

Physics

1

A system consists of three particles each of mass 'm' located at points (1, 1), (2, 2) and (3, 3). Then find the co-ordinates of the centre of mass.

1

(1,1)

2

(2,2)

3

(3,3)

4

(6,6)

2

A pendulum bob has a speed of 3 m/s at its lowest position. The pendulum is 0.5 m long. What will be the speed of the bob, when the length makes an angle of 60° to the vertical? (If $g = 10 \text{ m/s}^2$)

1

$\frac{1}{2} \text{ m/s}$

2

2 m/s

3

$\frac{1}{3} \text{ m/s}$

4

3 m/s

3

$x = Ka^m t^n$ gives the position of a body where 'a' is acceleration and 't' is time. Then evaluate dimensions of m and n.

1

$m = 1, n = 1$

2

$m = 2, n = 1$

3

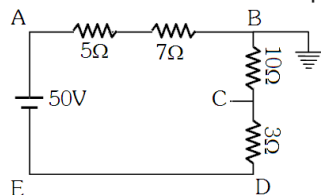
$m = 1, n = 2$

4

$m = 2, n = 2$

4

In the circuit shown, the point 'B' is earthed. What is the potential at the point 'A'?



1

50 V

2

28 V

3

24 V

4

14 V

5

An electric fan has blades of length 30 cm as measured from the axis of rotation. If the fan is rotating at 1200 rpm, estimate the acceleration of a point on the tip of the blade.

1

5055 ms^{-2}

2

2370 ms^{-2}

3

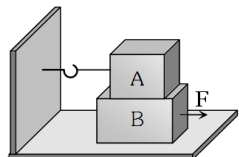
4740 ms^{-2}

4

1600 ms^{-2}

6

Let a block 'A' with mass 100 kg is resting on another block 'B' of mass 200 kg. A horizontal rope tied to a wall holds it as shown in figure. The coefficient of friction between A and B is 0.2 while coefficient of friction between B and the ground is 0.3. What will be the minimum required force F to start moving B?



1

1200 N

2

1100 N

3

900 N

4

700 N

7

How much heat is required to convert one gram of ice at 0°C into steam at 100°C ? (Given: steam = 536 cal/gm)

1

1 kilocalorie

2

716 calorie

3

100 calorie

4

0.01 kilocalorie

8

Sand drops vertically at the rate of 2 kg/sec on to a conveyor belt moving horizontally with a velocity of 0.2 m/sec. Then _____ is the extra force required to keep the belt moving.

1

0.4 N

2

0.2 N

3

0.04 N

4

0.08 N

9

A car moves for half of its time at 80 km/hr and for rest half of time at 40 km/hr. Total distance covered is 60 km. Evaluate the average speed of the car.

1

40 km / hr

2

60 km / hr

3

80 km / hr

4

100 km / hr

10

A body of density d_1 is counterpoised by Mg of weights of density d_2 in air of density ' d '. Then find the true mass of the body.

1

 M

2

$$\frac{M(1 - d/d_2)}{(1 - d/d_1)}$$

3

$$M\left(1 - \frac{d}{d_1}\right)$$

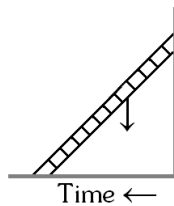
4

$$M\left(1 - \frac{d}{d_2}\right)$$

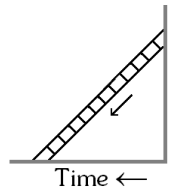
11

A ladder is leaned against a smooth wall and it is allowed to slip on a frictionless floor. Find the centre of mass from the following figure representing its trace.

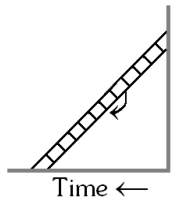
1



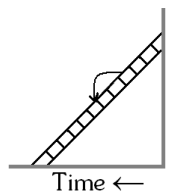
2



3

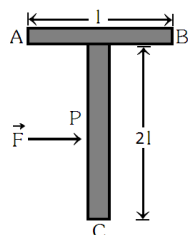


4



12

Following figure shows a 'T' shaped object with dimensions is lying on a smooth floor. A force \vec{F} is applied at the point P parallel to AB, such that the object has only the translational motion without rotation. Determine the position of P with respect to C.



1

|

2

 $\frac{2}{3}|$

3

 $\frac{3}{2}|$

4

 $\frac{4}{3}|$

13

A spring balance is attached to the ceiling of a lift. A man hangs his bag on the spring and the spring reads 49 N, when the lift is stationary. If the lift moves downward with an acceleration of 5 m/s^2 , then find the reading of the spring balance.

1

15 N

2

24 N

3

49 N

4

74 N

14

A body weighs 700 g wt on the surface of the earth. Calculate the mass it will weigh on the surface of a planet whose mass is $\frac{1}{7}$ as well as radius is half that of the earth.

1	100 g wt
2	200 g wt
3	300 g wt
4	400 g wt

15

Determine the ratio of surface energy of 1 small drop and 1 large drop, if 1000 small drops combined to form 1 large drop.

1	1:100
2	10:1
3	100:1
4	1000:1

16

Volume of an air bubble becomes 3 times as it rises from the bottom of a lake to its surface. Suppose that the atmospheric pressure is 75 cm of Hg and the density of water is $\frac{1}{10}$ of the density of mercury, then find the depth of the lake.

1	20 m
---	------

2

15 m

3

10 m

4

5 m

17

Minimum number of coplanar vectors having different magnitudes that can be added to give zero resultant are:

1

1

2

4

3

3

4

2

18

With an initial velocity of 10 m/s, a cylinder of mass 10 kg is sliding on a plane. How long it will cover, if coefficient of friction between surface and cylinder is 0.5?

1

5 m

2

7.5 m

3

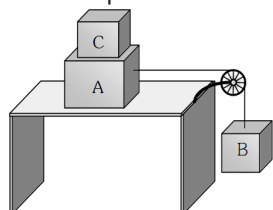
10 m

4

12.5 m

19

Following figure shows two masses A and B of 10 kg and 5 kg which are connected with a string passing over a frictionless pulley fixed at the corner of a table. The coefficient of static friction of A with table is 0.2. Determine the minimum mass of C that may be placed on A to prevent it from moving.



1

5 kg

2

10 kg

3

12 kg

4

15 kg

20

Two cars A and B are travelling in the same direction with velocities v_1 and v_2 ($v_1 > v_2$). When the car A is at a distance d ahead of the car B, the driver of the car A applied the brake producing a uniform retardation a . For which of the following condition, there will be no collision?

1

$$d < \frac{v_1^2 - v_2^2}{2a}$$

2

$$d < \frac{(v_1 - v_2)^2}{2a}$$

3

$$d > \frac{v_1^2 - v_2^2}{2a}$$

4

$$d > \frac{(v_1 - v_2)^2}{2a}$$

21

A sample of ideal gas ($\gamma = 1.4$) is heated at constant pressure. If 100 J of heat is supplied to the gas, then what is the work done by the gas?

1

28.57 J

2

56.54 J

3

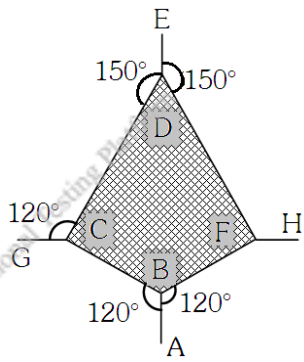
65.38 J

4

38.92 J

22

The figure is the part of a horizontally stretched net. If section AB is stretched with a force of 10 N, then find the tensions in the sections BC and BF.



1

10 N, 6 N

2

10 N, 10 N

3

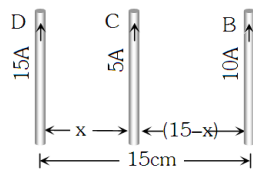
10 N, 11 N

4

Can't be calculated due to insufficient data.

23

The following figure shows arrangement of 3 long, straight and parallel wires carrying currents. The wire C which carries a current of 5 amp is so placed that it experiences no force. What is the distance of wire C from wire D?



1

3 cm

2

5 cm

3

7 cm

4

9 cm

24

Two equally charged, identical metal spheres A and B repel each other with a force 'F'. The spheres are placed fixed with a distance 'r' between them. A third identical, but uncharged sphere C is brought in contact with A and then kept at the mid-point of the line joining A and B. What is the magnitude of the net electric force on C?

1

 $F/4$

2

 $F/2$

3

 $3F/4$

4

F

25

The ratio of the shortest wavelength of the Balmer series to the shortest wavelength of the Lyman series is

1

5 : 9

2

4 : 9

3

4 : 3

4

4 : 1

26

Dimensions of 4 wires of the same material are given below. Determine the wire in which the increase in length will be maximum when the same tension is applied.

1

Length 50 cm, Diameter 0.5 mm

2

Length 100 cm, Diameter 1 mm

3

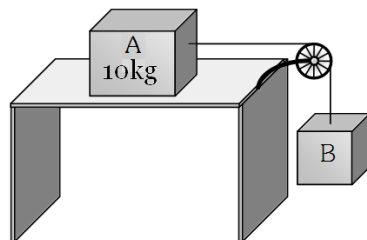
Length 200 cm, Diameter 2 mm

4

Length 300 cm, Diameter 3 mm

27

Consider mass A = 10 kg, coefficient of static friction = 0.2, coefficient of kinetic friction = 0.2. Then what is the mass of B to start motion?



1

200 gm

2

2 kg

3

2.2 kg

4

4.8 kg

28

A body of mass 3 kg is under a force, which causes a displacement in it is given by

$s = \frac{t^3}{3}$ (in m). What is the work done by the force in first 2 seconds?

1

24 J

2

5.2 J

3

3.8 J

4

2 J

29

A body is moving with uniform acceleration describes 40 m in the first 5 seconds and 65 m in next 5 seconds. Its initial velocity will be

1

2.5 m/s

2

4 m/s

3

5.5 m/s

4

11 m/s

30

Unpolarized light of intensity 32 Wm^{-2} passes through three polarizers such as transmission axes of the first and second polarizer makes an angle 30° with each other and the transmission axis of the last polarizer is crossed with that of the first. Then what will be the intensity of final emerging light?

1

 3 Wm^{-2}

2

 4 Wm^{-2}

3

 8 Wm^{-2}

4

 30 Wm^{-2}

31

A plane electromagnetic wave travels in free space along X-direction. If the value of \vec{B} (in tesla) at a particular point in space and time is $1.2 \times 10^{-8} \hat{k}$. What is the value of \vec{E} (in V m^{-1}) at that point?

1

 $1.2 \hat{j}$

2

 $3.6 \hat{j}$

3

 $1.2 \hat{k}$

4

 $3.6 \hat{k}$

32

A ball is rolled off the edge of a horizontal table at a speed of 4 m/s. After 0.4 s it hits the ground. Then which of the following statement is true?

1

The speed with which it hits the ground is 4.0 m/s

2

It hits the ground at a horizontal distance 1.6 m from the edge of the table

3

Height of the table is 0.8 m

4

Both (2) & (3)

33

A body of mass 1 kg tied to one end of string is revolved in a horizontal circle of radius 0.1 m with a speed of 3 revolution/second, assuming the effect of gravity is negligible, then what will be the linear velocity, acceleration and tension respectively in the string?

1

3.88 m/s, 55.5 m/s^2 , 55.5 N

2

2.88 m/s, 45.5 m/s^2 , 45.5 N

3

1.88 m/s, 35.5 m/s^2 , 35.5 N

4

None of these

34

A particle moves from position $\vec{r}_1 = 3\hat{i} + 2\hat{j} - 6\hat{k}$ to position $\vec{r}_2 = 14\hat{i} + 13\hat{j} + 9\hat{k}$ under the action of force $4\hat{i} + \hat{j} + 3\hat{k}$ N. Then calculate work done.

1

50 J

2

75 J

3

100 J

4

200 J

35

The energy flux of sunlight reaching the surface of the earth is $1.388 \times 10^3 \text{ W m}^{-2}$. The photons in the sunlight have an average wavelength of 550 nm. Calculate the number of photons per square metre are incident on the earth per second.

1

 4×10^{21}

2

 4×10^{28}

3

 4×10^{31}

4

 4×10^{34}

36

Consider $x = at + bt^2$, where x is the distance travelled by the body in kilometres, while ' t ' is the time in seconds, then find the units of b .

1

km - s

2

km / s

3

km - s²

4

km / s²

37

Length of an elastic string is ' a ' metre, when the longitudinal tension is 4 N and ' b ' metre when the longitudinal tension is 5 N. Determine the length of the string in metre when the longitudinal tension is 9 N.

1

 $a - b$

2

 $4a - 3b$

3

 $5b - 4a$

4

 $2b - \frac{1}{4}a$

38

A ball is projected from the ground at a speed of 10 ms^{-1} making an angle of 30° with the horizontal. Another ball is simultaneously released from a point on the vertical line

along the maximum height of the projectile. How much is the initial height of the second ball is (Taking $g = 10 \text{ m s}^{-2}$)

1

5 m

2

2.5 m

3

3.75 m

4

6.25 m

39

Air is pumped into an automobile tube upto a pressure of 200 kPa in the morning when the air temperature is 22°C . During the day, temperature rises to 42°C and the tube expands by 2%. Find the pressure of the air in the tube at this temperature.

