers to these should be given in one word or one sentence.

(iii) Section–B - question no. 21 to 26 are short answer type questions, carrying 2 marks each. Answers to these questions should be in the range of 30 to 50 words.

(iv) Section–C - question no. 27 to 33 are short answer type questions, carrying 3 marks each. Answers to these questions should be in the range of 50 to 80 words.

(v) Section–D – question no. - 34 to 36 are long answer type questions carrying 5 marks each. Answers to these questions should be in the range of 80 to 120 words.

(vi) There is no overall choice. However, internal choices have been provided in some questions. A student has to attempt only one of the alternatives in such questions.

(vii) Wherever necessary, neat, and properly labelled diagrams should be drawn.

Section-A

1. Which law states that in a chemical compound, elements always combine in a fixed proportion?

   OR

   An unknown substance 'A' on thermal decomposition produces 'B' and 'C'. What is 'A'—an element, a compound or a mixture?
2. You are given two samples of water labelled as 'A' and 'B'. At 1 atm, sample 'A' boils at 100°C and sample 'B' boils at 102°C. Which sample of the water will not freeze at 0°C? Comment.
3. An element which can exhibit valencies of 2, 4 and 6 can be:
   A. copper
   B. iron
   C. mercury
   D. sulphur
4. Define uniformly accelerated motion and give one example of it.
5. What is the displacement of a satellite when it makes a complete round along its circular path?
6. While standing a person has a weight of 50 N. What is the magnitude and direction of the reaction exerted by the ground on the person?

   OR

   A ball rolls off the back of a train going 80km/h. Neglecting air resistance, what is the horizontal speed of the ball just before it hits the ground?
7. What is the work done against gravity when a body is moved horizontally along a frictionless surface?
8. Which would have a greater effect on the kinetic energy of an object: doubling the mass or doubling the velocity?
9. Calculate the work done when a force of 15 N moves a body by 5 m in its direction.

   OR

   To what height should a body of mass 5 kg be raised so that its potential energy is 490 J? (Take g = 9.8 m/s^2)
10. Which of the following options are not a function of Ribosomes?
    (i) It helps in the manufacture of starch grains
    (ii) It helps in the manufacture of hormones.
    (iii) It helps in the manufacture of enzymes
    (iv) It helps in the manufacture of proteins molecules

a. (i) and (iii)
b. (ii) and (iii)
c. (iii) and (iv)
d. (i) and (ii)

11. Presence of which tissue allows the branch of a tree to move and bend freely under conditions of high wind velocity?
12. What will be the signs and symptoms of diseases if the following organs of our body are targeted by microbes?
    a. Lungs
    b. Liver
    c. Brain
13. Select from the following the biotic component of the biosphere:
    Water, grass, air, animals in a forest
14. DIRECTION: In the following questions, a statement of assertion (A) is followed by a statement of the reason (R).
    Assertion: Atomic mass of aluminium is 27
    Reason: An atom of aluminium is 27 times heavier than 1/12th of the mass of the C – 12 atom

    A. Both assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the assertion
    B. Both assertion (A) and Reason (R) are true but reason (R) is not the correct explanation of assertion (A)
    C. Assertion (A) is true but reason (R) is false.
    D. Assertion (A) is false but reason (R) is true.
15. Assertion(A): Topsoil that is bare of vegetation is likely to get eroded easily.
    Reason(R): Vegetative cover on the ground has a role to play in percolation of water into deeper layers.
    A. Both assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the assertion
    B. Both assertion (A) and Reason (R) are true but reason (R) is not the correct explanation of assertion (A)
    C. Assertion (A) is true but reason (R) is false.
    D. Assertion (A) is false but reason (R) is true.
16. Assertion: The numerical ratio of displacement to distance is equal to one or less than one.

Reason: Displacement is a vector quantity and distance is a scalar quantity.

A. Both assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of the assertion
B. Both assertion (A) and Reason (R) are true but reason (R) is not the correct explanation of assertion (A)
C. Assertion (A) is true but reason (R) is false.
D. Assertion (A) is false but reason (R) is true.

