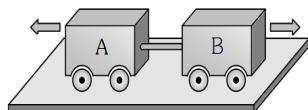


Physics

1

Two carts of masses 200 kg and 300 kg on horizontal rails are pushed apart. Suppose the coefficient of friction between the carts and the rails are same. If 200 kg cart travels a distance of 36 m and stops, then find the distance travelled by the cart weighing 300 kg.



1

12 m

2

16 m

3

24 m

4

32 m

2

In Bohr model of hydrogen atom, find the ratio of periods of revolution of an electron in $n = 2$ and $n = 1$ orbits.

1

16:1

2

8:1

3

4:1

4

2:1

3

When heat energy of 1500 Joules is supplied to a gas at constant pressure $2.1 \times 10^5 \text{ N/m}^2$, there was an increase in its volume equal to $2.5 \times 10^{-3} \text{ m}^3$. Then how much increase is there in internal energy of the gas (in joules)?

1

2025

2

975

3

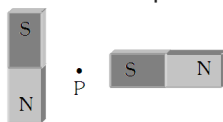
525

4

450

4

Two equal bar magnets are kept as shown in the figure. Which of the following arrow head at the point P represents the direction of resultant magnetic field approximately?



1



2



3



4



5

The false statement regarding a particle moving in a circle with a constant angular speed is:

1

The acceleration vector is tangent to the circle

2

The velocity and acceleration vectors are perpendicular to each other

3

The velocity vector is tangent to the circle

4

The acceleration vector points to the centre of the circle

6

A liquid drop of diameter D breaks upto into 27 small drops of equal size. If the surface tension of the liquid is σ , then what is the change in surface energy?

1

$$4\pi D^2\sigma$$

2

$$3\pi D^2\sigma$$

3

$$2\pi D^2\sigma$$

4

$$\pi D^2\sigma$$

7

$T = P^a D^b S^c$ represents the period of a body under SHM; where 'P' is pressure, 'D' is density and 'S' is surface tension. Then find the values of a, b and c.

1

-1, -2, 3

2

 $1, 2, \frac{1}{3}$

3

 $\frac{1}{2}, -\frac{3}{2}, -\frac{1}{2}$

4

 $-\frac{3}{2}, \frac{1}{2}, 1$

8

A particle executes simple harmonic motion with an amplitude of 4 cm. At the mean position the velocity of the particle is 10 cm/s. Find the distance of the particle from the mean position when its speed becomes 5 cm/s.

1

 $2(\sqrt{5}) \text{ cm}$

2

 $2(\sqrt{3}) \text{ cm}$

3

 $\sqrt{5} \text{ cm}$

4

 $\sqrt{3} \text{ cm}$

9

If two waves defined by $y_1 = 4 \sin \omega t$ and $y_2 = 3 \sin\left(\omega t + \frac{\pi}{3}\right)$ interfere at a point, then what will be the amplitude of resulting wave?

1

4

2

5

3

6

4

7

10

In a straight line, a free body of mass 8 kg is travelling at 2 meter per second. At a certain instant, the body splits into 2 equal parts due to internal explosion which releases 16 joules of energy. Neither part leaves the original line of motion finally. Give the reason.

1

One part comes to rest and the other moves in the same direction as that of the original body

2

One part comes to rest and the other moves in the direction opposite to that of the original body

3

Both parts continue to move in the same direction as that of the original body

4

One part moves in the same direction and the other in the direction opposite to that of the original body

11

A rubber cord 10 m long is suspended vertically. Determine the stretch under its own weight. (Density of rubber = 1500 kg/m^3 , $Y = 5 \times 10^8 \text{ N/m}^2$, $g = 10 \text{ m/s}^2$)

1

 $7.5 \text{ \AA} \times 10^{-4} \text{ m}$

2

 $12 \text{ \AA} \times 10^{-4} \text{ m}$

3

 $15 \text{ \AA} \times 10^{-4} \text{ m}$

4

 $25 \text{ \AA} \times 10^{-4} \text{ m}$

12

In an ac circuit, the current is given by $i = 5 \sin\left(100t - \frac{\pi}{2}\right)$ and the ac potential is $V = 200 \sin(100t)$ volt. Then find its power consumption.

1

0 watt

2

20 watts

3

40 watts

4

1000 watts

13

A rod of length 'l' and radius 'r' is joined to a rod of length l/2 and radius r/2 of same material. The free end of small rod is fixed to a rigid base and the free end of larger rod is given a twist of θ° , what will be the twist angle at the joint?

1	80/9
2	50/6
3	0/2
4	0/4

14

A bird weighing 2 kg is inside a closed cage of 1 kg. What will be the weight of the bird and cage assembly, if it starts flying?

1	4 kg
2	3 kg
3	2.5 kg
4	1.5 kg

15

A block of 1 kg is stopped against a wall by applying a force F perpendicular to the wall. If $\mu = 0.2$, then what is the minimum value of F ?

1	49 N
2	98 N

3

490 N

4

980 N

16

Two vessels of different materials are similar in size in every respect. The same quantity of ice filled in them gets melted in 20 minutes and 30 minutes. What will be the ratio of their thermal conductivities?

1

1

2

1.5

3

4

4

 $\frac{2}{3}$

17

If a car travels the first half of a distance between two places at a speed of 30 km/hr and the second half of the distance at 50 km/hr. Then what is the average speed of the car for the whole journey?

1

35.5 km/hr

2

37.5 km/hr

3

40.1 km/hr

4

44.5 km/hr

18

A uniform chain of length 2m is kept on a table such that a length of 60cm hangs freely from the edge of the table. The total mass of the chain is 4kg. What is the work done in pulling the entire chain on the table?

1

1200 J

2

120 J

3

7.2 J

4

3.6 J

19

Two particles, each of mass m and carrying charges Q , are separated by some distance. If they are in equilibrium under mutual gravitational and electrostatics forces then Q/m (in C/kg) is of _____ order.

1

 10^{-20}

2

 10^{-15}

3

 10^{-10}

4

 10^{-5}

20

Watt does not equals:

1

Ampere/volt

2

 $(\text{Ampere})^2 \times \text{ohm}$

3

Ampere \times volt

4

Joule/second

21

If $\vec{A} = 4\hat{i} - 3\hat{j}$ and $\vec{B} = 6\hat{i} + 8\hat{j}$, then what will be the magnitude and direction of $\vec{A} + \vec{B}$?

1

 $25, \tan^{-1}(3/4)$

2

 $10, \tan^{-1}(5)$

3

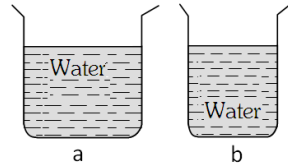
 $5\sqrt{5}, \tan^{-1}(1/2)$

4

 $5, \tan^{-1}(3/4)$

22

Determine the correct observation considering adjacent figure.



1

Pressure on the bottom of (a) and (b) is the same

2

Pressure depend on the shape of the container

3

Pressure on the bottom of the tank (a) is smaller than at the bottom of (b)

4

Pressure on the bottom of tank (a) is greater than at the bottom of (b)

23

A man weighing 80 kg is standing in a trolley weighing 320 kg. The trolley is resting on frictionless horizontal rails. If the man starts walking on the trolley with a speed of 1 m/s, then after 4 seconds his displacement relative to the ground will be

1

3.0 m

2

3.2 m

3

4.8 m

4

5 m

24

Imagine a new planet having the same density as that of earth but it is 3 times bigger than the earth in size. If the acceleration due to gravity on the surface of earth is g and that on the surface of the new planet is g' , then find the correct one.

1

$$g' = 3g$$

2

$$g' = 27g$$

3

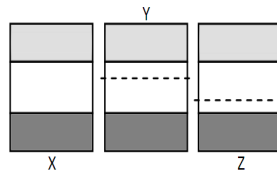
$$g' = \frac{g}{9}$$

4

$$g' = 9g$$

25

The following figures represents energy band diagrams for three semiconductor samples of silicon. What we can assert from?



1

Sample X is undoped while both samples Y and Z have been doped with a fifth group impurity

2

Sample X is undoped while samples Y and Z have been doped with a third group and a fifth group impurity respectively

3

Sample X is undoped while samples Y and Z have been doped with a fifth group and a third group impurity respectively

4

Sample X has been doped with equal amounts of third and fifth group impurities while samples Y and Z are undoped

26

If the velocity of light 'c', gravitational constant 'G' and Planck's constant 'h' are chosen as fundamental units, then what are the dimensions of mass in new system?

1

$$[c^{1/2}G^{1/2}h^{1/2}]$$

2

$$[c^{-1/2}G^{1/2}h^{1/2}]$$

3

$$[c^{1/2}G^{1/2}h^{-1/2}]$$

4

$$[c^{1/2}G^{-1/2}h^{1/2}]$$

27

Phase difference between 2 points separated by 1 m in a wave of frequency 120 Hz is 90° . Evaluate the wave velocity.

1

720 m/s

2

480 m/s

3

240 m/s

4

180 m/s

28

Magnetic flux in a circuit containing a coil of resistance 2Ω changes from 2 Wb to 10 Wb in 0.2 s. Calculate the charge passed through the coil in this time.

1

1 C

2

4 C

3

5 C

4

0.3 C

29

Choose the correct statement w.r.t to the rotational motion of a rigid body.

1

The centre of mass of the body moves uniformly in a circular path

2

Individual particles of the body do not undergo accelerated motion

3

The centre of mass of the body remains unchanged

4

Individual particles and centre of mass of the body undergo an accelerated motion

30

There is a current of 20 ampere in a copper wire of 10^{-6} square meter area of cross-section. If the number of free electrons per cubic meter is 10^{29} , then what is value of drift velocity?

1

$$1.25 \times 10^{-4} \text{ m/s}$$

2

$$1.25 \times 10^{-3} \text{ m/s}$$

3

$$12.5 \times 10^{-3} \text{ m/s}$$

4

$$125 \times 10^{-3} \text{ m/s}$$

31

An alpha particle enters a hollow tube of 4 m length with an initial speed of 1 km/s. It is accelerated in the tube and comes out of it with a speed of 9 km/s. Find the time for which it remains inside the tube.

1

$$8 \times 10^{-4} \text{ s}$$

2

$$8 \times 10^{-3} \text{ s}$$

3

$$80 \times 10^{-3} \text{ s}$$

4

$$800 \times 10^{-3} \text{ s}$$

32

Why the spring is made up of steel instead of copper?

1

Steel is more elastic than copper

2

Copper is more costly than steel

3

Copper is more elastic than steel

4

None of the above

33

At atmospheric pressure, the temperature of an ideal gas is 300 K and volume 1 m^3 . If temperature and volume become double, then what will be the pressure?

1

$4 \times 10^5 \text{ N/m}^2$

2

$2 \times 10^5 \text{ N/m}^2$

3

10^5 N/m^2

4

$0.5 \times 10^5 \text{ N/m}^2$

34

Evaluate the work done in pulling up a block of wood weighing 2 kN for a length of 10 m on a smooth plane inclined at an angle of 15° with the horizontal.

1

9.82 kJ

2

8.91 kJ

3

5.17 kJ

4

4.36 kJ

35

Determine the value of linear velocity, if $\vec{\omega} = 3\hat{i} - 4\hat{j} + \hat{k}$ and $\vec{r} = 5\hat{i} - 6\hat{j} + 6\hat{k}$.

1

 $6\hat{i} - 2\hat{j} + 8\hat{k}$

2

 $6\hat{i} + 2\hat{j} - 3\hat{k}$

3

 $4\hat{i} - 13\hat{j} + 6\hat{k}$

4

 $-18\hat{i} - 13\hat{j} + 2\hat{k}$

36

Estimate the work done in shifting a particle of mass m from centre of earth to the surface of the earth. (where R is the radius of the earth)

1

 $-mgR$

2

 $+\frac{mgR}{2}$

3

 $-\frac{mgR}{2}$

4

zero

37

2 wires of same length are shaped into a square and a circle. What is the ratio of the magnetic moment, if they carry same current?

1

 $\pi:2$

2

 $2:\pi$

3

 $4:\pi$

4

 $\pi:4$

38

It is desired to photograph the image of an object placed at a distance of 3 m from the plane mirror. The camera which is at a distance of 4.5 m from the mirror should be focused for how much distance?