1

200 kPa

2

206 kPa

3

209 kPa

4

212 kPa

40

Let A and B be two layers of different material of a wall. The thickness of both the layers is same. The thermal conductivity of A and B are K_A and K_B such that $K_A = 3K_B$. The

temperature across the wall is 20°C temperature across the wall. Find the thermal difference across A in thermal equilibrium.

1

The rate of transfer of heat through A is more than that through B

2

The temperature difference across A is 10°C

3

The temperature difference across A = 5°C

4

The temperature difference across A = 15°C

41

A binary star system consists of two stars. One star has twice the mass of the other. The star rotates about their common centre of mass. Identify the correct statement.

1

Star having the smaller mass has twice angular momentum compared to heavier star

2

Both stars have same angular momentum about centre of mass

3

Both the stars have same kinetic energy

4

Both stars have same linear speed

42

A block of mass 'm' is placed on a smooth wedge of inclination θ . The whole system is accelerated horizontally so that the block does not slip on the wedge. Determine the force exerted by the wedge on the block. (g = acceleration due to gravity)

1

 mg

2

 $mg \cos \theta$

3

 $mg \sin \theta$

4

 $mg / \cos \theta$

43

Two forces $\vec{F}_1 = 5\hat{i} + 10\hat{j} - 20\hat{k}$ and $\vec{F}_2 = 10\hat{i} - 5\hat{j} - 15\hat{k}$ act on a single point. Then determine the angle between \vec{F}_1 and \vec{F}_2 .

1

 75°

2

 60°

3

 45°

4

 30°

44

A coil having 'n' turns and resistance $R \Omega$ is connected with a galvanometer of resistance $4R \Omega$. This combination is moved in time 't' seconds from a magnetic field W_1 weber to W_2 weber. Which of the following relation indicates induced current in the circuit?

1

$$-\frac{n(W_2 - W_1)}{Rt}$$

2

$$-\frac{(W_2 - W_1)}{Rnt}$$

3

$$-\frac{n(W_2 - W_1)}{5Rt}$$

4

$$-\frac{(W_2 - W_1)}{5Rnt}$$

45

A 60 kg weight is dragged on a horizontal surface by a rope upto 2 metres. When coefficient of friction is $\mu = 0.5$, the angle of rope with the surface is 60° and $g = 9.8 \text{ m/s}^2$, then evaluate the work done.

1

197 joules

2

294 joules

3

315 joules

4

588 joules

46

Determine the correct relation if a point moves with uniform acceleration and v_1, v_2 and v_3 denote the average velocities in the three successive intervals of time t_1, t_2 and t_3 .

1

$$(v_1 - v_2):(v_2 - v_3) = (t_1 - t_2):(t_1 - t_3)$$

2

$$(v_1 - v_2):(v_2 - v_3) = (t_1 - t_2):(t_2 + t_3)$$

3

$$(v_1 - v_2):(v_2 - v_3) = (t_1 - t_2):(t_2 - t_3)$$

4

$$(v_1 - v_2):(v_2 - v_3) = (t_1 + t_2):(t_2 + t_3)$$

47

An inverted bell lying at the bottom of a lake 47.6 m deep has 50 cm³ of air trapped in it. The bell is brought to the surface of the lake. What will be the volume of the trapped air? (atmospheric pressure = 70 cm of Hg and density of Hg = 13.6 g/cm³)

1

$$200 \text{ cm}^3$$

2

$$250 \text{ cm}^3$$

3

$$300 \text{ cm}^3$$

4

$$350 \text{ cm}^3$$

48

When a body loses half of its velocity on penetrating 3 cm in a wooden block, then before coming to rest it penetrate ____ more.

1

$$4 \text{ cm}$$

2

$$3 \text{ cm}$$

3

2 cm

4

1 cm

49

A resistor of $500\ \Omega$, an inductance of $0.5\ \text{H}$ are in series with an ac which is given by $V = 100\sqrt{2} \sin(1000t)$. What is the power factor of the combination?

1

$$\frac{1}{\sqrt{2}}$$

2

$$\frac{1}{\sqrt{3}}$$

3

0.6

4

0.5

50

Match List I with List II and find the correct answer using the codes given in below the lists:

List I (Position of the object)	List II (Magnification)
(I) An object is placed at focus before a convex mirror	(A) Magnification is $-\infty$
(II) An object is placed at center of curvature before a concave mirror	(B) Magnification is 0.5
(III) An object is placed at focus before a concave mirror	(C) Magnification is +1
(IV) An object is placed at center of curvature before a convex mirror	(D) Magnification is -1
	(E) Magnification is 0.33

1

I-B, II-E, III-D, IV-C

2

I-C, II-B, III-A, IV-E

3

I-A, II-D, III-C, IV-B

4

I-B, II-D, III-A, IV-E

Chemistry

1

Find the true statement from the following statements for solution of 0.020 M H_2SO_4 .

1

2 litre of the solution contains 0.080 mole of H_3O^+

2

1 litre of the solution contains 0.020 mole of SO_4^{2-}

3

1 litre of the solution contains 0.020 mole H_3O^+

4

None of these

2

The compound that has electrovalent linkage is:

1

Cl_2

2



3



4



3

In lithium nitride, Nitride ion is composed of

1

$10 \text{ P} + 10 \text{ e}$

2

$7 \text{ P} + 10 \text{ e}$

3

$10 \text{ P} + 7 \text{ e}$

4

$7 \text{ P} + 7 \text{ e}$

4

A mixture contains 18 g water and 414 g ethanol. Then what is the mole fraction of water in mixture?(Assume ideal behavior of the mixture.)

1

0.8

2

0.7

3

0.4

4

0.1

5

Assuming fully decomposed, what will be the volume of CO_2 released at STP on heating 9.85 g of BaCO_3 ? (Given: Atomic mass of Ba = 137)

1

4.06 L

2

2.24 L

3

1.12 L

4

0.84 L

6

ΔU° of combustion of isobutylene is $-X \text{ kJ mol}^{-1}$. What is the value of ΔH° ?

1

 $< \Delta U^\circ$

2

 $= 0$

3

 $> \Delta U^\circ$

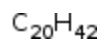
4

 $= \Delta U^\circ$

7

Solid paraffin at room temp. is given as

1



2



3



4



8

Why chemical equilibrium is dynamic in nature?

1

Because both forward and backward reactions occur at all times with same speed

2

Because equilibrium is maintained rapidly

3

Because the concentration of reactants and products are constant but different

4

both (1) & (3)

9

Which of the following is the best method for the separation of naphthalene and benzoic acid from their mixture?

1

Sublimation

2

Distillation

3

Crystallization

4

Chromatography

10

The aqueous solution of which one of the following is basic?

1

 NaOCl

2

 NH_4NO_3

3

 NaHSO_4

4

 HOCl

11

What happens when Sn^{2+} changes to Sn^{4+} in a reaction?

1

It gains two protons

2

It loses two protons

3

It gains two electrons

4

It loses two electrons

12

Maximum no. of moles of electrons taken up by one mole of NO_3^- , when it is reduced to

1

 NO_2

2

 NO

3

 NH_2OH

4

 NH_3

13

The metal which does not displace hydrogen from water and acid on the basis of position in the electrochemical series is

1

 Ba

2

 Pb

3

 Al

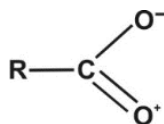
4

 Hg

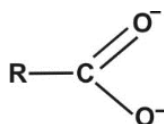
14

Which is the correct structure representation of carboxylate ion?

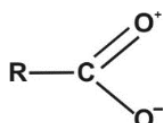
1



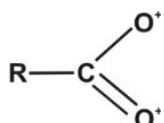
2



3



4



15

Alkali metals in each period of the periodic table possess

1

lowest ionization potential

2

smallest size

3

highest ionization potential

4

highest electronegativity

16

Which one of the following will posses least hindered rotation about carbon-carbon bond?

1

Ethylene

2

Ethane

3

Hexachloroethane

4

Acetylene

17

One mole of an ideal gas is allowed to expand reversibly and adiabatically from a temperature of 27°C . During the process, if the work done is 3 kJ , then what is the final temperature of the gas ? ($C_V = 20 \text{ J/K}$)

1

255 K

2

195 K

3

150 K

4

100 K

18

Identify the group comprising of all metals.

1	2
2	3
3	4
4	7

19

The ammonia evolved from the treatment of 0.30 g of an organic compound for the estimation of nitrogen was passed in 100 ml of 0.1 M sulphuric acid. The excess of acid needed 20 mL of 0.5 M sodium hydroxide (NaOH) solution for complete neutralization. Identify the organic compound.

1	Thiourea
2	Acetamide
3	Benzamide
4	Urea

20

Which of the following kind of fission is favoured by sunlight?

1

Homolytic fission

2

Heterolytic fission

3

Both (1) and (2)

4

None of these

21

On ____, lattice energy of an ionic compound depends.

1

size of the ion only

2

packing of ions only

3

charge on the ion only

4

charge on the ion and size of the ion

22

Ammonia forms the complex ion $[\text{Cu}(\text{NH}_3)_4]^{2+}$ with copper ions in alkaline solutions but not in acidic solution. The reason for it is

1

Copper hydroxide is an amphoteric substance

2

In alkaline solutions insoluble $\text{Cu}(\text{OH})_2$ is precipitated which is soluble in excess of any alkali

3

In acidic solutions protons coordinate with ammonia molecules forming NH_4^+ ions and NH_3 molecules are not available

4

In acidic solutions hydration protects copper ions

23

What is the mole of helium gas occupying 22.4 L at 0°C at 1 atm. pressure?

1

1.11

2

1.0

3

0.90

4

0.11

24

In a 500 ml capacity vessel CO and Cl_2 are mixed to form COCl_2 . It contains 0.2 moles of COCl_2 and 0.1 mole of each of CO and CO_2 at equilibrium. What is the equilibrium constant K_c for the reaction $\text{CO} + \text{Cl}_2 \rightarrow \text{COCl}_2$?

1

20

2

15

3

10

4

5

25

_____ represents the electronic configuration of a transition element.

1

 $1s^2, 2s^2p^6 \dots ns^2p^6d^3, (n+1)s^2$

2

 $1s^2, 2s^2p^6 \dots ns^2p^3$

3

 $1s^2, 2s^2p^6 \dots ns^2p^6d^{10}, (n+1)s^2p^1$

4

 $1s^2, 2s^2p^6 \dots ns^2p^6$

26

Pure ammonia is placed in a vessel at temperature where its dissociation constant (α) is appreciable. What happens at equilibrium?

1

concentration of H_2 is less than that of N_2

2

concentration of NH_3 does not change with pressure

3

α does not change with pressure

4

K_p does not change significantly with pressure

27

Hydrogen peroxide (H_2O_2) reduces MnO_4^- ion to

1

 Mn^-

2

 Mn^{3+}

3

 Mn^{2+}

4

 Mn^+

28

Time needed for the completion of ionic reactions in comparison to the molecular reactions is

1

equal

2

maximum

3

minimum

4

none

29

The values of dissociation constants of some acids (at 25°C) are as follows. Which of the following is the strongest acid in water?

1

$$4.4 \times 10^{-10}$$

2

$$4.3 \times 10^{-7}$$

3

$$1.6 \times 10^{-4}$$

4

$$1.4 \times 10^{-2}$$

30

The interionic attraction depends on_____.

1

interaction of solute-solute

2

interaction of the charges

3

interaction of solvent-solvent

4

interaction of molecular properties

31

Molten sodium chloride conducts electricity because of the presence of

1

free ions

2

free electrons

3

free molecules

4

atoms of sodium and chlorine

32

Ethyl amine on heating with CS_2 in presence of HgCl_2 produces

1

 $\text{C}_2\text{H}_5(\text{CS})_2$

2

 $(\text{C}_2\text{H}_5)_2\text{CS}$

3

 $(\text{C}_2\text{H}_5)_2\text{S}$

4

 $\text{C}_2\text{H}_5\text{NCS}$

33

In methyl alcohol solution, bromine reacts with ethylene to produce $\text{BrCH}_2\text{CH}_2\text{OCH}_3$ in addition to 1, 2-dibromoethane because

1

this is a free-radical mechanism

2

the reaction follows Markownikoff's rule

3

the methyl alcohol solvates the bromine

4

the ion formed initially may react with Br^- or CH_3OH

34

In periodic table going down in the fluorine group,

1

ionic radius will increase

2

reactivity will increase

3

electronegativity will increase

4

ionization potential will increase

35

Which of the following are called as mercaptans?

1

Thio-aldehydes

2

Thio-acids

3

Thio-ethers

4

Thio-alcohols

36

Find the number of electrons in one molecule of CO_2 .

1

88

2

66

3

44

4

22

37

The conductance of the solution ____ when a solution of an electrolyte is heated.