17. Answer question numbers (a) to (d) on the basis of your understanding of the following paragraph and related studied concepts :
The soil that we see today in one place has been created for a very long period of time. However, some of the factors that created the soil in the first place and brought the soil to that place may be responsible for the removal of the soil too. The fine particles of soil may be carried away by flowing water or wind. If all the soil gets washed away and the rocks underneath are exposed, we have lost a valuable resource because very little will grow on the rock.
    a. How can we affect soil adversely?
    b. How is soil formed?
    c. Study the given diagram. According to you, which tray will eventually have more soil. The one with plants or the one without any?

    d. Besides holding the topsoil. What is the other advantage of having the vegetation?

18. Read the following and answer any **four** questions from 18 (a) to 18 (e)
    (a) Name three mixtures found in nature.
    (b) Which of the following is a mixture?
    Salt, Air, Water, Alum, Sugar
    (c) Which type of elements, metals or non-metal show the property of brittleness?
    (d) Name one element, one compound and one mixture.
    (e) Classify the following as elements or compounds:
    Iron, Iron sulphide, Sulphur, Washing soda, Sodium, Carbon, Urea
    Compounds: Iron sulphide, washing soda and urea.

19. Read the following and answer any **four** questions from 19 (a) to 19 (e)

Fill in the following blanks with suitable words:

(a) An element is made up of only one kind of …….

(b) Alcohol is a …….

(c) Brass is an alloy which is considered a …….

(d) The three important metalloids are …….

(e) The elements which are sonorous are called …….

20. Read the following and answer any four questions from 20 (a) to 20 (e). The following table shows the variation of velocity with respect to time for a scooter. Study the table and answer the questions.

Time in seconds	0	1	2	3	4	5	6	7	8	9	10
Velocity in km/h	0	0.5	1.0	1.5	2.0	2.5	3.2	4.0	6.0	9.0	9.5

(a) Define acceleration and mention its SI Unit.

(b) What can you say about the motion of the scooter? Is it uniform or non-uniform?

(c) Does the scooter have constant acceleration? If yes then what is the value of the scooter's acceleration.

(d) Calculate the acceleration of the scooter in the first five seconds.

(e) What is the distance covered by the scooter in the first five seconds?

Section-B

21. What is the main function of each of the following cell components?

(i) Plasma membrane

(ii) Mitochondria

(iii) Chromosomes

(iv) Lysosomes

(v) Ribosomes

(vi) Golgi apparatus

OR

How is simple tissue different from complex tissues in plants?

22. What is an immunisation?

23. Define a solution. If 10 mL of H_2SO_4 is dissolved in 90 mL of water, calculate the concentration of a solution (volume/volume percentage).

OR

Non-metals are usually poor conductors of heat and electricity. They are non-lustrous, non-sonorous, non-malleable and are coloured.

(a) Name a lustrous non-metal.
(b) Name a non-metal which exists as a liquid at room temperature.
(c) The allotropic form of a non-metal is a good conductor of electricity. Name the allotrope.
(d) Name a non-metal which is known to form the largest number of compounds.

24. $^{222}_{86}Rn$ is an isotope of a noble gas, radon. How many protons, neutrons and electrons are there in one atom of this radon isotope?
25. A player brings a cricket ball of mass 100 g moving with a speed of 30 m/s to rest. Then find the change in momentum of the ball.
26. The gravitational force between two objects is F. If masses of both objects are halved without changing distance between them, then what would be the gravitational force?

Section-C

27. What do you know about holes in the ozone layer? Explain the probable damage caused by it.

OR

Differentiate between RER and SER.

28. List any four salient features of meristematic tissue.
29. Give reasons for the following statements:
    (i) Percentage of gases like oxygen, nitrogen and carbon dioxide remain almost the same in the atmosphere.
    (ii) Even though the moon is at the same distance from the sun as the earth, still the range of temperature is very wide i.e., from -190*C to 110*C.
    (iii) Fossil fuels cause air pollution.
30. (i) A car travels 100 km east and then 100 km south. Finally, it comes back to the starting point by the south-east route. Throughout the journey, the speed is constant at 60 kmh^{-1}. Calculate the average velocity for the whole journey if the time taken is 3.3 hours.
    (ii) If a sprinter runs a distance of 1000 metres in 9.83 seconds, calculate his average speed in km/h
31. (a) Calculate the formula unit mass of Na_2SO_4
    (b) What is the mass of one mole of sulphur atoms?
    (c) Convert 12 g of sulphur into the mole.
32. Write the formula of the compounds formed by the following ions.

(a) Mg^{2+} and S^{2-}

(b) Cu^{2+} and OH^{-}

Name the compounds formed in each case.