1

7.5 m

2

6 m

3

4.5 m

4

3 m

39

Let m , $2m$, $3m$ and $4m$ be the masses of particles arranged at the corners of a parallelogram having each side ' a ' and one of the angle between 2 adjacent sides is 60° . The parallelogram lies in the x - y plane with mass ' m ' at the origin and $4m$ on the x -axis. Determine the position of centre of mass of the arrangement.

1

$$\left(\frac{a}{2}, \frac{3a}{4} \right)$$

2

$$\left(\frac{3a}{4}, \frac{a}{2} \right)$$

3

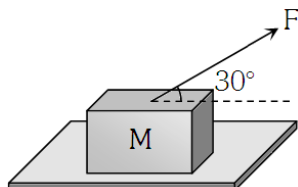
$$\left(0.95 a, \frac{\sqrt{3}}{4} a \right)$$

4

$$\left(\frac{\sqrt{3}}{2} a, 0.95 a \right)$$

40

A block of mass $M = 5$ kg is resting on a rough horizontal surface for which the coefficient of friction is 0.2. When a force $F = 40$ N is applied, then what will be the acceleration of the block? ($g = 10$ m/s²)



1

$$3.17 \text{ m/s}^2$$

2

$$5.73 \text{ m/s}^2$$

3

$$8.0 \text{ m/s}^2$$

4

10.0 m/s²

41

A cannon ball has a range R on a horizontal plane, such that the corresponding possible maximum heights reached are H_1 and H_2 . Then, which is the correct expression for R ?

1

$$(H_1 H_2)^{1/2}$$

2

$$\frac{(H_1 + H_2)}{2}$$

3

$$2(H_1 H_2)^{1/2}$$

4

$$4(H_1 H_2)^{1/2}$$

42

Find the vector that must be added to the vector $\hat{i} - 3\hat{j} + 2\hat{k}$ and $3\hat{i} + 6\hat{j} - 7\hat{k}$ to get the resultant vector as a unit vector along the y axis.

1

$$-4\hat{i} - 2\hat{j} + 5\hat{k}$$

2

$$3\hat{i} + 4\hat{j} + 5\hat{k}$$

3

$$4\hat{i} + 2\hat{j} + 5\hat{k}$$

4

Null vector

43

When a bullet of mass 5 gm moving with velocity 100 m /s, penetrates the wooden block upto 6 cm. Evaluate the average force imposed by the bullet on the block.

1

Zero

2

417 N

3

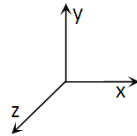
830 N

4

8300 N

44

Light wave is travelling along y-direction. If the corresponding \vec{E} vector at any time is along the x-axis, then direction of \vec{B} vector at that time is along which axis?



1

x-axis

2

y-axis

3

-z axis

4

+z axis

45

A body starts from the origin and moves along the X-axis such that the velocity at any instant is given by $(4t^3 - 2t)$, where t is in second and velocity in m/s. Evaluate the acceleration of the particle, when it is 2 m from the origin.

1

 10 m/s^2

2

 12 m/s^2

3

 22 m/s^2

4

 24 m/s^2

46

A force $\vec{F} = -K(y\hat{i} + x\hat{j})$ (where K is a positive constant) acts on a particle moving in the x - y plane. Starting from the origin, the particle is taken along the positive x -axis to the point $(a, 0)$ and then parallel to the y -axis to the point (a, a) . Find the total work done by the forces \vec{F} on the particle.

1

 $2Ka^2$

2

 $-2Ka^2$

3

 Ka^2

4

 $-Ka^2$

47

A body of mass 2 kg has an initial velocity of 3 meters per second along OE and it is subjected to a force of 4 N in a direction perpendicular to OE. After 4 seconds the distance of the body from O will be:

1

8 m

2

12 m

3

20 m

4

40 m

48

Two rods, one of aluminum and the other made of steel, having initial length l_1 and l_2 are connected together to form a single rod of length $l_1 + l_2$. The coefficients of linear expansion for aluminum and steel are α_a and α_s respectively. If the length of each rod increases by the same amount when their temperature are raised by $t^\circ\text{C}$, then find the ratio $\frac{l_1}{(l_1 + l_2)}$.

1

$$\frac{\alpha_a}{(\alpha_a + \alpha_s)}$$

2

$$\frac{\alpha_s}{(\alpha_a + \alpha_s)}$$

3

$$\frac{\alpha_a}{\alpha_s}$$

4

$$\frac{\alpha_s}{\alpha_a}$$

49

Which of the following is the unit of permittivity of free space (ϵ_0)?

1

coulomb / newton – metre

2

coulomb² / newton – metre²

3

coulomb² / (newton – metre)²

4

Newton – metre² / coulomb²

50

Gravitational mass is proportional to which of the following quantity?

1

Gravitational force

2

Gravitational potential

3

Gravitational field

4

Gravitational particles

Chemistry

1

The equilibrium constant for the given reaction $\text{H}_2 + \text{I}_2 \rightleftharpoons 2\text{HI}$ is correctly given by which of the following expression?

1

$$K_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]}$$

2

$$K_c = \frac{[\text{H}_2][\text{I}_2]}{[\text{HI}]^2}$$

3

$$K_c = \frac{[\text{H}_2][\text{I}_2]}{[2\text{HI}]}$$

4

$$K_c = \frac{[\text{H}_2][\text{I}_2]}{[\text{HI}]}$$

2

The second order Bragg's diffraction of X-rays with $\lambda = 1\text{\AA}$... from a set of parallel planes in a metal occurs at an angle of 60° . What is the distance between the scattering planes in crystal?

1

2.00 Å...

2

1.15 Å...

3

1.00 Å...

4

0.575 Å...

3

What does the reduction involve?

1

Gain of electrons

2

Loss of electrons

3

Increase in the valency of positive part

4

Decrease in the valency of negative part

4

Empirical formula of a compound is C_2H_5O and its molecular weight is 90. What is the molecular formula of the compound?

1

$C_5H_{14}O$

2

$C_4H_{10}O_2$

3

$C_3H_6O_3$

4

C_2H_5O

5

Velocity of the reaction doubles every $10^\circ C$ rise of temperature. If the temp. is raised by $50^\circ C$, the velocity of the reaction increases to about

1

16 times

2

20 times

3

32 times

4

50 times

6

Equivalent conductance at infinite dilution of a weak acid such as HF

1

is an undefined quantity

2

can best be determined from measurements on dilute solutions of NaF, NaCl and HCl

3

can be determined by extrapolation of measurements on dilute solutions of HCl, HBr and HI

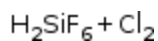
4

can be determined by measurement of very dilute HF solution

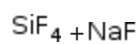
7

Silicon chloroform (SiHCl_3) is prepared by

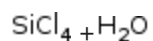
1



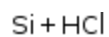
2



3



4



8

___ is used for reviving the exhausted permutit.

1

10% NaCl solution

2

10% MgCl_2 solution

3

10% CaCl_2 solution

4

HCl solution

9

SO_2 behaves as temporary bleaching agent but Cl_2 behaves as permanent bleaching agent because

1

Cl_2 bleaches due to oxidation but SO_2 due to reduction

2

Cl_2 bleaches due to reduction but SO_2 due to oxidation

3

Both of these

4

None of these

10

In which one of the following pairs of experimental observations and phenomenon does the experimental observation correctly account for phenomenon?

1

Experimental observation	Phenomenon
The photoelectric effect	The nuclear atom

2

Experimental observation	Phenomenon
Emission spectra	The quantization of energy

3

Experimental observation	Phenomenon
α - particle scattering	Quantized electron orbit

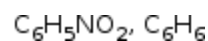
4

Experimental observation	Phenomenon
X - ray spectra	Charge on the nucleus

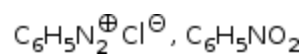
11

In the series of reaction
$$\text{C}_6\text{H}_5\text{NH}_2 \xrightarrow[0-5^\circ\text{C}]{\text{NaNO}_2/\text{HCl}} \text{X} \xrightarrow[\text{CH}_2\text{O}]{\text{HNO}_2} \text{Y} + \text{N}_2 + \text{HCl}$$
, find the values of X and Y.

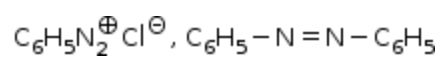
1



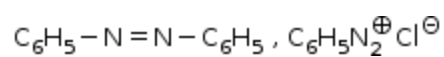
2



3



4



12

Which of the following catalyst is used in Raschig's process?

1

Copper chloride

2



3

Sunlight

4

Ethanol/Na

13

70% component of acid rain is

1



2



3



4



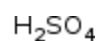
14

Find the product formed when SiF_4 reacts with water.

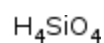
1



2



3



4



15

The equilibrium expression for the reaction $\text{P}_{4(s)} + 5\text{O}_{2(g)} \rightleftharpoons \text{P}_4\text{O}_{10(s)}$ is:

1

$$K_c = 1/[\text{O}_2]^5$$

2

$$K_c = [\text{P}_4\text{O}_{10}]/[\text{P}_4][\text{O}_2]^5$$

3

$$K_c = [\text{O}_2]^5$$

4

$$K_c = [\text{P}_4\text{O}_{10}]/5[\text{P}_4][\text{O}_2]$$

16

Find the amount of work done during the expansion of a gas from a volume of 4dm^3 to 6dm^3 against a constant external pressure of 3atm ? ($1\text{L atm} = 101.32\text{ J}$)

1

- 6 J

2

-608 J

3

-304 J

4

+ 304 J

17

Identify the statement which is false for alkali metals.

1

All alkali metals give blue solution in liquid ammonia

2

Li^+ is exceptionally small

3

Na is amphoteric in nature

4

Lithium is the strongest reducing agent

18

If we take 44 g of CO_2 and 14 g of N_2 , then mole fraction of CO_2 in the mixture will be:

1

 $1/4$

2

 $2/3$

3

 $1/3$

4

 $1/5$

19

Which one of the following statement is/are correct for hard water(s)?

1

Water containing a few drops of HCl

2

Water containing some potash alum

3

Water containing calcium nitrate

4

All of above

20

Which of the following process is used for the removal hardness of water?

1

Hoope

2

Serpeck

3

Bayer

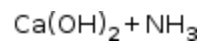
4

Calgon

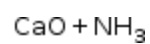
21

Calcium cyanamide on treatment with steam gives

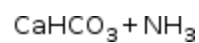
1



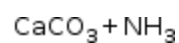
2



3



4



22

3.2 moles of hydrogen iodide were heated in a sealed bulb at 444°C till the equilibrium state was reached. Its degree of dissociation at this temperature was found to be 22%. Find the no. of moles of hydrogen iodide present at equilibrium.

1

4

2

2.496

3

2

4

1.87

23

____ has highest melting point.

1



2



3



4



24

Fats and oils are the mixture of

1

glycerides of saturated and unsaturated fatty acids

2

glycerides and saturated fatty acids

3

glycerides and unsaturated fatty acids

4

only saturated and unsaturated fatty acids

25

From the given pairs of ions, the lower oxidation state in aqueous solution is more stable than the other in

1	V^{2+}, VO^{2+}
2	Cr^{2+}, Cr^{3+}
3	Cu^{+}, Cu^{2+}
4	Tl^{+}, Tl^{3+}

26

What does the natural petroleum contains?

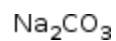
1	Cyclic saturated hydrocarbons
2	Saturated hydrocarbons
3	Compounds of sulphur
4	All of these

27

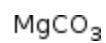
_____ doesn't decompose on heating.

1	$Ca(HCO_3)_2$
2	Li_2CO_3

3



4



28

Best conductor of electricity is a 1.0 M solution of which of the following?

1

Phosphoric acid

2

Sulphuric acid

3

Acetic acid

4

Boric acid

29

Which of the following represents the relation between change in internal energy (ΔU), change in enthalpy (ΔH) and work done (W)?

1

$$\Delta U = \Delta H - W$$

2

$$\Delta U = W - \Delta H$$

3

$$W = \Delta U - \Delta H$$

4

$$\Delta H = \Delta U - W$$

30

During compression, by which expression the work done on the system is expressed?