1

increases because the electrolyte is dissociated more

2

increases because of the electrolyte conducts better

3

decreases because of the increased heat

4

decreases because of the dissociation of the electrolyte is suppressed

38

An ionizing solvent possess

1

high value of dielectric constant

2

low value of dielectric constant

3

a dielectric constant equal to 1

4

has a high melting point

39

For preparing 0.1 N solution of a compound from its impure sample of which the percentage purity is known, find the weight of the substance required.

1

Less than the theoretical weight

2

More than the theoretical weight

3

Same as the theoretical weight

4

None of these

40

Proteins when heated with conc. HNO_3 give a yellow colour. This is

1

xanthoproteic test

2

oxidizing test

3

Hoppe's test

4

acid-base test

41

Chloral is

1

 $\text{CCl}_3\text{CH}_2\text{OH}$

2

 $\text{CCl}_3\text{COCCl}_3$

3

 $\text{CCl}_3\text{COCH}_3$

4

 CCl_3CHO

42

Ionic bonds are generally formed by combination of elements with ____.

1

low ionization potential and low electron affinity

2

high ionization potential and high electron affinity

3

low ionization potential and high electron affinity

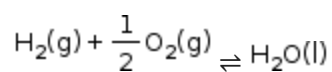
4

high ionization potential and low electron affinity

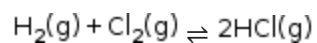
43

For which of the following reaction, $\Delta U = \Delta H$?

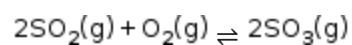
1



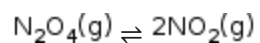
2



3



4



44

Ammonium carbamate when heated to 200°C gives a mixture of NH_3 and CO_2 vapour with a density of 13.0. The degree of dissociation of ammonium carbonate is:

1

1

2

2

3

 $1/2$

4

3/2

45

An electric current is passed through an aqueous solution of the following. Which one of the following shall decompose?

1

Ethyl alcohol

2

 AgNO_3

3

Glucose

4

Urea

46

One calorie =

1

418.4 Joule

2

41.84 Joule

3

4.184 Joule

4

0.4184 Joule

47

What is the most probable radius (in pm) for finding the electron in He^+ ?

1

105.8

2

52.9

3

26.5

4

0.0

48

For the reaction $2\text{N}_2\text{O}_5(\text{g}) \rightarrow 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$, if concentration of NO_2 in 100 secs is increased by $5.2 \times 10^{-3}\text{m}$. Then what will be the rate of reaction?

1

 $2 \times 10^{-3}\text{ms}^{-1}$

2

 $7.6 \times 10^{-4}\text{ms}^{-1}$

3

 $5 \times 10^{-4}\text{ms}^{-1}$

4

 $1.3 \times 10^{-5}\text{ms}^{-1}$

49

When copper turnings are added to the silver nitrate (AgNO_3) solution, a blue coloured solution is formed after some time. It is because

1

copper is reduced to Cu^{2+}

2

copper is oxidized to Cu^{2+}

3

copper forms a blue coloured complex with AgNO_3

4

copper displaces silver from the solution

50

Which of the following is a linear polymer?

1

Amylose

2

Starch

3

Glycogen

4

Amylopectin

Botany

1

Match the following.

	Column I		Column II
P.	Control of weeds	(i)	Gibberellin
Q.	Induction of germination	(ii)	Cytokinin
R.	Ripening of fruit	(iii)	2, 4-D
S.	Delaying of senescence	(iv)	Ethylene

1

P-(ii), Q-(iv), R-(iii), S-(i)

2

P-(iii), Q-(i), R-(iv), S-(ii)

3

P-(ii), Q-(iii), R-(i), S-(iv)

4

P-(i), Q-(ii), R-(iv), S-(iii)

2

After fertilization, the ovary is converted into _____.

1

seed

2

endosperm

3

fruit

4

embryo

3

In a polluted environment, in which of the following, the maximum pollutant will occur?

1

Primary consumers

2

Tertiary consumers

3

secondary consumers

4

Primary producers

4

Who observed first time the process of double fertilisation in plants?

1

John Ray

2

Strasburger

3

Kolreuter

4

S.G. Nawaschin

5

_____ is commonly used plant growth hormone in tea plantations.

1

Absciscic acid

2

Ethylene

3

Zeatin

4

Indole-3-acetic acid

6

What is the chief function of sieve tubes?

1

To conduct minerals

2

To transport water from root to leaves

3

To help the plant in forming wood

4

To translocate the organic materials manufactured in the leaves

7

Choose the correct option: A gene showing co-dominance has

1

alleles that are recessive to each other

2

both alleles independently expressed in the heterozygote

3

alleles tightly linked on the same chromosomes

4

one allele dominant on the other

8

In between ____ synapsis occurs.

1

S male and a female gamete

2

Spindle fibres and centromere

3

Two homologous chromosomes

4

mRNA and ribosomes

9

The rosette habit of cabbage can be changed by application of which of the following phytohormone?

1

ABA

2

GA

3

IAA

4

ethaphon

10

Pneumatophores occur in plants of _____.

1

water

2

marshy soil

3

sandy soil

4

saline marshy soil

11

Number of meiotic divisions required to produce 500 seeds is

1

500

2

575

3

625

4

675

12

Choose the correct option: In Kranz anatomy, the bundle sheath cells have

1

thin walls, many intercellular spaces and no chloroplasts

2

thick walls, no intercellular spaces and large number of chloroplasts

3

thick walls, many intercellular spaces and few chloroplasts

4

thin walls , no intercellular spaces and several chloroplasts

13

Energy released during movement of electron through the photosystems in photosynthesis is used to drive protons across the membrane against concentration gradient. It results in the protons accumulate in

1

thylakoid lumen

2

stroma

3

intrathylakoid space

4

Both (a) and (c)

14

The presence of _____ characterizes the brown algae.

1	haematochrome
2	fucoxanthin
3	phycoerythrin
4	phycocyanin

15

Cyclic -photophosphorylation results in the formation of _____ molecule.

1	NADPH + H^+
2	ATP and NADPH + H^+
3	ATP
4	ADP

16

Where is ATP synthesized?

1	Plasmalemma
2	Ion channels

3

 F_1 particles

4

 F_0 particles

17

_____ reproduces PPLO.

1

Endospore

2

Akinetes

3

Binary fission

4

Gametic fusion

18

Cell wall is not present in

1

Mycoplasma

2

Gametes

3

Amoeba

4

All of these

19

An ecologist uses the term biodiversity for the variety of which of the following species?

1

All living animals

2

All living plants

3

Both (a) and (b)

4

(a), (b) and microbes also living in their natural habitats

20

Oxidative decarboxylation occurs during the formation of which of the following compounds?

1

Citric acid and oxaloacetic acid

2

Citric acid and succinic acid

3

Acetyl CoA and Succinyl CoA

4

Oxakiacetic acid and Oxalosuccinic acid

21

Mendel was lucky, as ____.

1

the *Pisum sativum* is short-lived plant

2

he was born in Austria which is a nice country

3

he used pea plant for his experiment which is rich in protein

4

the genes for different characters are located on different chromosomes in *Pisum sativum*

22

Early studies on the pathway of CO₂ fixation in plants were form during 1940s in

1

Unicellular green algae by Calvin

2

Isolated chloroplast of spinach by Hill

3

Bundle sheath cells of maize by Hatch and Slack

4

Mesophyll cells of variegated leaves by Arnon

23

Branch of Botany which deals with the study of internal organization of plants is called

1

Ecology

2

Physiology

3

Anatomy

4

Cytology

24

_____ is the smallest plant which contain green pigment such as higher green plant.

1

Phaeophyceae

2

Chlorophyceae

3

Rhodophyceae

4

Schizomycetes

25

After double fertilisation, _____ present in a mature ovule.

1

1 diploid and 1 haploid cell

2

1 diploid and 1 triploid cell

3

1 haploid and 1 triploid cell

4

2 haploid and 1 triploid cell

26

Uneven distribution of _____ results in phototropic curvature.

1

gibberellin

2

phytochrome

3

auxin

4

cytokinins

27

Mitochondria are the site for _____.

1

Transpiration

2

Carboxylation

3

Oxidative phosphorylation

4

Photophosphorylation

28

If nucleus represents its large size in proportion to cytoplasm of cell, it stated that

1

Cell is dying

2

Cell is about to die

3

The nucleolus is in resting phase

4

The nucleus has entered S-phase of interphase

29

_____ serves as a reservoir of phosphorus in phosphorus cycle.

1

Soil

2

Rocks

3

Atmosphere

4

Living matter

30

Mesosomes in prokaryotes do not help in:

1

Cell wall formation

2

DNA Replication

3

Respiration

4

Photosynthesis

31

In the movement of electron through ETC

1

pH of matrix increases

2

electrons are transported by active transport

3

electrons show fluorescence

4

electrons are resonated

32

The rate of biomass production and the rate of production of organic matter during photosynthesis are known as

1

gross primary productivity, gross secondary productivity

2

total productivity, primary production

3

net primary productivity, secondary productivity

4

productivity, gross primary productivity

33

What is the phenotypic ratio in plant Snapdragon in F_2 ?

1

2 : 1

2

1 : 1

3

3 : 1

4

1 : 2 : 1

34

Identify the correct statements.

1

Species diversity, in general, increases from poles to the equator.

2

Conventional taxonomic methods are equally suitable for higher plants and microorganisms.

3

There are about 25000 known species of plants in India.

4

India's share of global species diversity is about 18%.

35

The complex formed by a pair of synapsed homologous chromosomes is known as

1

kinetochore

2

axoneme

3

equatorial plate

4

bivalent

36

_____ hydrolyses internal phosphodiester, bonds in a polynucleotide chain.

1

Lipase

2

Protease

3

Exonuclease

4

Endonuclease

37

What is the main basis of classification of phylum protozoa?

1

Number of nuclei

2

Size

3

Shape

4

Locomotory organelle

38

India has only 2.4% of the world's land area but ____% is its share of the global species diversity.

1

1.8

2

3.1

3

5.1

4

8.1

39

When cell has stalled DNA replication fork, ____ checkpoint should be predominantly activated.

1

M

2

 G_2 / M

3

 G_1 / S

4

Both G_2 / M and M

40

Which of the following term is used for a condition where a certain gene is present in only a single copy in a diploid cell?

1

Monogamous

2

Heterozygous

3

Homozygous

4

Hemizygous

41

From which of the following, the highest amount of carbon dioxide is evolved?

1

Oceans

2

River

3

Ponds

4

Forest

42

A stage in cell division is shown in the figure. Mark the answer which gives correct identification of the stage with its characteristics.



1

Telophase

Endoplasmic reticulum and nucleolus not reformed yet.

2

Cytokinesis

Cell plate formed, mitochondria distributed between two daughter cells.

3

Telophase

Nuclear envelope reforms, Golgi complex reforms.

4

Late
anaphaseChromosomes move away from
equatorial plate, Golgi complex not
present.

43

_____ is absent in root hair.

1

Vacuole

2

Cell wall

3

Nucleus

4

Chloroplast

44

In a plant species, flower colour yellow is dominant over white, and fruit shape round is dominant over elongated. Crossing was performed between two purelines-one having yellow-flower and round-fruit, and another with white-flower and elongated-fruit. About 20 plants survived in F_1 progeny. Plants of F_1 were allowed to self-fertilize, and about 960 plants survived in F_2 . If the traits follow Mendelian inheritance, what are the number of plants would have yellow-flower and round -fruit in F_1 and F_2 ?

1

10, 60

2

10, 180

3

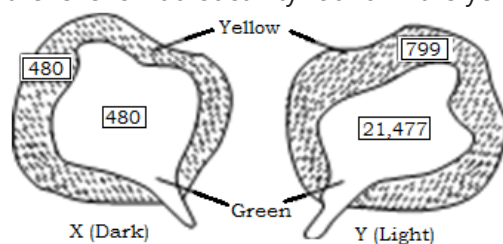
20, 540

4

20, 960

45

Variegated leaves of a plant were supplied with radioactive carbon dioxide (nothing $^{14}\text{CO}_2$) during an experiment. Leaf X was kept in the dark and leaf Y was kept in the light. At the end of the experiment the radioactivity in the leaves was measured and found to be as shown on the diagram below. Which of the following is the most likely explanation for the level of radioactivity found in the yellow zone of Y



1

Radioactive carbon dioxide diffuses into the leaf and accumulates here

2

Photosynthesis occurs but no storage of starch occurs in this zone

3

Products of photosynthesis diffuse into the yellow zone

4

Photosynthesis proceeds slowly in the absence of chlorophyll a and b

46

Find an example of CAM plant.

1

Snake plant (*Sansevieria trifasciata*)

2

Blank nightshade (*Solanum nigrum*)

3

Sugarbeet (*Beta vulgaris*)

4

Lemon grass (*Cymbopogon flexuosus*)

47

In _____, the size of most of the cells is best expressed.

1

micrometers (μm)

2

nanometers (nm)

3

millimeters (mm)

4

Å...

48

Identify false statements about sporopollenin.