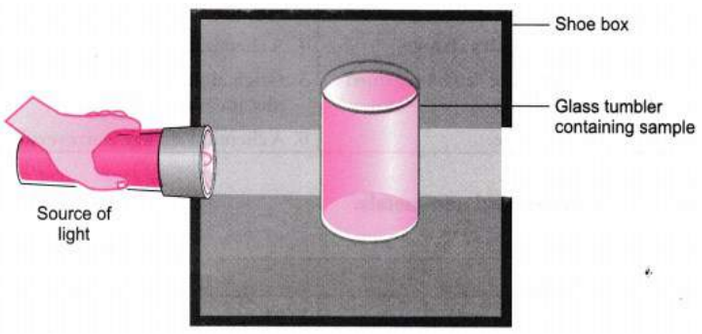
33. (i) A champagne cork with a mass of 10 grams accelerates off the top of the champagne bottle at $4m/s^2$ for 2 seconds. What is the final kinetic energy of the cork after 2 seconds?

(ii) Mention the commercial unit of energy. Express it in terms of joules. Calculate the energy in joule consumed by a device of 60 W in 1 hour.

Section-D

34. A group of students took an old shoebox and covered it with a black paper from all sides. They fixed a source of light (a torch) at one end of the box by making a hole in it and made another hole on the other side to view the light. They placed a milk sample contained in a beaker/tumbler in the box as shown in the figure. They were amazed to see that milk taken in the tumbler was illuminated. They tried the same activity by taking a salt solution but found that light simply passed through it.

(a) Explain why the milk sample was illuminated. Name the phenomenon involved.



(b) Same results were not observed with a salt solution. Explain.

(c) Can you suggest two more solutions which would show the same effect as shown by the milk solution?

OR

(a) Find the mass of 10 moles of sodium sulphite (Na_2SO_3).

(b) Calculate the number of moles in 8 g of oxygen gas.

(c) Convert 22 g of CO_2 into moles.

35. The immune system of Ravi is damaged by the attack of a pathogen on his body.

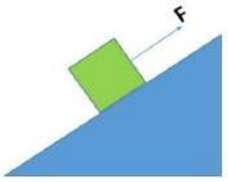
(i) Name the disease he is suffering from.

(ii) Name the pathogen that has attacked his body

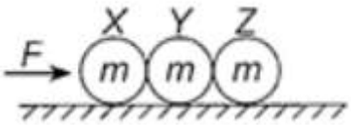
(iii) Mention any three modes of transmission of this disease.

36. (i) A ball moves with a velocity of 3 m/s and has a mass of 5 kg. After another ball hits it, its velocity in the same direction reduces to 1 m/s. What is the magnitude of change in momentum of the ball?

(ii) What is the direction of the force of gravity acting on the box in the figure shown below?



(iii) Three identical bodies, each of mass m, are pushed by a force F on a frictionless table as shown in the figure. Then, find (i) the net force on X and (ii) normal reaction between X and Y,



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Hints & Solutions

Section-A

1. Answer: Law of constant proportion or law of definite proportion states that in a chemical compound, elements always combine in a fixed proportion.

   OR

   Answer: Unknown substance 'A' should be a compound because elements and mixture do not decompose.
2. Answer: Sample 'B' will not freeze at 0°C because it is not pure water. At 1 atm, the boiling point of pure water is 100°C and the freezing point of pure water is 0°C.
3. Answer: Sulphur has 2 valence electrons in its outermost shells. Hence it exhibits valencies of 2, 4 and 6.
4. Answer: Uniformly Accelerated motion: When a body moves along a straight line and its velocity increases by equal amounts in equal intervals of time then the motion is called uniformly accelerated motion.
   E.g. Motion of a freely falling body
5. Answer: Displacement along a circular path is zero as the final and the initial points meet each other that is both the points are same
6. Answer: The ground exerts an equal and opposite force on the person and since the person's weight is 50 N, the ground also exerts a force of 50 N on the person upward.

   OR

   Newton's first law states that an object in motion tends to stay in motion unless acted upon by an external force. Because we are disregarding air friction, there is no external force to slow the ball down in the horizontal direction after it falls off the train. The acceleration of gravity would only affect the ball in the vertical direction. Therefore, its velocity will be the same 80km/h.
7. Answer: Force of gravity acts vertically downward, while the body moves horizontally. Thus, the force of gravity is not causing the motion. So, the work done by the force of gravity is zero.
8. Answer: If the mass of a body is doubled, its kinetic also gets doubled and if the mass of a body is halved, its kinetic energy also gets halved.