1

$$\frac{w}{V_f} = -p_{\text{ex}} \left(1 - \frac{V_i}{V_f} \right)$$

2

$$w = -p_{\text{ex}} (V_f - V_i)$$

3

$$w = -p_{\text{ex}} V_f + p_{\text{ex}} V_i$$

4

All of these

31

Find the chief impurity present in red bauxite.

1



2



3



4



32

Identify the complexes in which oxidation state of metal is zero.

1	$[\text{Cr(en)}_2\text{Cl}_2]$
2	$[\text{Cr}(\text{NH}_3)_3\text{Cl}_3]$
3	$[\text{Cr}(\text{CO})_6]$
4	$[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$

33

Last element of group-IV is

1	weak metallic
2	strong non-metallic
3	strong metallic
4	weak non-metallic

34

Under a given set of experimental conditions, as the concentration of the reactants increases, the rate of a chemical reaction__

1	increases
2	decreases

3

remains unaltered

4

first decreases and then increases

35

Oxidation of thiosulphate ($\text{S}_2\text{O}_3^{2-}$) ion by iodine provides

1



2



3



4



36

 $2\text{CuI} \rightarrow \text{Cu} + \text{CuI}_2$ identify the reaction.

1

neutralization

2

redox

3

oxidation

4

reduction

37

Nylon-66 is said to be

1

substitution polymer

2

addition polymer

3

condensation polymer

4

natural polymer

38

The pair that has both members from the same period of the periodic table is:

1

Cl – Br

2

Ca – Cl

3

Na – Cl

4

Na – Ca

39

Heat Q for a reaction at constant volume is equivalent to

1	$U_P - U_R$
2	$H_P - H_R$
3	$H_R - H_P$
4	None of these

40

In main group elements (i) as we proceed down the same group in the periodic table and (ii) as we proceed from left to right in the same period, then the atomic radius

1	(i) Decreases continuously; (ii) Decreases upto the group IV and then increases upto the end of the period
2	(i) Increases continuously; (ii) Decreases upto the group IV and then increases upto the end of the period
3	(i) Decreases continuously; (ii) Increases continuously
4	(i) Increase continuously; (ii) Decreases continuously

41

Why many ionic crystals dissolve in water?

1	Because water decreases the interionic attraction in the crystal lattice due to solvation
---	---

2

Because the process is accompanied by a positive heat of solution

3

Because water is a high boiling liquid

4

Because water is an amphoteric solvent

42

During electrovalent bond formation, the main reaction is

1

elimination reaction

2

addition reaction

3

substitution reaction

4

redox reaction

43

On reduction with hydrogen, 3.6 g of an oxide of metal left 3.2 g of metal. What will be the simplest formula of the oxide if the vapor density of metal is 32?

1

M_2O_3

2

MO

3



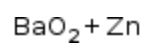
4



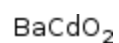
44

Philosopher's wool gives a compound when heated with BaO at $1100^\circ C$. Identify the compound.

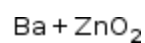
1



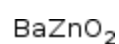
2



3



4



45

The metal that could not be obtained on electrolysis of aqueous solution of its salts is

1



2



3



4



46

Which of the following is the true statement?

1

The conjugate base of a weak acid is a strong base

2

The conjugate base of a strong acid is a strong base

3

The conjugate base of a weak acid is a weak base

4

The base and its conjugate acid react to form a neutral solution

47

The hydrolysis of ozonide of 1-butene forms

1

acetaldehyde only

2

propionaldehyde and Formaldehyde

3

acetaldehyde and Formaldehyde

4

ethylene only

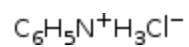
48

The least ionic from the following is____

1

KCl

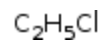
2



3



4



49

Reaction between an ester and excess of Grignard reagent shall finally result in

1

ketone

2

tertiary alcohol

3

primary alcohol

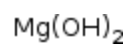
4

secondary alcohol

50

Find the hydroxides which sublime on heating.

1



2



3



4

LiOH

Botany

1

What are the biomass available for consumption to heterotrophs and the rate of formation of new organic matter by consumers?

1

Gross primary productivity and secondary productivity respectively

2

Net primary productivity and gross primary productivity respectively

3

Gross primary productivity and net primary productivity respectively

4

Net primary productivity and secondary productivity respectively

2

Which of the following bacteria found in root nodules of legumes?

1

Azotobacter

2

Nitrosomonas

3

Rhizobium

4

Nitrobacter

3

The highest number of species amongst the following in the world is represented by which of the following species?

1

fungi

2

lichens

3

algae

4

mosses

4

The activity of intercalary meristems adds to _____.

1

secondary growth

2

primary growth

3

both (1) and (2)

4

none of the above

5

Mycoplasma is a ____ organism.

1

eukaryotic and unicellular

2

prokaryotic and unicellular

3

prokaryotic and multicellular

4

eukaryotic and multicellular

6

Which genotype characterises an organism that is heterozygous for two genes?

1

RRYY

2

RrYy

3

RrYY

4

RRYy

7

The significance of meiosis lies in ____.

1

production of genetic variability in the population of a species

2

reduction of the diploid number of chromosomes to haploid

3

maintaining constancy in the number of diploid chromosomes during sexual reproduction

4

All the above

8

Which type of pyramid that cannot be inverted in a stable ecosystem?

1

Biomass

2

Energy

3

Number

4

All the above

9

_____ is depicted by a cross in which the F_1 generation resembles both the parents.

1

Inheritance of one gene

2

Co-dominance

3

Complete dominance

4

Incomplete dominance

10

RNA is used as a template to synthesize DNA by ____.

1

DNA dependant RNA polymerase

2

DNA polymerase

3

Reverse transcriptase

4

RNA polymerase

11

_____ steps in Krebs' cycle indicates substrate level phosphorylation.

1

Conversion of malic acid to oxalo acetic acid

2

Conversion of succinic acid to α -ketoglutaric acid

3

Conservation of Succinyl CoA to succinic acid

4

Conservation of succinic acid to malic acid

12

When a pond dries, the Amoeba ____.

1

encysts

2

reproduces

3

degenerates

4

behaviour is uncertain

13

Photosynthetically active radiation (PAR) represents _____range of wavelength.

1

450-950 nm

2

500-600 nm

3

340-450 nm

4

400-700 nm

14

Mark the correct statement.

1

Oxygen is vital in respiration for removal of hydrogen.

2

Pyruvate is formed in the mitochondrial matrix.

3

During the conversion of Succinyl CoA to succine acid a molecule of ATP is synthesised.

4

There is complete breakdown of glucose in fermentation.

15

In which chloroplast pyrenoids are characteristically found?

1

Algae

2

Fungi

3

Pteridophytes

4

Angiosperms

16

Aerenchyma is produced in the tissue of

1

Phloem

2

Parenchyma

3

Sclerenchyma

4

None of the above

17

In a test cross involving F_1 dihybrid flies, more parental-type offspring were produced than the recombinant-type offspring. What it indicates?

1

The two genes are linked and present on the same chromosome

2

Chromosomes failed to separate during meiosis

3

Both of the characters are controlled by more than one gene

4

The two genes are located on two different chromosomes

18

_____ represent maximum number of species among global biodiversity.

1

Mosses and Ferns

2

Fungi

3

Lichens

4

Algae

19

In the electron transport system present in the inner mitochondrial membrane, what are the complexes I and IV?

1

 FADH_2 and NADH dehydrogenase

2

NADH dehydrogenase and FADH_2

3

NADH dehydrogenase and cytochrome oxidase complex

4

NADH dehydrogenase and ATP synthase

20

Which of the following is the latest model that is proposed to explain the structure of plasma membrane?

1

Molecular model

2

Fluid mosaic model

3

Unit membrane model

4

None of the above

21

If living cells similar to those found on earth, were found on another planet where there was no oxygen. Which cell organelle would most probably be not present

1

Mitochondria

2

Chromosomes

3

Ribosomes

4

Cell membrane

22

_____ refer to the entry of the pollen tube with two male gametes and tube nucleus through micropyle.

1

Mesogamy

2

Porogamy

3

Autogamy

4

Chalazogamy

23

_____ is not a physiological effect of auxin.

1

Promotes flowering

2

Initiates rooting in stem cuttings

3

Prevents fruit and leaf drop at early stages

4

Promotes bolting

24

Choose from the following plant and its mode of nutrition which is not correctly matched.

1

Mucor - Autotroph

2

Cuscuta - Stem parasite

3

Orobancha - Root parasite

4

Drosera - Insectivorous

25

Spirogyra is a ____.

1

Marine and free floating alga

2

Fresh water and free floating alga

3

Fresh water and locomotory alga

4

None of the above

26

The two factors primarily affect the developmental phase of growth of plants are

1

Light and temperature

2

Light and wind

3

Rainfall and temperature

4

Temperature and relative humidity

27

Pneumatophores or breathing roots present in ____.

1

epiphytes

2

hydrophytes

3

xerophytes

4

mangrove plants

28

The law of limiting factor for photosynthesis was expressed by

1

Blackman

2

Hill

3

Kalmen

4

Ruben

29

_____ are the locomotory structures of Amoeba.

1

Cilia

2

Pseudopodia

3

Flagella

4

None of the above

30

In 1959, who was awarded Nobel Prize for synthesis of RNA?

1

A. Kornberg

2

S. Ochoa

3

H. Khorana

4

Nirenberg

31

A brewery subjects about 1 tonne of purified jaggery to fermentation under ideal conditions. If it has developed 0.3 tonne of alcohol, what quantity of CO_2 it has expelled to its atmosphere?

1

0 tonne

2

0.3 tonne

3

0.7 tonne

4

1 tonne

32

Mark the correctly matched pair.

1

Stratification - Population

2

Aerenchyma - Opuntia

3

Parthenium hysterophorus - Threat to biodiversity

4

Age pyramid - Biome

33

Meiotic division in zygote present in ____.

1

pteridophyta

2

pymnosperms

3

angiosperms

4

thallophyta

34

The residual persistent nucellus is called as

1

perisperm

2

integuments

3

pericarp

4

none of these

35

After fertilization, the seed coats of seed arise from

1

Integuments

2

Embryo sac

3

Ovule

4

Chalaza

36

Peroxisomes, in plant cells, are involved in which process

1

Photorespiration

2

Photooxidation

3

Photophosphorylation

4

Photolysis of water

37

In maize, the fibrous roots produced from

1

Upper internodes

2

Lower nodes

3

Upper nodes

4

None of the above

38

Which phytohormone promotes the cell division in plants?

1

Gibberellin

2

Absciscic acid

3

Ethylene

4

Cytokinin

39

Occurrence of triploid ($3n$) primary endosperm nucleus is a characteristic feature of which of the following organism?

1

Gymnosperms

2

Algae

3

Angiosperms

4

Bryophytes

40

Decline in the activity of the enzyme hexokinase by glucose-6-phosphate is caused by

1

Denaturation of enzymes

2

Allosteric modulator

3

Competitive inhibitions

4

Non-competitive

41

Mark the correct statement related to mitosis.

1

Amount of DNA in the parent cell is first doubled and then distributed into four daughter cells.

2

Amount of DNA in the parent cell is first doubled and then distributed into two daughter cells.

3

Amount of DNA in the parent cell is first halved and then distributed into four daughter cells.

4

Amount of DNA in the parent cell is first halved and then distributed into two daughter cells.

42

Protists are

1. Unicellular and eukaryote
2. Unicellular and prokaryote
3. Multicellular and eukaryote
4. Autotroph and heterotroph

1

1 + 4

2

$3 + 4$

3

$1 + 3 + 4$

4

$1 + 2 + 3$

43

Which of the following is the correct statement about asexual reproduction.

- (i) It involves a single parent
- (ii) It is slower than sexual reproduction
- (iii) It produces progeny that are genetically identical with the parent but not with one another
- (iv) The progeny of asexual reproduction can be termed as clones

1

(i), (iii) and (iv)

2

(i) and (iv)

3

(ii) and (iii)

4

(i) and (ii)

44

In Mendelism, linkage was not observed because of ____.

1

synapsis

2

mutation

3

crossing over

4

independent assortment

45

By the activity of _____, bamboo and grasses elongate

1

apical meristem

2

lateral meristem

3

secondary meristem

4

intercalary meristem

46

The ecosystem has very little primary productivity is

1

river

2

forest

3

sea

4

grassland

47

In _____ syngamy can occur outside the body of the organism.