1

Sporopollenin can withstand high temperatures and strong acids

2

Exine is made up of sporopollenin

3

Exine has apertures called germ pores where sporopollenin is present

4

Sporopollenin is one of the resistant organic materials

49

Who worked on the details of tricarboxylic acid path?

1

Hans Krebs

2

Meischer

3

Pasteur

4

None of these

50

Which of the following step involvd in double fertilization?

1

Fertilization of two eggs in the same embryo sac by two sperms brought by one pollen tube

2

Fertilization of the egg by two male gametes

3

Fertilisation of the egg and the central cell by two sperms brought by different pollen tubes

4

Fertilisation of the egg and the central cell by two sperms brought by the same pollen tube

Zoology

1

If _____, then only fertilisation in humans is practically feasible.

1

the sperms are transported into cervix within 48 hrs of release of ovum in uterus

2

the ovum and sperms are transported simultaneously to ampullary -isthmic junction of the cervix

3

the sperms are transported into vagina just after the release of ovum in Fallopian tube

4

the ovum and sperms are transported simultaneously to ampullary -isthmic junction of the Fallopian tube

2

Which are an important muscle proteins that help in movement?

1

Tropomyosin

2

Actin and myosin

3

Troponin

4

All of these

3

Mucous membrane act as a barrier by

1

killing pathogen

2

rejecting pathogen

3

immobilizing pathogen

4

preventing entry of pathogen

4

_____ hormones has no effect on heart beat.

1

Thyroxine

2

Oxytocin

3

Noradrenaline

4

Adrenaline

5

_____ is used to transfer T-DNA.

1

Streptomyces hygroscopicus

2

Agrobacterium tumefaciens

3

Escherichia coli

4

Salmonella typhi

6

Determine the common means of transmission of AIDS.

1

Placental transfer

2

Sexual intercourse

3

Blood transfusion

4

All of these

7

Addison disease is caused because of

1

hyposecretion from adrenal cortex

2

hypersecretion from thyroid gland

3

hypersecretion from adrenal cortex

4

hyposecretion from thyroid gland

8

Choose the correct option: In peritoneal dialysis, _____

1

the blood is removed from the body and a natural filter is employed

2

the blood is not removed from the body and a natural filter is used

3

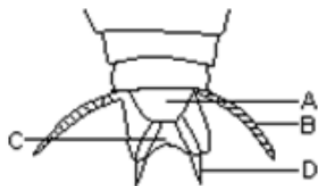
the blood is not removed from the body and an artificial filter is used

4

the blood is removed from the body and an artificial filter is employed

9

The diagram represents the reproductive organ of male cockroach. Choose the correct



combination of labeling?

1

A-10th tergum, B-anal cercus, C-anal style, D-8th sternum

2

A-8th sternum, B-anal cercus, C-10th tergum, D-anal style

3

A-anal style, B-anal cercus, C-10th tergum, D-8th sternum

4

A-anal cercus, B-8th sternum, C-10th tergum, D-anal style

10

Population growth- curve is sigmoid, when the growth pattern is

1

logistic

2

geometric

3

accretionary

4

exponential

11

Which microorganism is used for commercial production of acetic acid?

1

Aspergillus niger

2

Saccharomyces cerevisiae

3

Acetobacter

4

Clostridium butylicum

12

Which amongst the following is an example of naturally acquired passive immunity?

1

Obtaining preformed antibodies from some other animal

2

Formation of antibodies after vaccination

3

Formation of antibodies after an infection

4

Passage of antibodies through colostrum

13

Identify correctly matched pair.

1

Agrobacterium tumefaciens- Tumour

2

Thermus aquaticus- Bt-gene

3

Ligase- Molecular scissors

4

pBR322 - Enzyme

14

The scientists discovered the triple helical structure of collagen is

1

G.N. Ramchandran

2

Anton von Leeuwenhoek

3

Rudolf Virchow

4

Theodor Schwann

15

Surplus of amino acids are broken down to produce urea in

1

Sweat gland

2

Kidney

3

Spleen

4

Liver

16

The self governing nervous system is called as

1

Peripheral nervous system

2

Central nervous system

3

Autonomic nervous system

4

Sympathetic nervous system

17

Write the name of pulmonary disease in which alveolar surface area involved in gas exchange is drastically reduced due to damage in the alveolar walls.

1

Asthama

2

Pneumonia

3

Pleurisy

4

Emphysema

18

In a muscle, what is the functional unit of contraction?

1

Portion of myofibril between two successive 'Z' lines

2

I band

3

H zone

4

A band

19

Calcium level decreases in the blood because of hyposecretion of

1

parathyroid hormone

2

calcitonin

3

adrenaline

4

thyroxine

20

Progestasert is an IUD which makes the uterus unsuitable and cervix hostile to the sperms as

1

they are hormone releasing IUDs

2

they are copper releasing IUDs

3

they are non- medicated IUDs

4

they are ideal contraceptive

21

For the discovery of _____, Flemming, Chain and Florey were awarded the Nobel Prize in 1945.

1

CT scan

2

HIV

3

penicillin

4

Staphylococcus

22

Identify the correct statements in regard to the excretion by the human kidneys.

1

Ascending limb of loop of Henle is impermeable to electrolytes

2

Distal convoluted tubule is incapable of reabsorbing HCO_3^-

3

Nearly 99 per cent of the glomerular filtrate is reabsorbed by the renal tubules

4

Descending limb of loop of Henle is impermeable to water

23

In which of the following process bioreactors are useful?

1

Separation and purification of a product

2

Processing of large volumes of culture

3

Isolation of genetic material

4

Micro-injection

24

Except _____, all of the following events are involved in the spermiogenesis.

1

formation of proximal and distal centrioles

2

formation of mitochondrial sheath

3

formation of acrosome

4

shortening of sperm

25

Who created the coacervate in laboratory?

1

Pasteur

2

Haldane

3

Spallanzani

4

Oparin and Fox

26

Which of the following organisms are capable of maintaining constant body temperature?

1

Stenothermal

2

Homeothermal

3

Conformers

4

Poikilothermal

27

Oral contraceptive prevents pregnancy by which of the following process?

1

Blocking fertilisation

2

Killing the ovum

3

Preventing ovulation

4

Preventing implantation

28

In _____ biolistic technique is used.

1

tissue culture process

2

gene transfer process

3

germplasm conservation process

4

hybridization process

29

Statement 1: T-Cells involved in cell mediated immunity.

Statement 2: B-cells involved in antibody mediated immunity.

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

30

_____ is not secreted in urine.

1

Thiamine

2

Ascorbic acid

3

Cholecalciferol

4

Niacin

31

In _____ pair the two items mean one and the same thing.

1

Malleus - anvil

2

SA node - pacemaker

3

Haemophilia - blood cancer

4

Leucocytes - lymphocytes

32

Following are few characters of a disorder in human body.

(a) Inflammation of the mucous membrane of nasal passage

(b) Watery secretion by mucous glands

(c) Continuous sneezing

(d) Rise in body temperature

Find the disorder from the choices given below

1

Emphysema

2

Rhinitis

3

Bronchial carcinoma

4

Bronchial asthma

33

Between breaths the intrapleural pressure is approximately how much in mmHg less than atmospheric pressure?

1

10

2

4

3

8

4

1

34

What is the example of glycoprotein?

1

Lecithin

2

Mucin

3

Haemoglobin

4

Casein

35

Which substance responsible for making the stratum lucidum cells of the epidermis of skin of rabbit transparent?

1	Luciferin
2	Eleiden
3	Keratohyaline
4	Rhodopsin

36

Carpometacarpal joint of human thumb is an example of which type of joint?

1	Hinge joint
2	Pivot joint
3	Saddle joint
4	Ball and socket joint

37

In echolocation, which animal produces high frequency sounds?

1	Butterfly
---	-----------

2

Monkey

3

Bat

4

Squirrel

38

Choose the right combination of pair.

Column-I	Column-II
A. Escherichia coli	1. Nif gene
B. Rhizobium meliloti	2. Digestive hydrocarbon of crude oil
C. Bacillus thuringiensis	3. Production of human insulin
D. Pseudomonas putida	4. Biological control of fungal disease
	5. Bio-decomposed insecticide

1

A = 3, B = 1, C = 5, D = 2

2

A = 2, B = 1, C = 3, D = 4

3

A = 5, B = 2, C = 3, D = 4

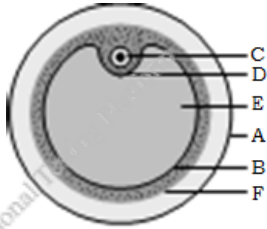
4

A = 3, B = 1, C = 5, D = 4

39

Different parts are indicated by alphabets, in the diagram of section of Graafian follicle; Find the answer in which these alphabets have been correctly matched with the parts

they indicate.



1

A = Membrana granulosa
B = Theca externa
C = Ovum
D = Cumulus oophorus
E = Antrum
F = Theca interna

2

A = Theca externa
B = Theca interna
C = Ovum
D = Cumulus oophorus
E = Antrum
F = Membrana granulosa

3

A = Theca externa
B = Theca interna
C = Ovum
D = Membrana granulosa
E = Antrum
F = Cumulus oophorus

4

A = Membrana granulosa
B = Theca interna
C = Ovum
D = Cumulus oophorus
E = Antrum
F = Theca externa

40

Correct statements about "lactational amenorrhoea" are:

- i) It means absence of menstruation
- ii) During the lactational period, ovulation does not occur
- iii) Chances of contraception are almost nil upto six months following parturition
- iv) Side effects are almost nil
- v) After the period of intense lactation, contraceptive efficiency reduces
- vi) It is a natural method of contraception
- vii) It increases phagocytosis of sperms

1

(i), (ii), (iii), (iv), (v), (vi)

2

(ii), (iii), (iv), (v), (vii)

3

(i), (ii), (iii), (iv)

4

(ii), (iii), (iv), (v), (vi)

41

Name the sexually transmitted disease, that can affect both the male and the female genitals and may damage the eyes of babies born of infected mothers.

1

Gonorrhoea

2

AIDS

3

Hepatitis

4

Syphilis

42

What is surfactant?

1

It is excessive in many premature infants resulting in difficulties in breathing

2

It is a protein produced by type II alveolar cells

3

It decreases the surfaces tension of the fluid lining the alveoli

4

It is lacking in individuals suffering from acute respiratory distress syndrome.

43

In rabbit, ____ increases the respiratory surface of lung.

1

atrium

2

bronchioles

3

alveoli

4

alveolar ducts

44

_____ causes an increase in sodium reabsorption in the distal convoluted tubule.

1

Increase in aldosterone levels

2

Increase in antidiuretic hormone levels

3

Decrease in antidiuretic hormone levels

4

Decrease in aldosterone levels

45

Choose the correct option: In human female the blastocyst

1

gets implanted into uterus 3 days after ovulation

2

forms placenta even before implantation

3

gets nutrition from uterine endometrial secretion only after implantation

4

gets implanted in endometrium by the trophoblast cells

46

Find the correct type of muscle present in respective organ.

1

Upper arm is smooth muscle and fusiform in shape

2

Heart is involuntary and unstriated smooth muscle

3

Thigh is striated and voluntary

4

Intestine is striated and involuntary

47

'Roquefort cheese' is ripened by using which microbes?

1

type of yeast

2

bacterium

3

cyanobacteria

4

fungus

48

Statement 1: Birth rate is the number of babies produced per thousand individuals.

Statement 2: Mortality is the birth rate per thousand individuals.

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

49

The effect of GnRH produced by hypothalamus is

1

stimulates the synthesis and secretion of androgens

2

stimulates secretion of milk in mammary glands

3

stimulates synthesis of carbohydrates from non-carbohydrates in liver

4

stimulates foetal ejection reflex

50

Calculate how many heme molecules are present in one molecule of haemoglobin.

1

2

2

1

3

3

Physics - Answer keys

1	2
2	2
3	3
4	3
5	3
6	2
7	2
8	1
9	2
10	2
11	3
12	4
13	2
14	4
15	1
16	2
17	3
18	3
19	4
20	4

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- 3

National Testing Platform

National Testing Platform

National Testing Platform

46

4

47

3

48

4

49

1

50

4

Chemistry - Answer keys

1

1

2

3

3

2

4

4

5

3

6

1

7

1

8

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36	4
37	1
38	1
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40	1
41	4
42	3
43	2

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Botany - Answer keys

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- 4
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- 2
- 4
- 1

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

Zoology - Answer keys

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

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30	3
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37	3
38	1
39	4

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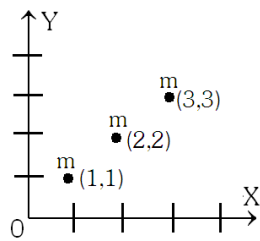
1

50

4

Physics - Solutions

1



Here, the co-ordinates of the centre of mass are,

$$x_{cm} = \frac{m_1x_1 + m_2x_2 + m_3x_3}{m_1 + m_2 + m_3}$$

$$\Rightarrow \frac{m \times 1 + m \times 2 + m \times 3}{m + m + m} = 2$$

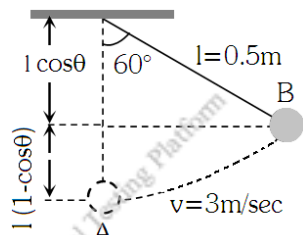
$$y_{cm} = \frac{m_1y_1 + m_2y_2 + m_3y_3}{m_1 + m_2 + m_3}$$

$$\Rightarrow \frac{m \times 1 + m \times 2 + m \times 3}{m + m + m} = 2$$

Therefore, the co-ordinates of centre of mass are (2, 2).