If the velocity of a body is doubled, its kinetic energy becomes four times and if the velocity of a body is halved, then its kinetic energy becomes one- fourth.

It is obvious that doubling the velocity has a greater effect on the kinetic energy of a body than doubling its mass.

9. Answer: The work done by a body is given as

$$W = Fd$$

It is positive since the body is displaced in the direction of the force. Therefore

$$W = 15 \times 5 = 75\,J$$

OR

We know that for a body of mass m, the potential energy at a height h is given as

$$P = mgh$$

Therefore

$$490 = 5 \times 9.8 \times h$$
$$h = 10\,m$$

10. Answer: (d) Starch grains are manufactured in chloroplast during photosynthesis. Hormones are manufactured by endocrine glands. Ribosomes are a site of protein synthesis and chemically all enzymes are proteins.
11. Answer: Presence of collenchyma tissue provides flexibility to plant parts and allows the branch of a tree to move and bend freely under conditions of high wind velocity.
12. Answer:
    a. Cough and breathlessness
    b. Jaundice
    c. Headaches, fits or unconsciousness
13. Answer: Grass and animals
14. Answer: A

    Answer: 1/12 of C-12 is 1u and the mass of Al atom is 27 u hence it is 27 times the 1/12th of C-12 atoms. So, reason explains the reason correctly.
15. Answer: (c) Vegetative cover i.e., plants roots bring the soil particles together thereby preventing soil erosion
16. Answer: A

    Answer: Since displacement has direction, displacement can never be greater than distance and therefore, the ratio of displacement to distance is less than or equal to one.

17. Answer:
    a. We affect soil adversely by deforestation and by adding substances, like fertilizers which spoil the fertility of the soil.
    b. Soil is formed by weathering of rocks which takes many years.
    c. According to me, the tray with plants will retain soil because their roots hold the soil particles, preventing soil erosion.
    d. The trees also help in recharging groundwater.
18. (a) Answer: (i) Milk
    (ii) Mixture of different colours - Paint
    (iii) Mixture of different gases-Air.
    (b) Answer: Air is made of different gases. Hence air is a mixture of gases.
    (c) Answer:
    Non-metals show the property of brittleness. A material is brittle if, when subjected to stress, it breaks without significant plastic deformation.
    (d) Answer:
    Element- Nitrogen
    Compound- Water
    Mixture- Air
    (e) Answer: Elements: Iron, Sodium, Sulphur and carbon.
    Compounds: Iron sulphide, washing soda and urea.
19. Answer:
    (a) atoms
    (b) compound
    (c) mixture
    (d) boron; silicon; germanium
    (e) metals
20. Answer: (a) Acceleration is defined as the change in velocity per unit time. Its SI unit is m/s^2.
    (b) From the table we can see that the velocity of the scooter is increasing with respect to time, i.e. it is accelerating. Therefore, the scooter is undergoing non-uniform motion.
    (c) We see that during the time interval 0-1 s, the velocity changes from 0 to 0.5 km 1h. In the equal time intervals 1-2 s, 2-3 s, 3-4 s and 4-5 s, the velocity changes by an equal amount i.e.. 0.5 km/h. So, the acceleration (the rate of change of velocity) remains the same during the interval 0-5 s. In this interval, the scooter has a constant acceleration. The velocity changes by 0.7 km, h during 5-6 s. 0.8 km h during 6-7 s.

2.0 km h during 7-S 10 km h during 8-9 s and 0.5 km h during 9-10 s. So, from 5 s to 10 s, the acceleration is not constant. Therefore, for the whole journey, the acceleration is **not constant.**

(d) In the first five seconds, the velocity of the scooter changes by 0.5 km/h each second. Therefore, acceleration:

$$a = \frac{0.5 \times \frac{1000}{3600}}{1} = 0.14\ m/s^2$$

(e) We know the acceleration in the first five seconds, then we can use the second equation of motion with zero initial velocity

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

$$S = \frac{1}{2} \times 0.14 \times 5^2 = 1.75\ m$$

Section-B

21. Answer:

i. It regulates entry and exit of molecules from within the cell to the exterior and vice-versa.

ii. Also known as the powerhouse of the cell. Cellular respiration takes place in this organelle resulting in the release of energy.

iii. Chromosomes contain genes. Genes are segments of DNA and are bearers of hereditary characteristics. These are responsible for one or more cellular functions.

iv. These are also known as suicidal bags of the cell. They contain digestive enzymes. They kill bacteria and remove worn-out cell organelles.

v. Ribosomes are the site of protein synthesis in a cell.

vi. Golgi apparatus or Golgi body is the secretory organelle of the cell. They are also involved in the formation of lysosomes.