1

ferns

2

algae

3

mosses

4

all of above

48

Complete the sentence: Tissue culture technique can produce infinite number of new plants from a small parental tissue. The economic importance of the technique is in raising

1

genetically uniform population identical to the original parent

2

homozygous diploid plants

3

variants through picking up somaclonal variations.

4

new species

49

The homologous chromosomes follow the process of synapsis in the stage or Pairing of homologous chromosome occur in

1

Zygotene

2

Leptotene

3

Diplotene

4

Pachytene

50

Biological membranes are made up of

1

60% proteins and 40% lipids

2

70% proteins and 30% lipids

3

50% proteins and 50% lipids

4

40% proteins and 60% lipids

Zoology

1

____ polypeptide chains are present in gamma immunoglobulin.

1

6

2

5

3

4

4

2

2

Choose the incorrect statements amongst the following:

- i) Condoms decrease sperm motility
- ii) Diaphragms, cervical caps and vaults are for both males and females
- iii) IUDs are inserted by expert nurses
- iv) Sterilization is a terminal method to prevent further pregnancy

1

(iii) and (iv)

2

(i) and (iii)

3

(ii) and (iv)

4

(i) and (ii)

3

Bartholin's glands are homologous to which part of reproduction system?

1

Bulbourethral glands

2

Seminal vesicle

3

Glans penis

4

Prostate gland

4

Sperms become non-motile in the vagina in _____.

1

less than 60 minutes

2

more than 60 minutes

3

25-30 hours

4

120 minutes

5

How do the pills work?

i) Inhibit ovulation and implantation

- ii) After the quality of cervical mucus to prevent or retard the entry of sperms
- iii) Prevent the ejaculated semen from entering the female vagina
- iv) Inhibit spermatogenesis

1	(iii) and (iv)
2	(ii), (iii), (iv)
3	(i) and (ii)
4	(i), (ii), (iii)

6

According to the theory of special creation, life is created by ____.

1	cosmozoa
2	supernatural power
3	catastrophils
4	non- living matter

7

A sexually transmitted disease symptomized by the pus containing discharge, pain around genitalia and burning sensation during urination is caused by which of the following infection?

1

Treponema pallidum

2

Neisseria gonorrhoeae

3

Hepatitis B virus

4

Human papilloma virus

8

Which of the following ganglia unite to form nerving in nervous system of Cockroach?

1

Three ganglia in thorax region and six ganglia of abdominal region unite to form nerving

2

Suboesophageal, supraesophageal and circum oesophageal commissures unite to form nerving

3

Three pairs of ganglia in thorax region and six pairs in abdominal regions

4

Three pairs supraesophageal and one pair suboesophageal ganglia unite to form nerving

9

Which of the following term refer to the anterior portion of the sperm head which is covered by a cap-like structure?

1

Acrosome

2

Antrum

3

Enzymes

4

Sertoli cells

10

_____ is the most abundant protein in the animal world.

1

Collagen

2

Insulin

3

Haemoglobin

4

Trypsin

11

If the length of a double helical DNA is 1.7 meters. What is the number of base pair present in the DNA?

1

 5×10^9

2

1.7×10^9

3

1.7×10^5

4

3.4×10^9

12

Which is correct about haemoglobin?

1

It is present in the dissolved state in blood plasma in earthworm

2

It is a dipeptide and present in red blood corpuscles in blood worm

3

It is present in dissolved state in blood plasma in scorpions

4

It is a dipeptide in mammals and localised in red blood corpuscles

13

Choose the correct option: The juxtaglomerular apparatus is a special region formed by close placement and cellular modifications in

1

loop of Henle and collecting duct

2

proximal convoluted tubule and distal convoluted tubule

3

afferent arteriole and distal convoluted tubule

4

afferent arteriole and proximal convoluted tubule

14

Determine the correct statement/s regarding subcutaneous implantation of synthetic progesterone.

1

It acts by blocking ovulation and preventing sperm motility

2

Six match-stick sized capsules containing the progestogen steroid are inserted under the skin of the inner arm above the elbow

3

It is a contraception technique

4

All of these

15

Identify the disease depicts in following picture.



1

Myxoedema

2

Acromegaly

3

Simple goiter

4

Cretinism

16

Which is the vector for T-DNA?

1

Salmonella typhimurium

2

Thermus aquaticus

3

Agrobacterium tumefaciens

4

Escherichia coli

17

At where the ornithine cycle occurs?

1

Hepatocytes

2

Osteocytes

3

Histiocytes

4

Adipocytes

18

Identify the correct statement.

1

In a population, number of births is different from birth rate

2

A sigmoid growth curve is depiction of exponential growth

3

'r' is equal to the difference between number of births and number of deaths in a population.

4

In a logistic growth curve the asymptote is beyond the carrying capacity

19

A single strand of nucleic acid tagged with a radioactive molecule is known as

1

selectable marker

2

vector

3

plasmid

4

probe

20

The main adaptation for a plant to survive in xerophytic condition is _____.

1

stipulate leaves

2

spines

3

no stomata

4

none of these

21

Which of the following is genetically dominant in man?

1

Colour blindness

2

Rh positive

3

Haemophilia

4

Albinism

22

The interaction between _____ is an example for commensalism.

1

Wasps and fig tree

2

Cattle or sheep and grass

3

Orchid and mango tree

4

Cuckoo and crow

23

From which one of the following, the purkinje fibres arises?

1

Apex of ventricles

2

Middle of ventricles

3

Posterior part of auricles

4

Anterior part of auricles

24

How does Cu ions work after releasing from copper releasing IUDs?

1

They suppress sperm motility

2

They increase phagocytosis of sperms

3

They prevent ovulation

4

They make uterus unsuitable for implantation

25

Mark the wrong statements.

1

Sella turcica is a bony cavity where the pituitary gland is located.

2

Parathyroid hormone decrease the Ca^{2+} levels in blood.

3

The middle layer of adrenal cortex is zona fasciculate.

4

Thymosins play a major role in T cell differentiation.

26

The junction between the axon of one neuron and the dendrite of the next is known as _____.

1

a joint

2

a synapse

3

junction point

4

constant bridge

27

___ is the free living anaerobic bacterium capable of N_2 fixation in soil.

1

Clostridium

2

Streptococcus

3

Azotobacter

4

Rhizobium

28

Vasa efferentia are the ductules that connect

1

epididymis to urethra

2

rete testis to vas deferens

3

vas deferens to epididymis

4

testicular lobules to rete testis

29

_____ hormones is correctly matched with its deficiency disease.

1

Relaxin- cretinism

2

Parathormone - tetany

3

Prolactin- astigmatism

4

Insulin -diabetes insipidus

30

How many lumbar vertebrae are present in human vertebral column?

1

2

2

5

3

7

4

12

31

Which compound has very important role in prebiotic evolution?

1

 CH_4

2

NO

3

 SO_2

4

 SO_3

32

_____ pairs is not correctly matched.

1

Streptomyces - Antibiotic

2

Serratia - Drug addiction

3

Rhizobium - Biofertiliser

4

Spirulina - Single cell protein

33

Find from the following which is not a gland.

1

Pituitary

2

Pancreas

3

Kidney

4

Adrenal

34

Which of the following is the second line of defense?

1

Skin barrier

2

Inflammatory barrier

3

Phagocytic barrier

4

Both (B) and (C)

35

_____ has H-shaped grey matter

1

Medulla oblongata

2

Cerebrum

3

Cerebellum

4

Spinal cord

36

The alternate name for the yellow spot in retina is

1

Corpus lutea

2

Canalis centralis

3

Fovea centralis

4

Macula lutea

37

As per Oparin theory, which was not present in primitive atmosphere of the Earth?

1

Oxygen

2

Water

3

Nitrogen

4

Ammonia

38

_____ antibodies are produced in response to hypersensitive reactions.

1

IgG

2

IgE

3

IgA

4

IgM

39

On which the organ of Corti is situated?

1

Reissner's membrane in the tympanic canal

2

Reissner's membrane in the vestibular canal

3

Basilar membrane in the median canal

4

Basilar membrane in the tympanic canal

40

What are the 'cell of Rauber'?

1

Inner cell mass of blastocoel

2

Secretory cells of endometrium in uterus

3

Outer cells of trophoblast in contact with uterine wall

4

cells of trophoblast, in contact with inner cell mass of blastocyst

41

The presence of _____ in urine is indicative of diabetes mellitus.

1

 Na^+

2

Glucose

3

Water

4

Urea

42

Statement 1: Morphine is a derivative of opium.**Statement 2:** Smack is more powerful analgesic than morphine.

1

Both Statement 1 and Statement 2 are true but Statement 2 is not the correct explanation of Statement 1

2

Both Statement 1 and Statement 2 are true and the Statement 2 is correct explanation of the Statement 1

3

This Statement 1 is true but the Statement 2 is false

4

Both Statement 1 and Statement 2 are false

43

Mark the correct statement.

1

Saccharomyces cerevisiae is used as clot buster.

2

Acetobacter aceti produces citric acid.

3

Penicillium notatum restrict the growth of *Staphylococci*.

4

Methanogens are found in aerobic conditions.

44

Which restriction enzyme(s) is/are used in recombinant DNA technology that make staggered cuts in DNA leaving sticky ends?

1

HindIII

2

EcoRI

3

BamHI

4

all of these

45

Match the following table:

Column-I	Column-II
A. Natural Methods	i. Coitus interruptus
B. IUDs	ii. LNG-20
C. Barrier methods	iii. Diaphragms
D. Surgical methods	iv. Multiload 375
E. Oral contraceptives	v. Saheli
	vi. <u>Nirodh</u>
	vii. Tubectomy
	viii. Vasectomy
	ix. <u>CuT</u>

1

A-(i), B-(iv); (ix); C-(ii); (iii); (vi), D-(vii); (viii), E-(v)

2

A-(i), B-(ii); (iv); (ix), C-(iii), D-(vii); (viii), E-(v); (vi)

3

A-(i), B-(ii); (iv), C-(iii); (vi); (ix), D-(vii); (viii), E-(v)

4

A-(i), B-(ii); (iv); (ix), C-(iii); (vi), D-(vii); (viii), E-(v)

46

Graves' disease is caused because of

1

hyposecretion of thyroid gland

2

hypersecretion of thyroid gland

3

hypersecretion of adrenal gland

4

hyposecretion of adrenal gland

47

In between ____ mitral valve is present.

1

left ventricle and right ventricle

2

left auricle and right auricle

3

left auricle and left ventricle

4

right auricle and right ventricle

48

_____ has the thickest wall.

1

Right ventricle

2

Right auricle

3

Left auricle

4

Left ventricle

49

If a highly purified of rat liver DNA is dissolved in pure water, what will be the pH of the resulting solution?

1

Basic

2

Acidic

3

Neutral

4

Highly basic

50

Maltose, lactose and sucrose are _____.