2

Consider the bob velocity 'v' at point B where it makes an angle of 60° with the vertical, then by using conservation of mechanical energy,



$$KE_A + PE_A = KE_B + PE_B$$

$$\Rightarrow \frac{1}{2} m \times 3^2 = \frac{1}{2} m v^2 + m g l (1 - \cos \theta)$$

$$\Rightarrow 9 = v^2 + 2 \times 10 \times 0.5 \times \frac{1}{2} \Rightarrow v = 2 \text{ m/s}$$

3

Given, $x = K a^m \times t^n$

$$[M^0 L T^0] = [L T^{-2}]^m [T]^n = [L^m T^{-2m+n}]$$

$$\therefore m = 1 \text{ and } -2m + n = 0 \Rightarrow n = 2$$

4

Current in the given circuit, $i = \frac{50}{(5 + 7 + 10 + 3)} = 2 \text{ A}$

\therefore Potential difference between A and B,

$$V_A - V_B = 2 \times 12 \Rightarrow V_A - 0 = 24 \text{ V} \Rightarrow V_A = 24 \text{ V}$$

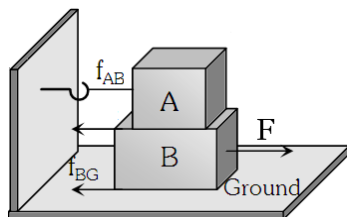
5

Acceleration of a point at the tip of the blade

= centripetal acceleration $= \omega^2 R = (2\pi v)^2 R$

$$= \left(2 \times \frac{22}{7} \times \frac{1200}{60} \right)^2 \times \frac{30}{100} = 4740 \text{ m s}^{-2}$$

6



From the figure, $F = f_{AB} + f_{BG}$

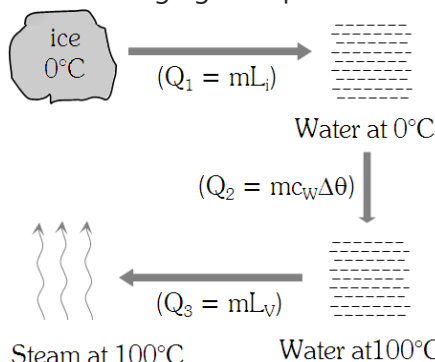
$$= \mu_{AB} m_A g + \mu_{BG} (m_A + m_B) g$$

$$= 0.2 \times 100 \times 10 + 0.3(300) \times 10$$

$$= 200 + 900 = 1100 \text{ N}$$

7

The following figure represents the conversion of ice (0°C) into steam (100°C).



Now, heat required in the given process $= Q_1 + Q_2 + Q_3$

$$= 1 \times 80 + 1 \times 1 \times (100 - 0) + 1 \times 536 = 716 \text{ cal}$$

8

Force required to keep the belt moving = F

$$\therefore F = v \frac{dm}{dt} = 0.2 \times 2 = 0.4 \text{ N}$$

9

$$\text{Time average speed} = \frac{v_1 + v_2}{2} = \frac{80 + 40}{2} = 60 \text{ km/hr}$$

10

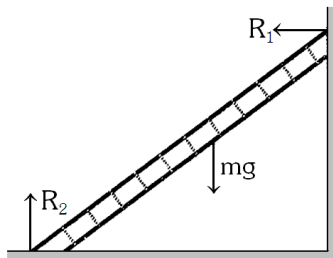
Consider, M_0 = mass of body in vacuum.

Now, Apparent weight of the body in air = Apparent weight of standard weights in air

\Rightarrow Actual weight - Upthrust due to displaced air (d_1) = Actual weight - Upthrust due to displaced air (d_2)

$$\Rightarrow M_0 g - \left(\frac{M_0}{d_1} \right) dg = Mg - \left(\frac{M}{d_2} \right) dg \Rightarrow M_0 = \frac{M \left[1 - \frac{d}{d_2} \right]}{\left[1 - \frac{d}{d_1} \right]}$$

11

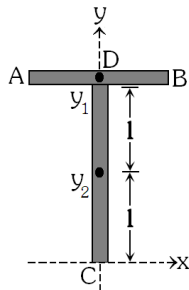


As shown in the above figure, because of net force in downward direction and towards left, centre of mass will follow the path as given in option (3).

12

The force should be applied on the centre of mass of the body for translatory motion. Thus it is necessary to calculate the location of centre of mass of 'T' shaped object. Let mass of rod AB is 'm' so the mass of rod CD will be 2m.

Suppose y_1 is the centre of mass of rod AB and y_2 is the centre of mass of rod CD. Consider that whole mass of the rod is placed at their respective centre of mass means mass m is placed at y_1 and mass 2m is placed at y_2 .



Taking point 'C' at the origin,

Position vector of point y_1 and y_2 can be written as,

$$\vec{r}_1 = 2l\hat{j}, \vec{r}_2 = l\hat{j}, m_1 = m \text{ and } m_2 = 2m$$

\therefore Position vector of centre of mass of the system,

$$\vec{r}_{cm} = \frac{m_1 \vec{r}_1 + m_2 \vec{r}_2}{m_1 + m_2} = \frac{m2l\hat{j} + 2m l\hat{j}}{m + 2m} = \frac{4ml\hat{j}}{3m} = \frac{4}{3}l\hat{j}$$

Hence, the distance of centre of mass from C = $\frac{4}{3}l$.

13

As the lift is stationary, $W = mg$.

$$\Rightarrow 49 = m \times 9.8 \Rightarrow m = 5 \text{ kg.}$$

Now when the lift is moving downward with an acceleration, the reading of the spring is,

$$R = m(9.8 - a) = 5[9.8 - 5] = 24 \text{ N.}$$

14

As we know, $g = \frac{GM}{R^2}$

On the planet, $g_p = \frac{GM/7}{R^2/4} = \frac{4g}{7} = \frac{4}{7}g$

Therefore, weight on the planet $= 700 \times \frac{4}{7} = 400 \text{ g wt}$

15

Volume of liquid remains same means volume of 1000 small drops will be equal to volume of one big drop.

$$\therefore n \frac{4}{3} \pi r^3 = \frac{4}{3} \pi R^3$$

$$\Rightarrow 1000r^3 = R^3 \Rightarrow R = 10r, \therefore \frac{r}{R} = \frac{1}{10}$$

Thus, $\frac{\text{surface energy of one small drop}}{\text{surface energy of one big drop}} = \frac{4\pi r^2 T}{4\pi R^2 T} = \frac{1}{100}$

16

We have, $P_1 V_1 = P_2 V_2$

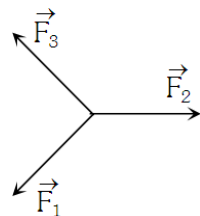
$$\Rightarrow (H_{Hg} \rho_{Hg} + H_W \rho_W) V = H_{Hg} \rho_{Hg} \times 3V$$

$$\Rightarrow H_{Hg} \rho_{Hg} + H_W \frac{\rho_{Hg}}{10} = 3H_{Hg} \rho_{Hg}$$

$$\Rightarrow H_W = 2H_{Hg} \times 10 = \frac{2 \times 75 \times 10}{100} = 15 \text{ m}$$

17

$\vec{F}_3 = \vec{F}_1 + \vec{F}_2$ There should be minimum three coplanar vectors having different magnitude, that should be added to give zero resultant.



18

Here, $s = \frac{u^2}{2\mu g} = \frac{10 \times 10}{2 \times 0.5 \times 10} = 10 \text{ m}$

19

Here, for limiting condition, $\mu = \frac{m_B}{m_A + m_C} \Rightarrow 0.2 = \frac{5}{10 + m_C}$
 $\Rightarrow 2 + 0.2 m_C = 5 \Rightarrow m_C = 15 \text{ kg}$

20

Here, Initial relative velocity $= v_1 - v_2$, Final relative velocity $= 0$

As $v^2 = u^2 - 2as \Rightarrow 0 = (v_1 - v_2)^2 - 2 \times a \times s$

$$\Rightarrow s = \frac{(v_1 - v_2)^2}{2a}$$

If the distance between two cars is 's', then collision will take place. To avoid collision $d > s$.

$$\therefore d > \frac{(v_1 - v_2)^2}{2a} \quad (\text{where } d = \text{actual initial distance between two cars})$$

21

At constant pressure, $\Delta Q = nC_P \Delta T$ and $\Delta U = nC_V \Delta T$

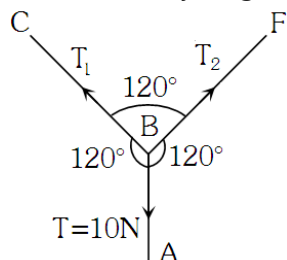
From the first law of thermodynamics, $\Delta W = \Delta Q - \Delta U = n(C_P - C_V) \Delta T$

$$\therefore \frac{\Delta W}{\Delta Q} = \frac{n(C_P - C_V)}{nC_P \Delta T} = 1 - \frac{C_V}{C_P} = 1 - \frac{1}{\gamma} = 1 - \frac{1}{1.4} = \frac{0.4}{1.4} = \frac{4}{14} = \frac{2}{7} \quad \text{or } \Delta W = \frac{2}{7} \Delta Q$$

$$= \frac{2}{7} \times 100 \text{ J} = 28.57 \text{ J}$$

22

From free body diagram of point B,



Assume the tension in the section BC and BF are T_1 and T_2 respectively.

From Lami's theorem,

$$\frac{T_1}{\sin 120^\circ} = \frac{T_2}{\sin 120^\circ} = \frac{T}{\sin 120^\circ} \Rightarrow T = T_1 = T_2 = 10 \text{ N}$$

23

In this case, for no force on wire C,

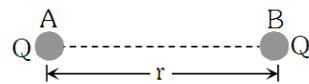
Force on wire C due to wire D = Force on wire C due to wire B

$$\Rightarrow \frac{\mu_0}{4\pi} \times \frac{2 \times 15 \times 5}{x} \times l = \frac{\mu_0}{4\pi} \times \frac{2 \times 5 \times 10}{(15 - x)} \times l$$

$$\Rightarrow x = 9 \text{ cm.}$$

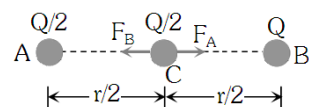
24

At initial condition,



$$F = k \frac{Q^2}{r^2} \quad \dots\dots(i)$$

At final condition,



$$F_A = \frac{k(Q/2)^2}{(r/2)^2} = \frac{kQ^2}{r^2}$$

Force on C due to A,

$$F_B = \frac{kQ(Q/2)}{(r/2)^2} = \frac{2kQ^2}{r^2}$$

And force on C due to B,

$$\therefore \text{Net force on C, } F_{\text{net}} = F_B - F_A = \frac{kQ^2}{r^2} = F$$

25

For a Balmer series

$$\frac{1}{\lambda_B} = R \left[\frac{1}{2^2} - \frac{1}{n^2} \right] \dots (i)$$

Where $n=3, 4, \dots$

By putting $n = \infty$ in equation (i), we obtain the series limit of the Balmer series. It is the shortest wavelength of the Balmer series.

$$\text{Or } \lambda_B = \frac{4}{R} \dots (ii)$$

For a Lyman series,

$$\frac{1}{\lambda_L} = R \left[\frac{1}{1^2} - \frac{1}{n^2} \right] \dots (iii)$$

where $n=2, 3, 4, \dots$

By putting $n = \infty$ in equation (iii), we obtain the series limit of the Lyman series. This is the shortest wavelength of the Lyman series.

$$\text{Or } \lambda_L = \frac{1}{R} \dots (iv)$$

$$\text{Dividing (ii) by (iv), we get, } \frac{\lambda_B}{\lambda_L} = \frac{4}{1}$$

26

$$\text{Young's modulus, } Y = \frac{F}{A} \frac{L}{\Delta L} \Rightarrow \Delta L \propto \frac{F}{A} \propto \frac{L}{\pi d^2}$$

$$\Delta L \propto \frac{L}{d^2} \quad [\because F \text{ and } Y \text{ are constant}]$$

Therefore the ratio of $\frac{L}{d^2}$ is maximum for the wire of Length 50 cm, Diameter 0.5 mm.