OR

Answer: The distinction between simple and complex tissue:

Simple tissue	**Complex tissue**
Simple tissue is a group of similar cells which are of one type performing the same function.	Complex tissue is made up of more than one type of cells and they work together as a unit.

Example, parenchyma, sclerenchyma and collenchyma	Example, xylem and phloem

22. Answer: Development of immunity against a pathogen through vaccination is called immunization/In-immunization, heat is killed or chemically weakened pathogens are inoculated. When our immune systems first encounter the microbe, it responds against it and then remembers it specifically. So, the next time that particular microbe or its close relative enters the body the immune response system responds with greater vigour. This eliminates the infection quickly. This is the basis of the principle of immunization.
23. Answer: For the definition of solution,
Volume of H_2SO_4 (solute) = 10 mL
Volume of water (solvent) = 90 mL
Volume of solution = (90 +10) mL

$$\text{Concentration of solution} = \frac{\text{Volume of solute}}{\text{Volume of solution}} \times 100 = \frac{(10\,\text{mL})}{(100\,\text{mL})} \times 100 = 10\%$$

OR

Answer:
(a) Iodine
(b) Bromine
(c) Graphite
(d) Carbon

24. Answer: The atomic number of radon = 86
The number of protons = 86
The number of electrons = Number of protons = 86
Number of neutrons = Atomic mass – Atomic number = 222 – 86 = 136
25. Answer: For the ball: initial velocity = 30 m/s and final velocity = 0 m/s. Therefore change in momentum of the ball

$$= m(v-u) = \frac{100}{1000}(0-30) = -3\ kg\ m/s$$

26. Answer: From universal law of gravitation, we have

$$F = G\frac{m_1 m_2}{r^2}$$

If both the masses are halved the masses are

$$F' = G\frac{\frac{m_1}{2}\frac{m_2}{2}}{r^2} = \frac{F}{4}$$

Section-C

27. Answer: Ozone, O_3 is a molecule that contains three atoms of oxygen. Ozone is poisonous but it is not stable near the earth's surface. It occurs in the zone of earth's atmosphere called the stratosphere. Ozone absorbs harmful ultraviolet radiations from the sun. Thus, it protects us from certain diseases like cancer. Various man-made compounds like CFCs react with ozone molecules and cause depletion in the ozone layer in the atmosphere.
Recently, a hole has been discovered above Antarctica. Due to ozone depletion, UV-rays can enter the earth's atmosphere and cause certain diseases.

OR

Answer: Difference between RER and SER:

RER	**SER**
Rough endoplasmic reticulum is a network of cisternae tubules and vesicles which have ribosomes attached to its membrane.	SER is a network of tubules which are devoid of ribosomes.
Ribosomes are attached to its membrane	Ribosomes absent

28. Answer: The characteristics features of meristematic tissue are as follows:
    1. The cells are small, isodiametric and undifferentiated which are compactly arranged.
    2. The cell wall is thin and elastic.
    3. Intercellular spaces are absent
    4. Dense cytoplasm is present containing large prominent nuclei.
    5. Vacuoles are absent or very small in number.
29. Answer:
    i. Oxygen cycle, nitrogen cycle and carbon control the percentage of gases in the atmosphere.
    ii. There is no atmosphere on the surface of the moon, therefore it cannot trap IR radiation.
    iii. Combustion of coal and petroleum releases oxides of carbon, sulphur and nitrogen.

30. Answer:

(i) We know that

$$Velocity = \frac{Displacment}{Time}$$

Now, Displacement = Final Position – Initial Position

Since the car comes back to its starting point, so, the displacement = 0

Therefore,

$$Velocity = \frac{0}{3.3} = 0$$

(ii) Total distance travelled=1000m

Total time taken = 9.83 sec

Average speed = Total distance travelled/ Total time taken

=1000/9.83 =101.72m/s

Average speed in km/h:

101.72 x (3600/1000)=366.2 km/h

31. Answer:

(a) Na_2SO_4 is an ionic compound. Therefore its formula unit mass is the same as its molecular mass

= 2 x 23 + 32 + (4 x 16) = 142 u

(b) The mass of one mole of sulphur atoms = 32 u.