1	monosaccharides
2	polysaccharides
3	disaccharides
4	trisaccharides

Physics - Answer keys

1	2
2	2
3	2
4	1
5	1
6	3
7	4
8	2
9	3
10	1
11	3
12	1
13	1
14	2
15	1

16	2
17	2
18	4
19	3
20	1
21	3
22	1
23	2
24	1
25	3
26	4
27	2
28	2
29	3
30	2
31	1
32	1
33	3
34	3
35	4
36	2
37	4
38	1
39	3
40	2

41	4
42	1
43	2
44	3
45	3
46	4
47	3
48	2
49	2
50	1

Chemistry - Answer keys

1	1
2	2
3	1
4	2
5	3
6	2
7	4
8	1
9	1
10	2
11	2
12	1
13	3

14	3
15	1
16	2
17	3
18	2
19	4
20	4
21	4
22	2
23	1
24	1
25	4
26	4
27	3
28	2
29	4
30	4
31	3
32	3
33	1
34	1
35	2
36	2
37	3
38	3

39	1
40	4
41	1
42	4
43	3
44	4
45	2
46	1
47	2
48	4
49	2
50	1

Botany - Answer keys

1	4
2	3
3	1
4	2
5	2
6	2
7	4
8	2
9	2
10	3
11	3

12	1
13	4
14	1
15	1
16	2
17	1
18	2
19	3
20	2
21	1
22	2
23	4
24	1
25	2
26	1
27	4
28	1
29	2
30	2
31	2
32	3
33	4
34	1
35	1
36	1

37	2
38	4
39	3
40	2
41	2
42	1
43	2
44	4
45	4
46	3
47	2
48	1
49	1
50	1

Zoology - Answer keys

1	3
2	4
3	1
4	1
5	3
6	2
7	2
8	2
9	1

10	1
11	1
12	4
13	3
14	4
15	2
16	3
17	1
18	1
19	4
20	2
21	2
22	3
23	1
24	1
25	2
26	2
27	1
28	2
29	2
30	2
31	1
32	2
33	3
34	4

35

4

36

4

37

1

38

2

39

3

40

4

41

2

42

1

43

3

44

4

45

4

46

2

47

3

48

4

49

2

50

3

Physics - Solutions

1

For given condition, $s \propto \frac{1}{m^2}$

$$\therefore \frac{s_2}{s_1} = \left(\frac{m_1}{m_2} \right)^2 = \left(\frac{200}{300} \right)^2$$
$$\Rightarrow s_2 = s_1 \times \frac{4}{9} = 36 \times \frac{4}{9} = 16 \text{ m}$$

2

We know, $T \propto n^3$

$$\Rightarrow \frac{T_2}{T_1} = \frac{2^3}{1^3} = \frac{8}{1}$$

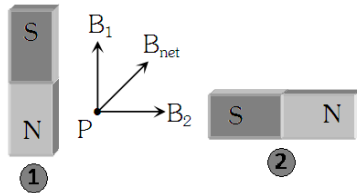
3

By the first law of thermodynamics,

$$\Delta Q = \Delta U + P(\Delta V) \Rightarrow \Delta U = \Delta Q - P(\Delta V)$$
$$= 1500 - (2.1 \times 10^5)(2.5 \times 10^{-3}) = 975 \text{ joule}$$

4

From the following figure,



5

The acceleration vector is tangent to the circle.

6

Here, Work done $= 4\pi R^2 T(n^{1/3} - 1)$

$$W = 4\pi \left(\frac{D}{2}\right)^2 \sigma (n^{1/3} - 1)$$

$$\Rightarrow \pi D^2 \sigma (27^{1/3} - 1) = 2\pi D^2 \sigma$$

7

Put the dimension of each quantity to get,

$$T = [ML^{-1}T^{-2}]^a [L^{-3}M]^b [MT^{-2}]^c$$

By solving, we get $a = -3/2$, $b = 1/2$ and $c = 1$.

8

$$\text{As } v_{\max} = a\omega, \therefore \omega = \frac{v_{\max}}{a} = \frac{10}{4}$$

$$\text{Now, } v = \omega \sqrt{a^2 - y^2} \Rightarrow v^2 = \omega^2 (a^2 - y^2) \Rightarrow y^2 = a^2 - \frac{v^2}{\omega^2}$$

$$\Rightarrow y = \sqrt{a^2 - \frac{v^2}{\omega^2}}$$

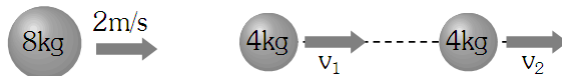
$$\Rightarrow y = \sqrt{4^2 - \frac{5^2}{(10/4)^2}} = 2\sqrt{3} \text{ cm}$$

9

Here, $\phi = \pi/3$, $a_1 = 4$, $a_2 = 3$

$$\therefore \text{Amplitude, } A = \sqrt{a_1^2 + a_2^2 + 2a_1 a_2 \cos \phi} \Rightarrow A \approx 6$$

10



Before explosion

After explosion

As the body splits into two equal parts because of internal explosion, therefore momentum of system remains conserved means $8 \times 2 = 4v_1 + 4v_2 \Rightarrow v_1 + v_2 = 4$ €(i)

According to the law of conservation of energy,

Initial KE + Energy released due to explosion = Final KE of the system

$$\Rightarrow \frac{1}{2} \times 8 \times (2)^2 + 16 = \frac{1}{2} 4v_1^2 + \frac{1}{2} 4v_2^2$$

$$\Rightarrow v_1^2 + v_2^2 = 16 \text{ €(ii)}$$

Solving equations (i) and (ii), we get, $v_1 = 4$ and $v_2 = 0$

i.e. one part comes to rest and other moves in the same direction as that of original body.

11

Here length,

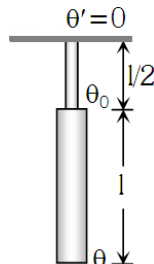
$$l = \frac{L^2 dg}{2Y} = \frac{(10)^2 \times 1500 \times 10}{2 \times 5 \times 10^8} = 15 \times 10^{-4} \text{ m}$$

12

Power, $P = Vi \cos \phi$

and phase difference, $\phi = \frac{\pi}{2}$
 $\therefore P = 0$

13



Here, $\tau = C \cdot \theta = \frac{\pi \eta r^4 \theta}{2L} = \text{Constant}$

$$\Rightarrow \frac{\pi \eta r^4 (\theta - \theta_0)}{2l} = \frac{\pi \eta (r/2)^4 (\theta_0 - \theta')}{2(l/2)}$$

$$\Rightarrow \frac{(\theta - \theta_0)}{2} = \frac{\theta_0}{16} \Rightarrow \theta_0 = \frac{8}{9} \theta$$

14

If the bird flies, it pushes air down to balance its weight. Therefore, the weight of the bird and closed cage assembly remains unchanged.

15

The force 'F' is given as, $F = \frac{W}{\mu} = \frac{1 \times 9.8}{0.2} = 49 \text{ N}$

16

We know, $Q = \frac{KA(\theta_1 - \theta_2)t}{l}$; in both the cases; A, l and $(\theta_1 - \theta_2)$ are same. Therefore $Kt = \text{constant}$.

$$\Rightarrow \frac{K_1}{K_2} = \frac{t_1}{t_2} = \frac{30}{20} = \frac{3}{2} = 1.5$$

17

Distance average speed $= \frac{2v_1 v_2}{v_1 + v_2} = \frac{2 \times 30 \times 50}{30 + 50}$

$$\Rightarrow \frac{75}{2} = 37.5 \text{ km/hr}$$

18

From the figure below,

Fraction of length of the chain hanging from the table $= \frac{1}{n} = \frac{60 \text{ cm}}{200 \text{ cm}} = \frac{3}{10} \Rightarrow n = \frac{10}{3}$



∴ Work done in pulling the chain on the table is given as

$$W = \frac{mgL}{2n^2} = \frac{4 \times 10 \times 2}{2 \times (10/3)^2} = 3.6 \text{ J}$$

19

The attractive gravitational force $= G \frac{m^2}{r^2}$ and the repulsive electrostatic force $= k \frac{Q^2}{r^2}$ where r is the separation between two particles

For equilibrium, $\frac{Gm^2}{r^2} = \frac{kQ^2}{r^2}$ or $\frac{Q}{m} = \sqrt{\frac{G}{k}} = \left[\frac{6.67 \times 10^{-11}}{9 \times 10^9} \right]^{1/2} \sim 10^{-10}$

20

Watt = Joule/second = Ampere²ohm

21

$$\begin{aligned} \vec{A} + \vec{B} &= 4\hat{i} - 3\hat{j} + 6\hat{i} + 8\hat{j} = 10\hat{i} + 5\hat{j} \\ \Rightarrow |\vec{A} + \vec{B}| &= \sqrt{(10)^2 + (5)^2} = 5\sqrt{5} \\ \tan\theta &= \frac{5}{10} = \frac{1}{2} \Rightarrow \theta = \tan^{-1}\left(\frac{1}{2}\right) \end{aligned}$$

22

Pressure = $h\rho g$ means pressure at the bottom is independent of the area of the bottom of the tank. It is dependent of the height of water upto which the tank is filled with water. As in both the tanks, the levels of water are the same, pressure at the bottom is also the same.

23

from the given problem, displacement of the man with respect to trolley in 4 seconds,

$$x_{mT} = 4\text{m} \Rightarrow x_{mT} = x_m + x_T \Rightarrow x_T = 4 - x_m$$

Here, position of centre of mass remain constant.

$$\Rightarrow (4 - x_m)320 = x_m \times 80 \Rightarrow x_m = \frac{16}{5} = 3.2 \text{ m.}$$



Alternatively, when the man starts walking on the trolley in the forward direction, then whole system will move in backward direction with same momentum.

∴ Momentum of man in forward direction = Momentum of system (man + trolley) in backward direction $\Rightarrow 80 \times 1 = (80 + 320) \times v \Rightarrow v = 0.2 \text{ m/s}$

Therefore, the velocity of man w.r.t. ground

$$= 1.0 - 0.2 = 0.8 \text{ m/s}$$

∴ Displacement of man w.r.t. ground

$$= 0.8 \times 4 = 3.2 \text{ m.}$$

24

Acceleration due to gravity on the surface of the earth is
Where R is the radius and ρ is the density of the earth.

$$g = \frac{G \frac{4}{3} \pi R^3 \rho}{R^2} = \frac{4}{3} \pi G R \rho$$

$$g' = \frac{4}{3} \pi G (3R) \rho = 3g$$

Acceleration because of gravity on the surface of the new planet is

25

In sample X no impurity level seen, thus it is undoped. In sample Y, impurity energy level lies below the conduction band thus it is doped with fifth group impurity. And in sample Z, impurity energy level lies above the valence band thus it is doped with third group impurity.

26

Suppose, $m \propto C^x G^y h^z$

By putting the following dimensions

$$[C] = LT^{-1}, [G] = [M^{-1}L^3T^{-2}] \text{ and } [h] = [ML^2T^{-1}]$$

By comparing both sides, we get

$$x = 1/2; y = -1/2, z = +1/2$$

$$\text{Thus, } m \propto [C^{1/2} G^{-1/2} h^{1/2}]$$

27

$$\text{Here, path difference, } \Delta = \frac{\lambda}{2\pi} \times \phi$$

$$\Rightarrow 1 = \frac{\lambda}{2\pi} \times \frac{\pi}{2} \Rightarrow \lambda = 4 \text{ m}$$

$$\therefore \text{Velocity, } v = n\lambda = 120 \times 4 = 480 \text{ m/s}$$

28

$$\text{In this case, } q = \frac{N}{R} (\Delta\phi)$$

$$\Rightarrow q = \frac{1}{2} \times (10 - 2) = 4 \text{ C}$$

29

In rotational motion the centre of mass of the body remains unchanged.

30

$$\begin{aligned} \text{The drift velocity, } v_d &= \frac{i}{nAe} \\ \Rightarrow v_d &= \frac{20}{10^{29} \times 10^{-6} \times 1.6 \times 10^{-19}} \\ \Rightarrow v_d &= 1.25 \times 10^{-3} \text{ m/s} \end{aligned}$$

31

$$\text{From given, } v^2 = u^2 + 2as \Rightarrow (9000)^2 - (1000)^2 = 2 \times a \times 4$$

$$\Rightarrow a = 10^7 \text{ m/s}^2. \text{ As, } t = \frac{v-u}{a}$$

$$\Rightarrow t = \frac{9000 - 1000}{10^7} = 8 \times 10^{-4} \text{ s}$$

32

Steel is more elastic than copper.

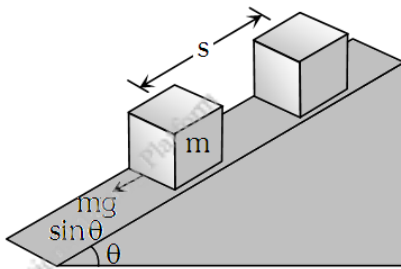
33

$$\text{We know, } PV = \mu RT \Rightarrow P \propto \frac{T}{V}.$$

Thus from the relationship, if T and V both are doubled then pressure remains same, means $P_2 =$

$$P_1 = 1 \text{ atm} = 1 \times 10^5 \text{ N/m}^2.$$

34



From the above figure, work done

$$W = mg \sin \theta \times s$$

$$\Rightarrow 2 \times 10^3 \times \sin 15^\circ \times 10 = 5.17 \text{ kJ}$$

35

$$\vec{v} = \vec{\omega} \times \vec{r} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 3 & -4 & 1 \\ 5 & -6 & 6 \end{vmatrix}$$

Here,

$$\vec{v} = -18\hat{i} - 13\hat{j} + 2\hat{k}$$

36

Gravitational potential energy at the centre of earth is

$$U_i = -\frac{3GmM}{2R} = -\frac{3}{2}gRm \left(\because g = \frac{GM}{R^2} \right)$$

Gravitational potential energy at the surface of earth is

$$U_f = -\frac{GmM}{R} = -mgR$$

$$W = U_f - U_i = -mgR - \left(-\frac{3}{2}mgR \right)$$

So, work done,

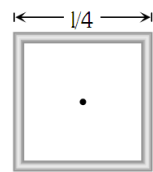
$$= -mgR + \frac{3}{2}mgR = \frac{mgR}{2}$$

37

Let, length of each wire is l .