27

The coefficient of static friction is,

$$\mu_s = \frac{m_B}{m_A} \Rightarrow 0.2 = \frac{m_B}{10} \Rightarrow m_B = 2 \text{ kg}$$

28

$$\text{Given that, } S = \frac{t^3}{3} \therefore dS = t^2 dt$$

$$\text{Acceleration, } a = \frac{d^2 S}{dt^2} = \frac{d^2}{dt^2} \left[\frac{t^3}{3} \right] = 2t \text{ m/s}^2$$

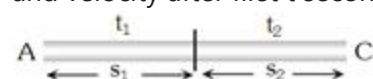
$$\text{Now work done by the force, } W = \int_0^2 F \cdot dS = \int_0^2 ma \cdot dS$$

$$\Rightarrow \int_0^2 3 \times 2t \times t^2 dt = \int_0^2 6t^3 dt = \frac{3}{2} [t^4]_0^2 = 24 \text{ J}$$

29

$$\text{From given data, } S_1 = ut + \frac{1}{2} at^2 \dots (i)$$

and velocity after first t seconds $v = u + at$



Here, $t_1 = t_2 = t$

$$\text{Now, } S_2 = vt + \frac{1}{2}at^2 = (u + at)t + \frac{1}{2}at^2 \dots (ii)$$

From, Equation(ii) - Equation(i) $\Rightarrow S_2 - S_1 = at^2$

$$\Rightarrow a = \frac{S_2 - S_1}{t^2} = \frac{65 - 40}{(5)^2} = 1 \text{ m/s}^2$$

now, from equation (i), we get,

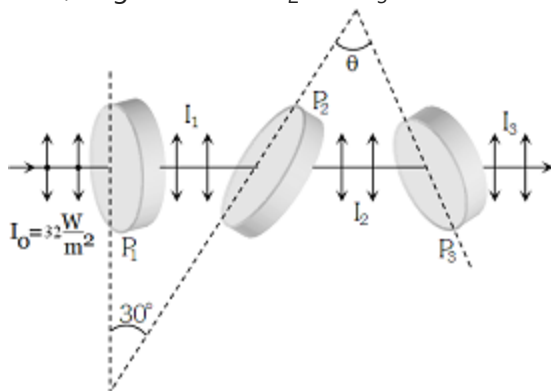
$$S_1 = ut + \frac{1}{2}at^2 \Rightarrow 40 = 5u + \frac{1}{2} \times 1 \times 25$$

$$\Rightarrow 5u = 27.5 \therefore u = 5.5 \text{ m/s}$$

30

Given that, Angle between P_1 and $P_2 = 30^\circ$

Thus, Angle between P_2 and $P_3 = \theta = 90^\circ - 30^\circ = 60^\circ$



The intensity of light transmitted by P_1 is,

$$I_1 = \frac{I_0}{2} = \frac{32}{2} = 16 \frac{W}{m^2}$$

By the Malus' law the intensity of light transmitted by P_2 is,

$$I_2 = I_1 \cos^2 30^\circ = 16 \left(\frac{\sqrt{3}}{2} \right)^2 = 12 \frac{W}{m^2}$$

Similarly, intensity of light transmitted by P_3 is,

$$I_3 = I_2 \cos^2 \theta = 12 \cos^2 60^\circ = 12 \left(\frac{1}{2} \right)^2 = 3 \frac{W}{m^2}$$

31

$$\text{Given, } \vec{B} = 1.2 \times 10^{-8} \hat{k} \text{ T}$$

$$\text{The magnitude of } \vec{E} \text{ is } E = Bc = (1.2 \times 10^{-8} \text{ T})(3 \times 10^8 \text{ m/s}) = 3.6 \text{ V/m}$$

\vec{B} is along Z-direction and the wave propagates along X-direction. Therefore \vec{E} should be in a direction perpendicular to both X and Z axes. Using vector algebra $\vec{E} \times \vec{B}$ should be along X-direction.

As $(+\hat{j}) \times (+\hat{k}) = +\hat{i}$, \vec{E} is along the Y-direction.

$$\text{Thus, } \vec{E} = 3.6 \hat{j} \text{ V/m}$$

32

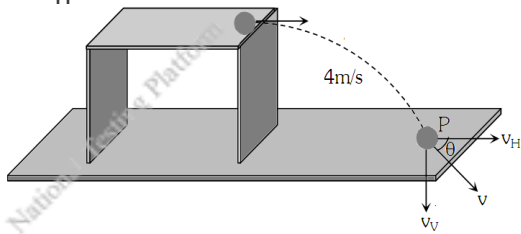
From the following figure,

Vertical component of velocity of ball at point P is,

$$v_y = 0 + gt = 10 \times 0.4 = 4 \text{ m/s}$$

And horizontal component of velocity = Initial velocity

$$\Rightarrow v_H = 4 \text{ m/s}$$



So the speed with which it hits the ground,

$$v = \sqrt{v_H^2 + v_V^2} = 4\sqrt{2} \text{ m/s}$$

$$\text{And } \tan \theta = \frac{v_V}{v_H} = \frac{4}{4} = 1, \text{ So } \theta = 45^\circ$$

∴ It is clear that the ball hits the ground at an angle of 45° to the horizontal.

$$\text{Height of the table, } h = \frac{1}{2}gt^2 = \frac{1}{2} \times 10 \times (0.4)^2 = 0.8 \text{ m}$$

$$\text{and Horizontal distance travelled by the ball from the edge of table, } h = ut = 4 \times 0.4 = 1.6 \text{ m}$$

33

Here, Linear velocity, $v = \omega r = 2\pi nr = 2 \times 3.14 \times 3 \times 0.1 = 1.88 \text{ m/s}$

and Acceleration, $a = \omega^2 r = (6\pi)^2 \times 0.1 = 35.5 \text{ m/s}^2$

and Tension in string, $T = m\omega^2 r = 1 \times (6\pi)^2 \times 0.1 = 35.5 \text{ N}$

34

As two position vectors are given, therefore work done

$$W = \vec{F} \cdot (\vec{r}_2 - \vec{r}_1) = (4\hat{i} + \hat{j} + 3\hat{k})(11\hat{i} + 11\hat{j} + 15\hat{k})$$

$$\therefore W = 44 + 11 + 45 = 100 \text{ Joule}$$

35

$$\text{Here, } I = 1.388 \times 10^3 \text{ W m}^{-2} \quad \lambda = 550 \times 10^{-9} \text{ m, } h = 6.63 \times 10^{-34} \text{ J s}$$

Number of photons incident on earth's surface per second per square meter is

$$n = \frac{I}{E} = \frac{I\lambda}{hc} \quad \left(\because E = \frac{hc}{\lambda} \right) = \frac{1.388 \times 10^3 \times 550 \times 10^{-9}}{6.63 \times 10^{-34} \times 3 \times 10^8} = 4 \times 10^{21} \text{ photons per square metre per second.}$$

36

$$[x] = [bt^2] \Rightarrow [b] = [x/t^2] = \text{km/s}^2$$

37

Consider L is the original length of the wire and K is force constant of wire.

Now, Final length = Initial length + Elongation

$$L' = L + \frac{F}{K}$$

From the given problem,

$$\text{For first condition, } a = L + \frac{4}{K} \quad \text{--- (i)}$$

$$\text{For second condition, } b = L + \frac{5}{K} \quad \text{--- (ii)}$$

Solving (i) and (ii) equation, we get,

$$L = 5a - 4b \text{ and } K = \frac{1}{b - a}$$

Now when the longitudinal tension is 9N, length of the string

$$= L + \frac{9}{K} = 5a - 4b + 9(b - a) = 5b - 4a.$$

38

$$H = \frac{u^2 \sin^2 \theta}{2g}$$

Maximum height of projectile,

$$\therefore H = \frac{(10)^2 \times \sin^2 30^\circ}{2 \times 10} = \frac{5}{4} = 1.25 \text{ m}$$

$$t = \frac{u \sin \theta}{g}$$

Time for attaining maximum height,

$$\therefore t = \frac{10 \times \sin 30^\circ}{10} = 0.5 \text{ s}$$

$$0.5 \text{ s}, S = \frac{1}{2} g t^2$$

Distance of vertical fall in

$$\text{or } S = \frac{1}{2} \times 10 \times (0.5)^2 = 1.25 \text{ m}$$

Initial height of the second ball = $S + H = 1.25 + 1.25 = 2.50 \text{ m}$

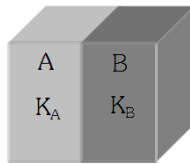
39

We have, $\frac{PV}{T} = R$ (constant)

$$\begin{aligned} \frac{P_1 V_1}{T_1} &= \frac{P_2 V_2}{T_2} \\ \Rightarrow \frac{200 \times V}{273 + 22} &= \frac{P_2 \times 1.02 V}{(273 + 42)} \quad (V_2 = V + 0.02 V) \\ \Rightarrow P_2 &= \frac{200 \times 315}{295 \times 1.02} = 209 \text{ kPa} \end{aligned}$$

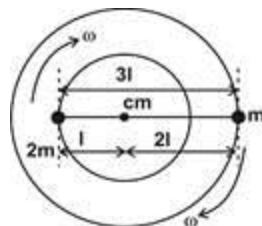
40

The rate of flow of heat is same in series.



$$\begin{aligned} \frac{K_A A (\theta_1 - \theta)}{l} &= \frac{K_B A (\theta - \theta_2)}{l} \\ \therefore 3K_B (\theta_1 - \theta) &= K_B (\theta - \theta_2) \\ \Rightarrow 3(\theta_1 - \theta) &= (\theta - \theta_2) \\ \Rightarrow 3\theta_1 - 3\theta &= \theta - \theta_2 \Rightarrow 4\theta_1 - 4\theta = \theta_1 - \theta_2 \\ \Rightarrow 4(\theta_1 - \theta) &= (\theta_1 - \theta_2) \Rightarrow 4(\theta_1 - \theta) = 20 \\ \Rightarrow (\theta_1 - \theta) &= 5^\circ \text{C} \end{aligned}$$

41

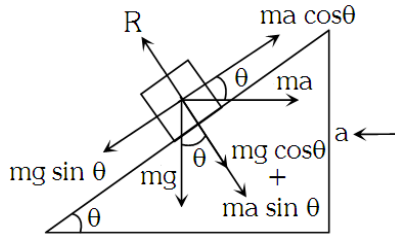
The distance between the two stars be $3l$. Then,Angular momentum of mass m about common centre of mass = $m(2l)^2 \omega$

Angular momentum of mass $2m$ about common centre of mass $= (2m)l^2\omega$

$$\frac{(L)_m}{(L)_{2m}} = \frac{m(2l)^2\omega}{2ml^2\omega} = 2$$

So, their ratio is

42



Pseudo force (ma) works on a block towards right, when the whole system is accelerated towards left.

For the condition of equilibrium,

$$mg \sin \theta = ma \cos \theta \Rightarrow a = \frac{g \sin \theta}{\cos \theta}$$

\therefore Force exerted by the wedge on the block,

$$R = mg \cos \theta + ma \sin \theta \Rightarrow mg \cos \theta + m \left(\frac{g \sin \theta}{\cos \theta} \right) \sin \theta$$

$$\Rightarrow R = \frac{mg(\cos^2 \theta + \sin^2 \theta)}{\cos \theta} = \frac{mg}{\cos \theta}$$

43

$$\cos \theta = \frac{\vec{F}_1 \cdot \vec{F}_2}{|\vec{F}_1| |\vec{F}_2|}$$

$$\cos \theta = \frac{(5\hat{i} + 10\hat{j} - 20\hat{k}) \cdot (10\hat{i} - 5\hat{j} - 15\hat{k})}{\sqrt{25 + 100 + 400} \sqrt{100 + 25 + 225}}$$

$$\Rightarrow \frac{50 - 50 + 300}{\sqrt{525} \sqrt{350}} \text{ i.e. } \cos \theta = \frac{1}{\sqrt{2}}, \therefore \theta = 45^\circ$$

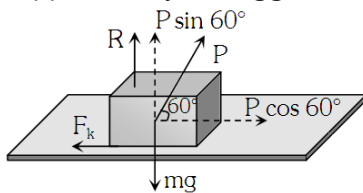
44

We know, $i = \frac{e}{R}$

$$\Rightarrow i = \frac{-N}{R} \frac{(\phi_2 - \phi_1)}{\Delta t} = \frac{-n(W_2 - W_1)}{5Rt}$$

45

Suppose body is dragged with force P , making an angle 60° with the horizontal.