(c) 32 g of sulphur = 1 mol

$$12 \text{ g of sulphur} = \frac{(12\text{g})}{(32\text{g})} \times 1 \text{ mol} = 0{\cdot}375 \text{ mol.}$$

32. Answer:

(a) Ions Mg^{2+} S^{2-}

Valencies 2 2

Compound: Mg_2S_2 or MgS; Magnesium sulphate

(b) Ions Cu^{2+} OH^-

Valencies 2 1

Compound: $Cu(OH)_2$; Copper (II) hydroxide.

33. Answer:

(i) We can find the final velocity by multiplying the acceleration by the time. We then plug this into the formula for kinetic energy and solve.

$$v = u + at$$

$$v = 0 + 4 \times 2 = 8 \ m/s$$

$$K = \frac{1}{2}mv^2 = \frac{1}{2} \times 0.01 \times 8^2 = 0.32 \ J$$

(ii) Commercial unit of Energy is Kilowatt per hour denoted by kWh.
1kWh = 3600000 Joules
Energy Consumed in 1 hour
60 W = 60 J/s
1 hour = 60×60 seconds
⇒ Energy consumed in 1 hour = 60 ×60×60 = 216000 J
216000 Joules of energy is consumed in 1 hour.

Section-D

34. Answer:

(a) Milk is a colloid. If a beam of light is put on a milk sample contained in a beaker, the path of the light beam is illuminated and becomes visible when seen from the other side. This is because the colloidal particles are big enough to scatter light falling on them. This scattered light enters our eyes and we can see the path of the light beam.

The scattering of light by colloidal particles is known as the Tyndall effect.

(b) Salt solution is a true solution. If a beam of light is put on a salt solution kept in a beaker in a dark room, the path of the light beam is not visible inside the solution when seen from the other side. This is because salt particles present in it are so small that they cannot scatter light rays falling on them.

(c) Detergent solution, sulphur solution.

OR

Answer:

(a) Molar mass of Na_2SO_3 = 2 × 23 + 32 + 3 × 16
= 46 + 32 + 48 = 126 g
Mass of 10 moles of Na_2SO_3 = 126 × 10 = **1260 g**

(b) Molar mass of oxygen (O_2) = 32 g
32 g of oxygen = 1 mol

$$8 \text{ g of oxygen} = (1 \text{ mol}) \times \frac{(8 \text{ g})}{(32 \text{ g})} = \mathbf{0{\cdot}25 \text{ mol}}$$

(c) Molar mass of CO_2 = 12 + 2 × 16 = 44 g
44 g of CO_2 = 1 mol

$$22 \text{ g of } CO_2 = (1 \text{ mol}) \times \frac{(22 \text{ g})}{(44 \text{ g})} = \mathbf{0{\cdot}5 \text{ mol.}}$$

35. Answer:

i. He is suffering from AIDS or Acquired immune deficiency syndrome

ii. The pathogen is a virus called HIV or Human Immunodeficiency virus.

iii. This virus is transmitted through the following ways:

a. Sexual contact with an infected person carrying the AIDS virus
b. Transmission of blood infected with HIV
c. Use of unsterilized needles, blades or razors
d. Transplacental transmission ie AIDS-infected mother to the foetus developing in her womb

36. Answer:

(i)The momentum of the ball initially

$$p_1 = mv_1$$
$$p_1 = 5 \times 3 = 15 \; kg \; m/s$$

After its velocity is changed the momentum:

$$p_2 = mv_2$$
$$p_2 = 5 \times 1 = 5 \; kg \; m/s$$

Therefore, change in momentum.

$$p_2 - p_1 = 5 - 15 = -10 \; kg \; m/s$$

(ii) The force of gravity always acts in the downward direction regardless of the orientation of the object. The gravitational force shall be in straight down in the figure.

(iii) Let the acceleration of all the bodies be a, then from Newton's second law of motion

$$F = 3ma$$

Where m is the mass of each body.

Then

$$a = \frac{F}{3m}$$

(i) Therefore, the Net force on X

$$X = ma$$

$$X = \frac{F}{3}$$

(ii) And since X is pushing both Y and Z, the force applied by X on Y is

$$Y_x = (m + m)a = \frac{2}{3}F$$

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