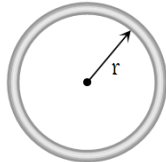
$$\therefore A_{\text{square}} = \left(\frac{l}{4} \right)^2 = \frac{l^2}{16}$$

$$A_{\text{circle}} = \pi r^2 = \pi \left(\frac{l}{2\pi} \right)^2 = \frac{l^2}{4\pi}$$



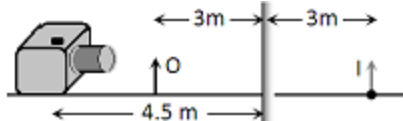
As, magnetic moment $M = iA$

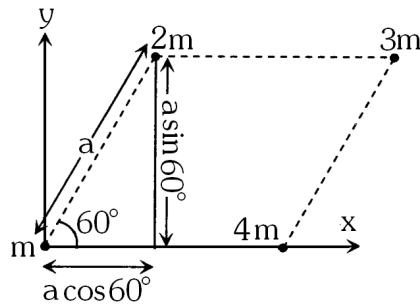
$$\Rightarrow \frac{M_{\text{square}}}{M_{\text{circle}}} = \frac{A_{\text{square}}}{A_{\text{circle}}} = \frac{l^2/16}{l^2/4\pi} = \frac{\pi}{4}$$



38

In this case, F_o using distance of image = $4.5 \text{ m} + 3 \text{ m} = 7.5 \text{ m}$





Suppose $m_1 = m$, $m_2 = 2m$, $m_3 = 3m$, $m_4 = 4m$

and from the figure, position vectors

$$\vec{r}_1 = 0\hat{i} + 0\hat{j}$$

$$\vec{r}_2 = a \cos 60^\circ \hat{i} + a \sin 60^\circ \hat{j} = \frac{a}{2} \hat{i} + \frac{a\sqrt{3}}{2} \hat{j}$$

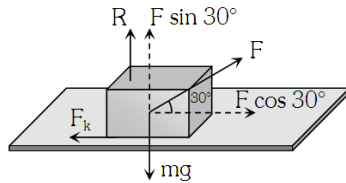
$$\vec{r}_3 = (a + a \cos 60^\circ) \hat{i} + a \sin 60^\circ \hat{j} = \frac{3}{2} a \hat{i} + \frac{a\sqrt{3}}{2} \hat{j}$$

$$\vec{r}_4 = a \hat{i} + 0 \hat{j}$$

Substituting above values in the following formula,

$$\vec{r} = \frac{m_1 \vec{r}_1 + m_2 \vec{r}_2 + m_3 \vec{r}_3 + m_4 \vec{r}_4}{m_1 + m_2 + m_3 + m_4} = 0.95 a \hat{i} + \frac{\sqrt{3}}{4} a \hat{j}$$

Thus, the location of centre of mass is $\left[0.95 a, \frac{\sqrt{3}}{4} a \right]$.



From the above figure,

$$\text{Kinetic friction} = \mu_k R = 0.2(mg - F \sin 30^\circ)$$

$$= 0.2 \left(5 \times 10 - 40 \times \frac{1}{2} \right) = 0.2(50 - 20) = 6 \text{ N}$$

$$\therefore \text{Acceleration of the block} = \frac{F \cos 30^\circ - \text{Kinetic friction}}{\text{Mass}}$$

$$\Rightarrow \frac{40 \times \frac{\sqrt{3}}{2} - 6}{5} = 5.73 \text{ m/s}^2$$

The cannon ball will have same horizontal range for angle of projection θ and $(90^\circ - \theta)$.

$$\text{So } H_1 = \frac{u^2 \sin^2 \theta}{2g} \quad \text{and} \quad H_2 = \frac{u^2 \sin^2 (90^\circ - \theta)}{2g} = \frac{u^2 \cos^2 \theta}{2g}$$

$$\therefore H_1 H_2 = \frac{1}{4} \left(\frac{u^2 \sin \theta \cos \theta}{g} \right)^2 = \frac{1}{4} \times \frac{R^2}{4} \left(\because R = \frac{u^2 \sin 2\theta}{g} \right) \text{ or } R = 4\sqrt{H_1 H_2}$$

Unit vector along y-axis $= \hat{j}$.

$$\text{So the required vector} = \hat{j} - [(\hat{i} - 3\hat{j} + 2\hat{k}) + (3\hat{i} + 6\hat{j} - 7\hat{k})] = -4\hat{i} - 2\hat{j} + 5\hat{k}$$

43

Here, given that, $u = 100 \text{ m/s}$, $v = 0$, $s = 0.06 \text{ m}$

$$\text{Retardation } = a = \frac{u^2}{2s} = \frac{(100)^2}{2 \times 0.06} = \frac{1 \times 10^6}{12}$$

$$\text{Thus, Force } = ma = \frac{5 \times 10^{-3} \times 1 \times 10^6}{12} = \frac{5000}{12} = 417 \text{ N}$$

44

The direction of wave propagation can be given by $\vec{E} \times \vec{B}$.

45

$$\text{Given, } v = 4t^3 - 2t, \therefore a = \frac{dv}{dt} = 12t^2 - 2$$

$$\text{and } x = \int_0^t v dt = \int_0^t (4t^3 - 2t) dt = t^4 - t^2$$

When particle is at 2m from the origin, $t^4 - t^2 = 2$

$$\Rightarrow t^4 - t^2 - 2 = 0 \Rightarrow (t^2 - 2)(t^2 + 1) = 0 \Rightarrow t = \sqrt{2} \text{ s}$$

Acceleration at $t = \sqrt{2} \text{ sec}$ is given by,

$$a = 12t^2 - 2 = 12 \times 2 - 2 = 22 \text{ m/s}^2$$

46

Motion of the particle from $(0, 0)$ to $(a, 0)$

$$\vec{F} = -K(0\hat{i} + a\hat{j}) \Rightarrow \vec{F} = -Ka\hat{j}$$

$$\text{Displacement } \vec{r} = (a\hat{i} + 0\hat{j}) - (0\hat{i} + 0\hat{j}) = a\hat{i}$$

Thus, work done from $(0, 0)$ to $(a, 0)$ is given by

$$W = \vec{F} \cdot \vec{r} = -Ka\hat{j} \cdot a\hat{i} = 0$$

For motion $(a, 0)$ to (a, a)

$$\vec{F} = -K(a\hat{i} + a\hat{j}) \text{ and displacement}$$

$$\vec{r} = (a\hat{i} + a\hat{j}) - (a\hat{i} + 0\hat{j}) = a\hat{j}$$

So, work done from $(a, 0)$ to (a, a)

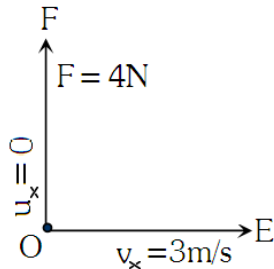
$$W = \vec{F} \cdot \vec{r} = -K(a\hat{i} + a\hat{j}) \cdot a\hat{j} = -Ka^2$$

Hence, the total work done $= -Ka^2$

47

Here, Displacement of body in 4 second along OE is,

$$s_x = v_x t = 3 \times 4 = 12 \text{ m}$$



Force along OF (i.e. perpendicular to OE) $= 4 \text{ N}$

$$\therefore a_y = \frac{F}{m} = \frac{4}{2} = 2 \text{ m/s}^2$$

Displacement of body in 4 second along OF,

$$\Rightarrow s_y = u_y t + \frac{1}{2} a_y t^2 = \frac{1}{2} \times 2 \times (4)^2 = 16 \text{ m} \quad [\because u_y = 0]$$

$$\therefore \text{Net displacement, } s = \sqrt{s_x^2 + s_y^2} = \sqrt{(12)^2 + (16)^2} = 20 \text{ m}$$

48

Here, given, $\Delta l_1 = \Delta l_2$ or $l_1 \alpha_a t = l_2 \alpha_s t$

$$\therefore \frac{l_1}{l_2} = \frac{\alpha_s}{\alpha_a} \text{ or } \frac{l_1}{l_1 + l_2} = \frac{\alpha_s}{\alpha_a + \alpha_s}$$

49

$$F = \frac{1}{4\pi\epsilon_0} \cdot \frac{Q_1 Q_2}{r^2} \Rightarrow \epsilon_0 \propto \frac{Q^2}{F \times r^2}$$

So, ϵ_0 has units of coulomb²/newton-metre².

50

Gravitational force

Chemistry - Solutions

1

$$K_c = \frac{[HI]^2}{[H_2][I_2]}$$

2

We know that, $2d \sin \theta = n\lambda$

$$\Rightarrow 2 \times d \times \sin 60^\circ = 2 \times 1 \text{ \AA}$$

$$\Rightarrow 2 \times d \times 0.8660 = 2 \quad (\because \sin 60^\circ = \sqrt{3}/2 \text{ or } 0.8660)$$

$$\Rightarrow d = 1.15 \text{ \AA}$$

3

Electrons are gained (electronation) in reduction

4

Empirical formula mass = $C_2H_5O = 24 + 5 + 16 = 45$

$$\text{Now, } n = \frac{\text{Mol. mass}}{\text{Emp. mass}} = \frac{90}{45} = 2$$

$$\therefore \text{Mol. formula} = (C_2H_5O)_2 = C_4H_{10}O_2$$

5

$$\frac{K_t + 10}{K_t} = \frac{r_t + 10}{r_t} = 2$$

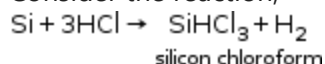
We know, $\frac{K_t + 10}{K_t} = \frac{r_t + 10}{r_t}$; For an increase of temperature to 50°C means 5 times, the rate increases by 2^5 times, i.e. 32 times.

6

can best be determined from measurements on dilute solutions of NaF, NaCl and HCl

7

Consider the reaction,



8

For reviving the exhaust permutit, 10% NaCl solution is used.

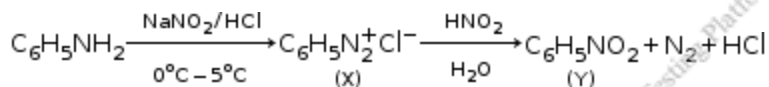
9

Cl_2 bleaches because of oxidation which is permanent bleaching whereas SO_2 bleaches because of reduction which is temporary bleach and convert in original by atmospheric oxygen.

10

Emission spectra of different λ implies to quantisation of energy.

11



12

Copper chloride.

13



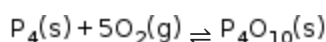
14

As silicon tetra fluoride reacts with water, H_2SiF_6 and H_4SiO_4 are formed as given below,

$$3\text{SiF}_4 + 4\text{H}_2\text{O} \rightarrow 2\text{H}_2\text{SiF}_6 + \text{H}_4\text{SiO}_4$$

Silicon tetrafluoride Water White silicic acid

15



$$K_c = \frac{[\text{P}_4\text{O}_{10}(\text{s})]}{[\text{P}_4(\text{s})][\text{O}_2(\text{g})]^5}$$

So,

As we know, concentration of a solid component is always unity thus $K_c = \frac{1}{[\text{O}_2]^5}$.