Let, F_k = Kinetic friction in the motion $= \mu_k R$

From the figure, $F_k = P \cos 60^\circ$ and $R = mg - P \sin 60^\circ$

$$\therefore P \cos 60^\circ = \mu_k (mg - P \sin 60^\circ)$$

$$\Rightarrow \frac{P}{2} = 0.5 \left(60 \times 10 - \frac{P\sqrt{3}}{2} \right) \Rightarrow P = 315.1 \text{ N}$$

$$\therefore F_k = P \cos 60^\circ = \frac{315.1}{2} \text{ N}$$

$$\text{Therefore, Work done} = F_k \times s = \frac{315.1}{2} \times 2 = 315 \text{ Joule}$$

46

Consider u_1, u_2, u_3 and u_4 be velocities at time $t = 0, t_1, (t_1 + t_2)$ and $(t_1 + t_2 + t_3)$ respectively

and acceleration is a , then $v_1 = \frac{u_1 + u_2}{2}, v_2 = \frac{u_2 + u_3}{2}$ and $v_3 = \frac{u_3 + u_4}{2}$

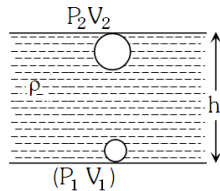
Also, $u_2 = u_1 + at_1, u_3 = u_1 + a(t_1 + t_2)$

and $u_4 = u_1 + a(t_1 + t_2 + t_3)$

By solving the above equations, we get $\frac{v_1 - v_2}{v_2 - v_3} = \frac{(t_1 + t_2)}{(t_2 + t_3)}$

$$\Rightarrow (v_1 - v_2):(v_2 - v_3) = (t_1 + t_2):(t_2 + t_3)$$

47



By the Boyle's law, pressure and volume are inversely proportional to each other i.e. $P \propto \frac{1}{V}$.

$$\Rightarrow P_1 V_1 = P_2 V_2 \Rightarrow (P_0 + h\rho_w g)V_1 = P_0 V_2$$

$$\Rightarrow V_2 = \left(1 + \frac{h\rho_w g}{P_0}\right) V_1$$

$$\Rightarrow V_2 = \left(1 + \frac{47.6 \times 10^2 \times 1 \times 1000}{70 \times 13.6 \times 1000}\right) V_1$$

$$\Rightarrow V_2 = (1 + 5)50 \text{ cm}^3 = 300 \text{ cm}^3 (\because P_2 = P_0 = 70 \text{ cm of Hg} = 70 \times 13.6 \times 1000)$$

48

For first condition given in the problem,

Initial velocity = u , Final velocity = $u/2$, $s = 3 \text{ cm}$

$$\therefore \text{From } v^2 = u^2 - 2as \Rightarrow \left(\frac{u}{2}\right)^2 = u^2 - 2as \Rightarrow a = \frac{3u^2}{8s}$$

And as per second condition,

Initial velocity = $u/2$, Final velocity = 0

$$\therefore \text{From } v^2 = u^2 - 2ax \Rightarrow 0 = \frac{u^2}{4} - 2ax$$

$$\therefore x = \frac{u^2}{4 \times 2a} = \frac{u^2 \times 8s}{4 \times 2 \times 3u^2} = s/3 = 1 \text{ cm}$$

49

Given, $R = 500 \Omega, L = 0.5 \text{ H}$

Compare $V = 100\sqrt{2} \sin(1000t)$ with $V = V_0 \sin \omega t$,

We get, $\omega = 1000 \text{ rad s}^{-1}$

The inductive reactance is

$$X_L = \omega L = (1000)(0.5) = 500 \Omega$$

Impedance of the LR circuit is

$$Z = \sqrt{R^2 + X_L^2} = \sqrt{(500 \Omega)^2 + (500 \Omega)^2} = 500\sqrt{2} \Omega$$

$$\cos \phi = \frac{R}{Z} = \frac{500 \Omega}{500\sqrt{2} \Omega} = \frac{1}{\sqrt{2}}$$

Hence power factor,

50

I-B, II-D, III-A, IV-E

Chemistry - Solutions

1

$$[\text{H}_3\text{O}^+] = 2 \times 0.02 = 0.04 \text{ M}$$

Thus, 2 litre solution contains 0.08 mole of H_3O^+ .

2

Na is highly electropositive and Cl is highly electronegative, thus they will form ionic bond.

3

$$7 \text{ P} + 10 \text{ e}$$

4

The molecular weight of $\text{C}_2\text{H}_5\text{OH} = 24 + 5 + 16 + 1 = 46$

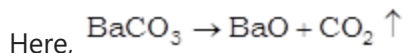
Molecular mass of $\text{H}_2\text{O} = 18$

414 g of $\text{C}_2\text{H}_5\text{OH}$ has $\frac{414}{46} = 9$ mole

18 g of H_2O has $= \frac{18}{18} = 1$ mole

$$\therefore \text{Mole fraction of water} = \frac{n_1}{n_1 + n_2} = \frac{1}{1 + 9} = \frac{1}{10} = 0.1$$

5



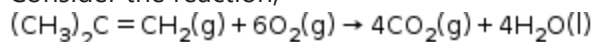
Molecular weight of $\text{BaCO}_3 = 137 + 12 + 3 \times 16 = 197$

Since, 197 gm produces 22.4 L at S.T.P.,

$$\therefore 9.85 \text{ gm produces } \frac{22.4}{197} \times 9.85 = 1.12 \text{ L at S.T.P.}$$

6

Consider the reaction,



Here, $\Delta n_g = 4 - 6 = -2$ (i.e. negative)

We know, $\Delta H = \Delta U + \Delta n_g RT$

$$\Rightarrow \Delta U = \Delta H - (\Delta n_g)RT \quad (\because \Delta n_g = -ve)$$

$$\therefore \Delta H < \Delta U$$

7



8

Both (1) & (3)

9

Mixture of benzoic acid as well as naphthalene can be separated from hot water in which benzoic acid dissolves but naphthalene does not.

10

NaOCl is a mixture of strong base as well as weak acid.

11

$\text{Sn}^{2+} \rightarrow \text{Sn}^{4+} + 2\text{e}^-$. Here, Sn^{2+} changes in Sn^{4+} and it is known as an oxidation reaction.

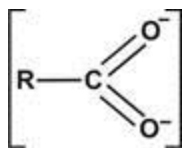
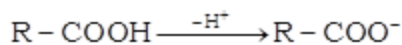
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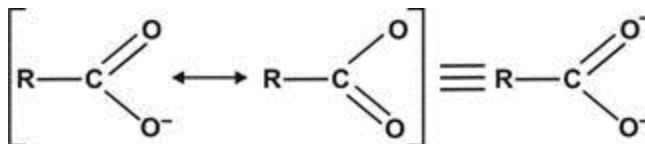
13

Hg as it lies above H_2 in electrochemical series and therefore cannot reduce it.

14



is a resonance hybrid of resonating structures.



15

Lowest ionization energy because of the largest size.

16

Free rotation around carbon-carbon bond occurs easily in alkanes. Now, both ethane and hexachloroethane are alkanes. But in hexachloroethane bulky chlorine atom hinders the rotation. Thus, least hindered rotation takes place in ethane.

17

Given data,

no. of moles = 1

Initial temp. = $27^\circ\text{C} = 300\text{ K}$

Work done by the system = $3\text{ kJ} = 3000\text{ J}$

It will be (-) as work is done by the system.

Heat capacity at constant volume (C_v) = 20 J/K

We know that work done,

$$W = -nC_v(T_2 - T_1)$$

$$\Rightarrow 3000 = -1 \times 20 (T_2 - 300)$$

$$\Rightarrow 3000 = -20 T_2 + 6000$$

$$\Rightarrow 20 T_2 = 3000 \Rightarrow T_2 = \frac{3000}{20} = 150\text{ K}$$

18

All elements are metal in 2 group whereas in 3, 4 and 5 groups non-metallic elements are also present.

19

Equivalent of NH_3 evolved

$$= \frac{100 \times 0.1 \times 2}{1000} - \frac{20 \times 0.5}{1000} = \frac{1}{100}$$

% of nitrogen in an unknown organic compound

$$= \frac{1}{100} \times \frac{14}{0.3} \times 100 = 46.6\%$$

% of nitrogen in urea $(\text{NH}_2)_2\text{CO}$

$$= \frac{14 \times 2}{60} \times 100 = 46.6\%$$

Therefore the compound must be urea.

20

Homolytic fission is favoured by sunlight. In this case, each bonded atom takes away its shared electrons and hence free radicals are produced.

21

The value of lattice energy is dependent on the charges present on the two ions and distance between them. It shall be high if charges are high and ionic radii are small.

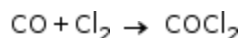
22

In acidic solutions protons coordinate with ammonia molecules forming NH_4^+ ions and NH_3 molecules are not available.

23

22.4 L is occupied by 1 mole of any gas at STP.

24



$$\text{Here, } [\text{CO}] = \frac{0.1}{0.5}, [\text{Cl}_2] = \frac{0.1}{0.5}, [\text{COCl}_2] = \frac{0.2}{0.5}$$

$$\therefore K_c = \frac{[\text{COCl}_2]}{[\text{CO}][\text{Cl}_2]} = \frac{\frac{0.2}{0.5}}{\frac{0.1}{0.5} \times \frac{0.1}{0.5}}$$

$$\Rightarrow K_c = \frac{2}{5} \times 25 = 10$$

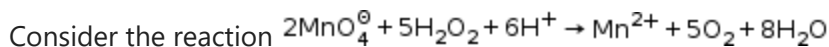
25

$1s^2, 2s^2p^6 \dots \dots ns^2p^6d^3, (n+1)s^2$ because last electron enters d-subshell.

26

K_p is constant and remains unchanged with pressure

27



28

Ionic reactions are very fast reactions means they take place instantaneously.

29

More is K_a , lesser is $\text{p}K_a$ ($\text{p}K_a = -\log K_a$) and therefore more the acidic strength.

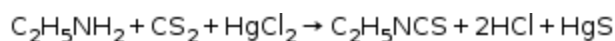
30

Interaction of the charges

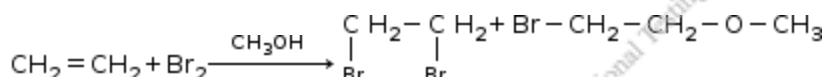
31

Because NaCl ionizes completely to yield free ions.

32



33



34

As number of shells increases, ionic radius will increase

35

Thio-alcohol is called as mercaptans.

36

We know one molecule of CO_2 have 22 electrons.

37

The degree of dissociation of weak electrolyte increases with increase in temp.

38

An ionizing solvent possess high value of dielectric constant. Higher the dielectric constant of a solvent, more of its ionizing power.

39

More than the theoretical weight

40

Protein + conc. $\text{HNO}_3 \rightarrow$ Yellow colour. This test is given by a protein which contains α -amino acids having a benzene ring such as tyrosine, phenylalanine etc. The yellow colour is because of nitration of benzene ring.

41

CCl_3CHO

42

Low ionization potential and high electron affinity.

43

For this reaction $\Delta n = 0$, thus $\Delta U = \Delta H$.

44

Here, $\text{NH}_2\text{COONH}_4 \rightleftharpoons 2\text{NH}_3 + \text{CO}_2$

$\alpha = \frac{D - d}{(n - 1) d}$, where D is the density (initial)

Now, $D = \frac{\text{mol. wt}}{2} = \frac{78}{2} = 39$

$n = \text{number of product} = 3$ $d = \text{final density}$

so degree of dissociation is,

$$\therefore \alpha = \frac{39 - 13}{(3 - 1) 13} = 1 \quad \alpha = 1$$

45

As AgNO_3 is an electrolyte.

46

4.184 Joule

47

Most probable radius = a_0/Z ,

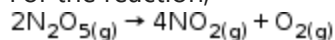
Given $a_0 = 52.9$ pm.

For helium ion, $Z = 2$,

$$\therefore r_{mp} = \frac{52.9}{2} = 26.45 \text{ pm.}$$

48

For the reaction,



\therefore Rate of reaction with respect to NO_2 is

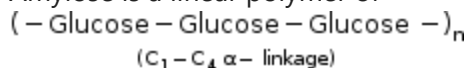
$$\begin{aligned} &= \frac{1}{4} \frac{d[\text{NO}_2]}{dt} \\ &= \frac{1}{4} \times \frac{5.2 \times 10^{-3}}{100} = 1.3 \times 10^{-5} \text{ ms}^{-1} \end{aligned}$$

49

Copper (Cu) is above of Ag in electrochemical series and hence $\text{Cu} + 2\text{Ag}^+ \rightarrow \text{Cu}^{2+} + 2\text{Ag}$ reaction takes place.

50

Amylose is a linear polymer of α -D-Glucose as below



Botany - Solutions

1

Gibberellins promotes germination of seeds by stimulating the production of certain hydrolytic enzymes and cytokinin delays senescence of leaves and other organs by mobilization of nutrients. 2, 4-D is synthetic growth regulator (auxin) which kills weeds growing in the fields and is used as weedicide. Ethylene helps in ripening of fruits. It is used to induce artificial ripening of unripe fruits which are transported in green or unripe condition.

2

After fertilization, the ovary is converted into fruit. Post fertilization changes in angiospermic plants involve endosperm formation, embryo development, seed formation and fruit formation. Zygote forms the embryo. Ovules at maturity or ripened ovules are called as seeds. Ripened ovary or fertilized ovary is called fruit.

3

Heavy metals and persistent pesticides like organochlorine or chlorinated hydrocarbons like DDT travel into food chain and increase in amount per unit weight of organisms with the rise in trophic level because of their accumulation in fat. As the tertiary consumer is the highest trophic level mentioned in the question so it will contain the maximum pollution. The phenomenon is known as biomagnification.

4

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) and it is known as vegetative fertilisation (or triple fusion).