16

As we know,
 $W = -p\Delta V$
 $\Rightarrow W = -3 \times (6 - 4)$
 $\Rightarrow W = -6 \times 101.32 (\because 1 \text{ L atm} = 101.32 \text{ J})$
 $\Rightarrow W = -608 \text{ J}$

17

Sodium has basic nature

18

$$\text{Here, Mole fraction of CO}_2 \text{ in the mixture} = \frac{n_{\text{CO}_2}}{n_{\text{CO}_2} + n_{\text{N}_2}}$$

$$= \frac{\frac{44}{44}}{\frac{44}{44} + \frac{14}{28}} = \frac{2}{3}$$

19

Water containing any cation other than NH_4^+ as well as alkali metal is a hard water.

20

Calgon process is used to remove the hardness of water.

21

Calcium cyanamide on treatment with steam gives out $\text{CaCO}_3 + \text{NH}_3$.

22

From given data, $\frac{22}{100} \times 3.2 = 0.704$

Thus At equilibrium, moles of HI = $3.2 - 0.704 = 2.496$

23

BaCl_2 has highest melting point. The BaCl_2 contains higher ionic character.

24

Glycerides of saturated and unsaturated fatty acids.

25

Tl^+ is more stable than Tl^{3+} due to inert pair effect

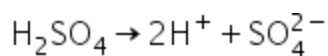
26

All of these.

27

Carbonates of group-I metals are stable to heat except Li_2CO_3

28



It is the only strong electrolyte in the given choices

29

$$W = -P\Delta V \text{ \& } \Delta H = \Delta U + P\Delta V$$

30

All of these

31

Red bauxite contains chief impurity of Fe_2O_3 .

32

Oxidation state of metal in metal carbonyl is zero.

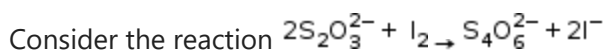
33

Weak metallic

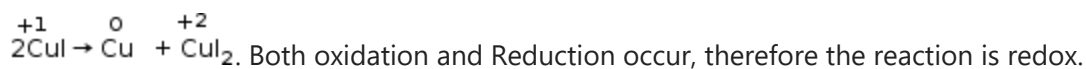
34

Increases

35



36



37

Nylon-66 is manufactured by the condensation polymerization of adipic acid along with hexamethylenediamine with the lose of H_2O in the form of steam.

38

Both Na – Cl belongs to III period.

39

As we know, $\Delta U_v = U_P - U_R$.

40

(i) Increase continuously; (ii) Decreases continuously.

41

Water is a polar solvent, therefore it decreases the interionic attraction in the crystal lattice because of solvation.

42

The electrovalent bond is formed by losing electrons from one atom and gaining electron by another atom means redox reaction.

43

As we know,

$$\text{Equivalent weight} = \frac{\text{weight of metal}}{\text{weight of oxygen}} \times 8 = \frac{3.2}{0.4} \times 8 = 64$$

$$\text{Vapor density} = \frac{\text{mol. wt}}{2}$$

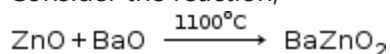
$$\Rightarrow \text{Mol. wt.} = 2 \times \text{V. D} = 2 \times 32 = 64$$

$$\text{Now we know, } n = \frac{\text{mol. wt}}{\text{eq. wt}} = \frac{64}{64} = 1$$

Suppose, the formula of metal oxide be M_2O_n . So, the formula of metal oxide $= M_2O$.

44

Consider the reaction,



45

The reduction potential of Mg is less than water ($E^\circ = -0.83 \text{ V}$). Thus, their ions in the aqueous solution cannot be reduced instead water will be reduced $2 \text{ H}_2\text{O} + 2 \text{ e}^- \rightarrow \text{H}_2 + 2 \text{ OH}^-$.

46

The conjugate base of weak acid is a strong base.

47

Propionaldehyde and Formaldehyde.

48

Ethyl chloride will be covalent, as it is an organic compound.

49

Tertiary alcohol.

50

On heating, $\text{Mg}(\text{OH})_2$ sublimes.

Botany - Solutions

1

Productivity is the rate of biomass production. It can be divided into gross primary productivity (GPP) and net primary productivity (NPP). Gross primary productivity of an ecosystem is the rate of production of organic matter during photosynthesis and a considerable amount of GPP is utilized by plants in respiration. Net primary productivity is the available biomass for the consumption to heterotrophs (herbivores and decomposers). Secondary productivity is defined as the rate of formation of new organic matter by consumers.

2

Root nodules have nitrogen fixing bacteria (*Rhizobium leguminosarum*) which fix atmospheric free nitrogen into ammonia. The fixed nitrogen is absorbed by the plant. In return, the plant provides food and shelter to bacteria. Such an association is known as mutualistic symbiosis.

3

More than 70% of all the species recorded on earth are animals, while plants (including algae, fungi, bryophytes, gymnosperms and angiosperms) consist no more than 22% of the total. Among plants, fungi are much more in number as compared to lichens, algae, ferns and mosses.

4

Primary growth

5

Prokaryotic and unicellular

6

Organisms phenotypically similar but genotypically different are known as heterozygous.

7

All the above

8

Because at each trophic level only 10% energy is left. Hence, the amount of energy decreases and pyramid will be straight and cannot be inverted in any condition.

9

Co-dominance is depicted by a cross in which the F_1 generation resembles both the parents. In this phenomena, both the alleles are able to express themselves independently when present together regulating in a phenotype that is intermediate between both the parental homozygous phenotypes, thereby resembling both of them, e.g., roan coat colour in cattle is a result of codominance of alleles for white and red coat colour.

10

Temin and Baltimore reported that formation of DNA on RNA template or DNA is also formed from RNA. This is known as reverse transcription or Teminism. This reverse transcription occurs under the influence of reverse transcriptase enzyme.

11

The direct synthesis of ATP from metabolites is known as substrate level phosphorylation and this is seen during conversion of Succinyl CoA to succinate acid. Succinyl CoA is acted upon by enzyme succinate or Succinyl CoA synthetase thiokinase to form succinate (a 4C compound) and the reaction releases sufficient energy to form ATP (in plants) or GTP (in animals). GTP can form ATP through a coupled reaction.

12

Encysts

13

400-700 nm

14

The aerobic process of respiration takes place only in the presence of oxygen, but the role of oxygen is limited to the terminal stage of the process. During terminal oxidation, oxygen acts as final hydrogen acceptor and combines with H^+ and forms the water.

Pyruvate is formed by glycolytic catabolism of carbohydrates in the cytosol.

In the process of fermentation, there is incomplete oxidation of glucose under anaerobic conditions.

Whereas in the conversion of Succinyl-CoA to succinic acid, a molecule of GTP is synthesised.

15

Algae

16

Parenchyma containing air spaces is called as aerenchyma. It provides buoyancy to hydrophytes.

17

If in a dihybrid test cross more parental combinations appear as compared to the recombinants in F_2 generation, then it is indicative of involvement of linkage. Linkage is the tendency of two different genes on the same chromosome to remain together during the separation of homologous chromosomes at meiosis. Whereas in complete linkage no recombinants are formed whereas in incomplete linkage few recombinants are produced along with parental combinations.

18

Fungi is a large kingdom of over 72,000 species. They are achlorophyllous, heterotrophic, spore forming, non-vascular, eukaryotic organisms. It consist of chitin or fungal cellulose in their walls and possess glycogen as food reserve. They are major decomposers of many ecosystems and are associate of many organisms.

19

Inner mitochondrial membrane produces five complexes. Complex V is connected with ATP synthesis ($F_0 - F_1$ particle). Complexes -I to IV are involved in electron transport -(i) NADH-Q reductase or NADH-dehydrogenase complex, (ii) Succinate Q- reductase complex, (iii) QH_2 - cytochrome c reductase complex, (iv) Cytochrome c oxidase complex.

20

Fluid mosaic model

21

Mitochondria is a respiratory organ. In absence of O_2 respiration does not occur and mitochondria would be absent.

22

Porogamy refer to the entry of the pollen tube with two male gametes and tube nucleus through micropyle. The pollen tube enters the ovule, either through its micropyle (porogamy, e.g., Lily), chalaza (chalazogamy, e.g., Casuarina, Juglaus) or the sides after piercing through the integuments or funicle (mesogamy, e.g., Cucurbita, Populus).

23

Auxins have been used extensively in agricultural and horticultural practices and help to initiate rooting in stem cuttings, promote flowering in pineapples. They prevent fruit and leaf drop at

early stages but promote the abscission of older mature leaves and fruits. Auxins also induce parthenocarp, e.g., tomatoes. They are widely used as herbicides. Auxins also control xylem differentiation and help in cell division. They prevent growth of lateral buds and ensure apical dominance. Bolting is induced by gibberellins which induce sub apical meristem to develop faster. This causes elongation of reduced stem or bolting in case of rosette plants.

- 24 Mucor - Autotroph
- 25 Spirogyra is a free floating, filamentous, green, freshwater alga which is popularly known as pond silk, hair of princess because its filaments are slimy to touch and shine in water.
- 26 Differential length of light and temperature influence the developmental phase of plant. Photoperiodism and vernalization are the two important factors that are responsible for the flowering of plants.
- 27 Mangrove plants
- 28 Blackman propounded the law of limiting factors and also proposed the occurrence of a dark phase in photosynthesis.
- 29 Pseudopodia
- 30 The Nobel prize for artificial synthesis of RNA was given to S. Ochoa (1959).
- 31 The volume of evolved CO_2 is always equal to the volume of produced alcohol in alcoholic fermentation.
- 32 Parthenium hysterophorus is commonly called as congress grass or carrot weed. It is herbaceous annual plant of Family Asteraceae. It is a deadly invasive, noxious weed infesting cropped and non- cropped areas. It rapidly colonises area replacing the native vegetation and causes a number of human health related problems such as skin allergy, rhinitis and eye irritations. Also, being toxic and unpalatable it causes fodder scarcity. Therefore, it is considered a threat to the biodiversity.
- 33 Thallophyta
- 34 The residual persistent nucellus is called as perisperm. The transformation of different parts of flower take place after fertilization in plants. Fertilised ovary forms fruit. Wall of the ovary forms fleshy or dry fruit wall called pericarp. Integuments form seed coats. Outer integument forms testa while inner integument forms tegmen. The remaining persistent nucellus is generally known as perisperm after fertilization in plants.

35

The main body of the ovule is covered with one or two envelopes known as integuments.

36

Photorespiration

37

Lower nodes

38

Cytokinin (Gk, cytos-cell, kinesis-division) promotes the cell division in plants. They are mildly basic growth hormones that are usually amino purine derivatives and promote cell division in plants. Along with auxins, they are extensively used in tissue culture experiments where they promote differentiation of root and shoot. They have also been found to delay senescence, overcome apical dominance and promote cell expansion, etc. Roots are the main source of cytokinin synthesis, e.g., zeatin, ribosyl zeatin, dihydrozeatin, etc., are some naturally occurring cytokinins.

39

Double fertilisation is the process of fusion of two male gametes brought by a pollen tube to two different cells of the same female gametophyte in order to produce two different structures. It is found only in angiosperms where it was first discovered by Nawaschin in 1898 in *Fritillaria* and *Lilium*. Out of the two male gametes one fuses with egg or oosphere to perform generative fertilisation (syngamy or true fertilisation). It gives rise to a diploid zygote or oospore. The second male gamete fuses with the two haploid polar nuclei or diploid secondary nucleus of the central cell to form a triploid primary endosperm nucleus (PEN). This is known as vegetative fertilisation (or triple fusion).

40

Substance which causes change in allosteric sites are called as modulators. They are two types activator and inhibitor. Hexokinase is the example of inhibitor modulator.

41

During synthetic phase of cell cycle, replication of DNA takes place on the template of the existing DNA. So, DNA content of the cell is doubled. During mitosis, it is equally distributed into two daughter cells, resuming the chromosome number of parent cell. Whereas, during meiosis it is divided into four daughter cells each with half the chromosome number of parent cell.

42

Protists are primitive single known as organism with well organised nucleus, that shows auto and heterotrophic mode of nutrition.

43

When offsprings are introduced by single parent with or without the involvement of gamete formation, the reproduction is called asexual. As a result, the offspring that are produced are not only similar to one another but are also the exact copies of their parent. Such a group of morphologically and genetically similar individuals is called clone. Asexual reproduction occurs usually in unicellular organisms, such as monerans, protists, plants and certain animals. It is faster than sexual reproduction.

44

Independent assortment

45

Intercalary meristem is responsible for increase in length, which is present at the base of internodes or at the base of leaves or at the base of nodes.

46

The amount of energy accumulation in green plants as biomass or organic matter per unit area over a time period through the process of photosynthesis is known as primary productivity. It depends upon plant species of the area, solar radiations, availability of nutrients, precipitation etc. In deep sea and oceans productivity is limited by light and nitrogen.

47

Syngamy refer to the complete and permanent fusion of male and female gametes to form the zygote. When fertilization occurs outside the body of the organism it is called external fertilization or external syngamy. In majority of algae, external fertilization occurs. Whereas in lower fungi, planogametic copulation occur where external fertilization is involved.

48

Micropropagation is used for rapid vegetative multiplication of plants. As the size of the propagule is minute, so the technique is named micropropagation. Each, such plant, will be genetically identical to the parent plant. Normally, apical or axillary meristems are free from viruses. Thus, can be used as explants in tissue culture to produce virus free plants.

49

In zygotene of prophase of meiosis, chromosomes pairing occurs for crossing over.

50

60% proteins and 40% lipids

Zoology - Solutions

1

Gamma immunoglobulin (IgG) has four polypeptide chains. Out of the four chains, there are two long chains, known as heavy chains and two short chains known as light chains, which may be either lambda or kappa type. The four polypeptide chains are held together by disulphide bonds to form a Y-shaped molecule.

2

Condom, made of thin rubber or latex, is used to cover the penis in the male just before coitus so that the ejaculated semen (sperms) do not enter into the female reproductive tract. Diaphragms, cervical caps and vaults are also made of rubber and are inserted into the female reproductive tract to cover the cervix during coitus. Both prevent conception by blocking the entry of sperms through the cervix.

3

The greater vestibular glands (= Bartholin's glands) are paired glands, situated one on each side of the vaginal orifice (opening) and these glands are homologous to the bulbourethral (Cowper's) glands of male and secrete viscid fluid that supplements lubrication during sexual intercourse.

4

Less than 60 minutes

5

Tablets or oral pills are used by females which are small doses of either progestogens or progestogen-estrogen combinations. Pills inhibit ovulation and implantation as well as alter the quality of cervical mucus to prevent or retard entry of sperms inside female genital tract.

6

According to the hypothesis of special creation, life is created by super natural power like God.

7

Pus containing discharge, pain around genitalia and burning sensation while urination are symptoms of gonorrhea disease. Gonorrhoea is caused by *Neisseria gonorrhoeae*. The organism is transmitted by sexual contact, common toilets and under clothes.

8

Suboesophageal, supraesophageal and circum oesophageal commisures unite to form nerving.

9

Acrosome is a cap-like structure that develops over the anterior half of the head in sperm cells of many animals, including human beings. It is derived from Golgi apparatus of the spermatid and contains proteolytic enzymes, known as sperm lysins. These sperm lysins, when releases, help to penetrate the egg (ovum) at the time of fertilization.

10

Collagen is the most abundant protein in the animal world. Collagen accounts for over 30% of total body protein of mammals. It is an insoluble fibrous protein found extensively in the connective tissue of skin, tendon and bone.

11

Length of 10 base pairs = $34 \overset{0}{\text{\AA}}$ or $34 \times 10^{-10} \text{ m}$ or, $34 \times 10^{-10} \text{ m}$ involves 10 base pairs
 $\therefore 1.7 \text{ m will involves} = \frac{10}{3.4 \times 10^{-10}} \times 1.7$ base pairs
 $= 5 \times 10^9$ base pairs present in the DNA.

12

It is a dipeptide in mammals and localised in red blood corpuscles

13

The smooth muscle cells of the afferent and efferent arterioles are swollen and contain dark granules. These cells are known as juxtaglomerular cells. The epithelial cells of the distal convoluted tubule that come in contact with the afferent and efferent arterioles are more dense than the other tubular cells and are collectively called the macula densa. The cells of the macula densa lie in close contact with the juxtaglomerular cells and macula densa together form the juxtaglomerular apparatus or complex.

14

All of these

15

Hypersecretion of growth hormone or somatotrophic hormone (STH) is responsible for acromegaly disease. It is an adulthood malformation due to abnormal growth in jaws, limbs, etc. Overgrowth of soft tissues and bones characteristically results in large spade like hands and feet prominent brow ridges, broadening of bridge of nose, etc.

16

Ti plasmid from the soil bacterium *Agrobacterium tumefaciens* is widely used as vector for gene transfer to plant cells. The part of Ti plasmid transferred into plant cell DNA, is termed the T-DNA. This T-DNA with desired DNA spliced into it, is inserted into the chromosomes of the host plant where it produces multiple copies of itself, by migrating from one chromosomal position to another at random.

17

The ornithine cycle occurs at hepatocytes, which are the cells of the liver, which make up 70-80% of the liver's mass. Urea cycle also called ornithine cycle which converts more toxic ammonia into less toxic urea takes place in the hepatocytes of liver.

18

Birth or production of new offspring is an attribute of an individual whereas birth rate i.e., production of new individuals per unit population per unit time is an attribute of population. A sigmoid growth curve is depiction of logistic growth, a more realistic growth model where individuals compete for limited resources and the fittest individual survives and reproduces. In an exponential growth curve (J-shape curve) the asymptote, is beyond carrying capacity as resources are unlimited. 'r' is intrinsic rate of natural increase.

19

A single strand of nucleic acid tagged with a radioactive molecule is known as probe. The probes having sequence complimentary to the gene to be identified are provided and bind with the particular gene segment. Radiation imaging identifies the location of that particular segment bind with probe. Probes are used as identification tool.

20

Xerophytic plant of deserts, has a number of adaptation to reduce transpiration for water conservation e.g. stem is covered by thick cuticle and has high succulency while leaves are modified into spines.

21

The difference between Rh positive and Rh negative depend on a single pair of genes (rr) with the gene responsible for the Rh positive condition dominant (RR, Rr).

22

Commensalism is the relationship where one organism is benefitted and the other is neither benefitted nor harmed. Orchid grows on mango tree to get proper light etc. and is beneficial but as it does not absorb nutrients from mango tree. So, the tree is neither harmed nor benefitted.

23

A mass of specialized fibres, the bundle of His arises from AV node within myocardium of ventricles and passes downwards into the inter ventricular septum and this bundle then divides

left and right bundle branches one going to each ventricle. Further the branches divide into a network of fine fibres known as purkinje fibres.

24

They suppress sperm motility

25

Parathyroid hormone or parathormone is released by parathyroid glands and it also known as Collip's hormone after the name of its discoverer. This hormone regulates the calcium and phosphate balance between blood and other tissues. It increases calcium reabsorption in nephron, mobilizes the release of calcium into blood from bones and hence increases blood calcium level.

26

A synapse

27

Clostridium is saprophytic, anaerobic N_2 fixing bacteria and have ability to fix atmospheric N_2 into NH_3 .

28

The seminiferous tubules are closed at one end but on the other side they join to a network the rete testis from where fine ciliated ductules, the vasa efferentia arise and cilia help in conducting sperms. The rete testis is a network of tubules conducting sperms from the seminiferous tubules of the testis to the vasa efferentia.

29

Parathormone - tetany hormones is correctly matched with its deficiency disease. Hypoparathyroidism causes the lowering of blood calcium level. This increases the excitability of nerves and muscles, causing cramps and convulsions. Sustained contractions of the muscles of larynx, face, hands and feet are produced. This disorder is known as parathyroid tetany or hypocalcaemic tetany.

30

There are 5 lumbar vertebrae, present in the abdomen.

31

Methane of prebiotic life reacts with various substances from which first nucleotides were produced hence CH_4 is known as most important in origin of life.

32

Serratia - Drug addiction is not correctly matched as Serratia marcescens is considered as a harmful human pathogen which causes urinary tract infections, wound infections, and pneumonia. Serratia bacteria also have many antibiotic resistance properties which may become important if the incidence of Serratia infections dramatically increases.

33

Kidney is excretory organ which is located outside coelom in body.

34

Both (B) and (C)

35

Spinal cord

36

A small oval, yellowish area of the retina lying exactly opposite the centre of the cornea is named as the macula lutea or yellow spot that has at its middle a shallow depression.

37

As per Oparin theory, the primitive atmosphere of earth was reducing i.e. without oxygen.

38

IgE antibodies are produced in response to hypersensitive reactions. These antibodies are less than 0.1% of all most antibodies in the blood. They are located on mast cells and basophils releasing histamine from mast cells and basophils and are involved in allergic and hypersensitive reactions, provides protection against parasitic worms.

39

The scala media or median canal is the most important canal/channel of the cochlea and it bears an upper membrane, the Reissner's membrane, and lower membrane, basilar membrane. On the basilar membrane a sensory ridge, the organ of Corti is present and the organ of Corti consists of hair cells (phonoreceptors), rods of Corti and supporting cells.

40

The blastomeres in the blastocyst are arranged into an outer layer called trophoblast and an inner group of cells attached to trophoblast known as the inner cell mass. The trophoblast does not take part in the formation of the embryo proper and it remains external to the embryo and gives rise to the extraembryonic membranes, namely, chorion and amnion, for the protection and nourishment of the embryo. The trophoblast cells in contact with the embryonal knob are known as cells of the Rauber.

41

Diabetes mellitus or hyperglycemia is the most common endocrine disorder of the pancreatic dysfunction. It has two types: insulin dependent and non-insulin dependent. The insulin dependent diabetes mellitus is caused by a failure of the Beta cells to produce adequate amount of insulin while non- insulin dependent diabetes mellitus appears to involve failure of insulin to facilitate movement of glucose into the cells and the excess of glucose starts to appear in the urine.

42

Morphine is an alkaloid obtained from opium. It is an analgesic and used for pain relieve. Brown sugar or smack (Diacetyl morphine hydrochloride) is more powerful analgesic than morphine.

43

Penicillium notatum restrict the growth of Staphylococci. Acetobacter aceti produces acetic acid and Saccharomyces cerevisiae is used for commercial production of ethanol. Streptococcus produces streptokinase which is genetically modified by to be used as a 'clot buster' for removing clots from the blood vessels of patients who have undergone myocardial infarction leading to heart attack. Bacteria which produces methane are collectively known as methanogens, and one such common bacterium is Methanobacterium. These bacteria are commonly found in the anaerobic sludge during sewage treatment.

44

A important and essential step in genetic engineering is to cut DNA is small, desired fragments. Nuclease enzymes are used for it, which may be exonuclease that forms nicks at terminals or

endonuclease that forms nicks somewhere in between. Restriction endonuclease cleave DNA duplex at specific site in such a way that single stranded staggered sticky ends projects from each fragment of DNA duplex. These ends can join similar complementary ends of other DNA fragments and form recombinant DNA. BamHI, EcoRI, and HindIII all are restriction endonucleases.

45

A-(i), B-(ii); (iv); (ix), C-(iii); (vi), D-(vii); (viii), E-(v)

46

Graves' disease is caused because of hypersecretion of thyroid gland. Exophthalmic goitre of Graves' disease is a thyroid enlargement (goitre) in which the thyroid secretes excessive amount of thyroid hormone and it is characterized by exophthalmia (protrusion of eye balls due to fluid accumulation behind them), loss of weight, slightly rise in the body temperature, excitability, rapid heart beat, nervousness and restlessness.

47

Mitral valve or Bicuspid valve is present in the atrioventricular opening between the left auricle and left ventricle. During atrial systole, the mitral valve opens to allow the flow of blood left auricle to left ventricle and during beginning of ventricular systole, mitral valve closes so as to prevent the backward flow of blood.

48

Ventricle is either of the two lower chambers of the heart, which have thick muscular walls. The left ventricle is thicker than the right, receives blood from the pulmonary vein via the left atrium and pumps it into the aorta and the right ventricle pumps blood received from the venae cavae (via the right atrium) into the pulmonary artery.

49

If a highly purified sample of rat liver DNA is dissolved in pure water, the pH of the resulting solution will be acidic, it is due to the DNA is made up of sugar (deoxyribose), a phosphate ion and a nitrogenous base. Even though basic nitrogenous bases are present in DNA, but these bases are very weak and give support to ribose sugars, whereas phosphate ion is highly acidic.

50

Disaccharides