5

Indole-3-acetic acid also known as auxin is a phytohormone which is generally produced by the growing apices of the stems and roots, from where they migrate to the regions of their action and it is observed that the growing apical bud inhibits the growth of the lateral (axillary) bud. (apical dominance). Since apical meristem is the site of auxin synthesis, it is the physiological effect of the auxin which results in the phenomenon of apical dominance. When shoot tips are removed it usually results in the growth of lateral buds. This is widely applied in tea plantation and hedge-making as in tea plantation and industries, the apical bud is plucked for tea processing which results in more lateral buds thus enhancing plantation and further industrial purposes.

6

The sieve tubes are syncytes and allow free diffusion of soluble organic substances. The callose plays an important role. Usually the perforations in the sieve plates are surrounded by callose. The callose is soluble and disappears when the solute is dilute in order that the solute can pass from one cell to another cell through the pores.

7

The phenomenon of expression of both the alleles in a heterozygous is termed as co-dominance. The alleles which do not show dominance-recessive relationship and are able to express themselves independently when present together are called codominant alleles. It results in the heterozygous condition has a phenotype different from either of homozygous genotypes, e.g., alleles for blood group A (I^A) and for blood group B (I^B) are codominant so that when they come together in an individual, they produce blood group AB.

8

In between two homologous chromosomes synapsis occurs. Synapsis is a close association between homologous chromosomes that develops during the crossing over first prophase i.e. zygotene stage of meiosis. The two chromosomes move together and a synaptonemal complex of proteins forms between them, ensuring exact pairing of corresponding points along their lengths as they lie side to side. The resulting structure is known as bivalent. After synapsis the cell enters into pachytene.

9

Gibberellins promote the stem elongation in "rosette" plants. Cabbage is a good example of such a plant in which leaf development is profuse, whereas intermodal growth is retarded. Just prior to the reproductive phase, the internodes elongate enormously causing a marked increase in stem height known as bolting. Bolting requires either long days or cold nights. If a cabbage head is kept under warm nights, it retains its rosette habit. Bolting in cabbage can be induced artificially by the application of gibberellins under conditions that would normally maintain the rosette form.

10

Some plants growing in salty marshes have some branches of tap root grow vertically upwards into the air from horizontally secondary roots, which are known as pneumatophores.

11

No of seeds = $n + n/4$

12

The C_4 plants are adapted to dry tropical regions and have greater productivity of biomass. They have special type of leaf anatomy called as kranz anatomy. In this type of anatomy the bundle sheath cells form several layers around the vascular bundles, they are characterized by having a large number of chloroplasts, thick walls impervious to gaseous exchange and no intercellular spaces.

13

As per chemiosmotic hypothesis energy released during movements of electrons through photosystems in photosynthesis is used to drive protons across the membrane against concentration gradient. As a result protons accumulate in thylakoid lumen or intrathylakoid space which further increases the proton gradient. This gradient is important due to the break down of the gradient provides enough energy to cause a conformational change in the F_1 particle of the ATPase, which makes enzyme to synthesise several molecules of energy -packed ATP.

14

In brown algae fucoxanthin is the chief pigment e.g. Fucus, Sargassum.

15

In cyclic photophosphorylation process only PS-I takes part and the electrons released from the reaction centre P_{700} returns to it after passing through series of carrier. It takes place in stromal lamellae of the chloroplast which lack PS II and NADP reductase enzyme. The excited electron does not pass on to $NADP^+$ but is cycled back to the PS I complex through electron transport chain. Therefore, through the cyclic flow only the synthesis of ATP takes place.

16

ATP molecules are synthesized with the help of energy liberated during oxidation of reduced co-enzymes ($NADH, FADH_2$) produced in respiration, known as oxidative phosphorylation and it takes place in mitochondria. The enzyme ATP synthase is required for this synthesis and ATP synthase is located in F_1 or head piece of $F_0 - F_1$ or elementary particles. The particles are present in the inner mitochondrial membrane.

17

Mycoplasma is irregular in shape and divides by simple binary fission.

18

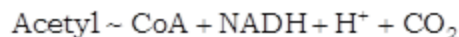
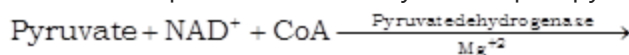
All of these

19

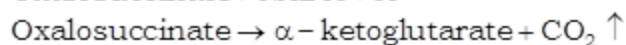
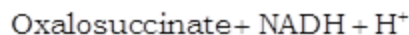
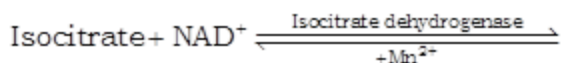
The term biodiversity was introduced by sociobiologist Edward Wilson (1992). Biological diversity is the occurrence of different types of ecosystems (ecological diversity), different species of organism with the whole range of their variants or biotypes (species diversity) and genetic variation in a species adapted to different climates (genetic diversity). Species diversity considers species of all the plants, animals and microorganisms. The maintenance of a high level of biodiversity is important for the stability of ecosystems.

20

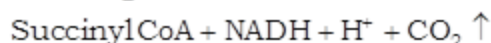
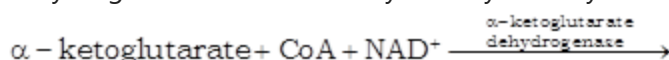
In the process of aerobic respiration in cells, pyruvate is the end product of glycolysis which enters mitochondria and undergoes oxidative decarboxylation to produce acetyl CoA, CO_2 and NADH in the presence of an enzyme complex pyruvate dehydrogenase.



In the formation of α -ketoglutarate, isocitrate undergoes oxidative decarboxylation in the presence of enzyme isocitrate dehydrogenase and Mn^{2+} . A transient oxalosuccinate is known as intermediate.



Another decarboxylation occurs in Krebs' cycle when α -ketoglutarate is both dehydrogenated and decarboxylated by an enzyme complex α -ketoglutarate dehydrogenase.



21

The genes for different characters are located on different chromosomes in *Pisum sativum*

22

Unicellular green algae by Calvin

23

Anatomy is the branch of Botany. It deals the study of internal structure of plants. N. Grew is the father of Anatomy (1682) and invent the term tissue and parenchyma.

24

Chlorophyll a and b pigments are found in chlorophyceae.

25

Double fertilisation refer to the 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) and is known as vegetative fertilisation (or triple fusion).

26

Uneven distribution of auxin resulted in phototropic curvature. Charles Darwin and his son Francis Darwin observed that the coleoptiles of canary grass responded to unilateral illumination by growing towards the light source (phototropism). After a series of experiments, it was concluded that the tip of coleoptile contain auxin that caused the bending of the entire coleoptile in relation to the direction of light.

27

Oxidative phosphorylation

28

The nucleus has entered S-phase of interphase

29

Rocks serve as a reservoir of phosphorus in the phosphorus cycle. The phosphorus cycle is a sedimentary nutrient cycle in which materials involved in circulation between biotic and abiotic components of the biosphere are non-gaseous. Phosphorus is mostly used as phosphate. Its reservoir pool is phosphate rocks and cycling pool is soil for terrestrial ecosystems and water for aquatic ecosystems. The atmospheric or gaseous cycle is absent. Phosphate circulates in the abiotic environment in the lithosphere as well as the hydrosphere.

30

Photosynthesis

31

Transport of the electrons from NADH over ETC helps in pushing three pairs of protons to the outer chamber while two pairs of protons are absorbed from the matrix during electron flow from FADH_2 (as the latter donates its electrons further down to the ETC). It results in a reduction in the concentration of H^+ ions in the matrix. Reduced H^+ concentration results in increased basicity of the matrix i.e. pH of the matrix is increased.

32

The rate of biomass production and the rate of production of organic matter during photosynthesis are known as productivity, gross primary productivity. The productivity of an ecosystem is the rate of biomass production, i.e., the amount of organic matter accumulated by any trophic level per unit area in unit time. Gross primary productivity is the total organic matter synthesised by the producers in the process of photosynthesis per unit time and area.

33

In *Antirrhinum majus* (snapdragon or dog flower), there are two types of flower colour in the pure state: red and white. When the two types of plants are crossed, the hybrid or plants of F_1 generation have pink flowers. If the latter are selfed, the plants of F_2 generation are of three types—red, pink and white flowered in the ratio of 1 : 2 : 1. This phenomenon is known as incomplete dominance.

34

Species diversity in general increases from poles to the equator. Conventional taxonomic methods are not equally suitable for higher plants and microorganisms. Microorganisms cannot be preserved easily and so cannot be classified easily. India has only 2.4% of the world's land area, its share of the global species diversity is an impressive 8.1 percent. Therefore, it makes our country one of the mega-diversity countries of the world. Nearly 45,000 species of plants and twice as many of animals have been recorded from India.

35

The complex formed by a pair of synapsed homologous chromosomes is known as a bivalent. In the zygotene stage, chromosomes start pairing together and this process of association is known as synapsis. Such paired chromosomes are called homologous chromosomes. Electron

micrographs of this stage indicate that chromosome synapsis is accompanied by the formation of a complex structure termed as synaptonemal complex. The complex formed by a pair of synapsed homologous chromosomes is called a bivalent or a tetrad and it has four chromatids and two centromeres.

36

Restriction endonuclease enzyme cuts the internal phosphodiester bonds of DNA and endonuclease act only on double stranded DNA.

37

Locomotory organelle

38

India has only 2.4% of the world's land area but 8.1% is its share of the global species diversity. The total number of species estimated is about 1.74 million. Out of these, the number of known species in India is 1,42,000 or roughly 8-8.1% of the total though India has only 2.4% land area. India with about 45000 species of plants and twice as many species of animals is one of the 12 megadiversity countries of the world.

39

When cell has stalled DNA replication fork, G_2 / M checkpoint should be predominantly activated.

If cell has stalled DNA replication fork, it indicates that it has crossed C_{G_1} or G_1 cyclin cell cycle check point and has entered S- phase of cell cycle, where it is preparing for chromosome replication. Later it will enter G_2 phase and will soon approach second check point called mitotic cyclin (CM) which lies between G_2 and M- phase).

40

Homozygous or pure refer to an organism that have two similar genes or alleles for a particular character in a homologous pair of chromosomes, e.g., TT or tt.

Heterozygous or hybrid organisms have two different alleles or individuals contain both dominant and recessive genes of an allelic pair, e.g., Tt.

The condition where only one gene or allele of allelic pair is present, is called hemizygous condition.

41

In oceans, producers are mainly phytoplanktons and a few larger algae. The number of consumers is enormous compared to that of producers. Producers evolve oxygen during photosynthesis and both producers and consumers evolve carbondioxide during respiration. Because of the large difference in number of consumers and producers, oxygen evolution cannot compensate carbondioxide evolution.

Therefore high amount of carbondioxide is released into environment from ocean ecosystem.

42

The figure shows a stage of mitotic cell division known as telophase stage. The individuals chromosomes are no longer seen and chromatin material tends to collect in a mass at the two poles and this is the stage which shows the following key events:

- Chromosomes cluster at opposite spindle poles and their identity is lost as discrete elements.
- Nuclear envelop assembles around the chromosome clusters.
- Nucleolus, Golgi complex and ER reform.

43

Chloroplast are absent in root hairs since root hairs do not develop food. These are meant for absorption of water and minerals from soil.

44

In F_1 generation, all the 20 plants would be heterozygous for the trait and so would possess yellow flower and round fruit. When heterozygous plants of F_1 generation undergo selfing, F_2 progeny gives 9 : 3 : 3 : 1 phenotypic ratio, where out of 16 plants 9 will have yellow flower with round fruit.

Therefore, in the given case, yellow flower with round fruit are
$$= 960 \times \frac{9}{16} = 540$$
.

45

Products of photosynthesis diffuse into the yellow zone

46

Snake plant (*Sansevieria trifasciata*) is a CAM plant. Crassulacean acid metabolism (CAM) is a process of photosynthesis which involves double fixation of CO_2 -initial PEP case fixation and final RuBisCO fixation of CO_2 , in the same cells but at different times, i.e., night and day. In CAM plants stomata remain closed during the daytime and open only at night.

47

Micrometers (μm)

48

The outer layer of a mature pollen grain is known as exine (which is made up of sporopollenin) and inner to it is intine (made up of pecto-cellulose) respectively. At certain places, exine remains thin and lacks sporopollenin and are called germ pores. During pollen germination, pollen tube come out through these pores.

49

The details of tricarboxylic acid path were worked out by Sir Hans Krebs' in the 1930s and also called as Krebs' cycle after its discoverer and citric acid cycle as the first product formed. The Krebs' cycle takes place in the matrix of mitochondria. In this cycle acetyl groups (2C) enter by combining with a 4C compound OAA (oxaloacetate) to form a 6C compound citrate. Two turns of Krebs' cycle takes place per glucose molecule and total output of ATP is 24 ATPs.

50

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1

If the ovum and sperms are transported simultaneously to ampullary -isthmic junction of the Fallopian tube, then only fertilisation in humans is practically feasible. The fusion of a haploid male gamete (sperm) and a haploid female gamete (ovum) to form a diploid zygote is known as fertilisation. In human beings, it takes place in the ampullary isthmic junction of the oviduct (Fallopian tube).

2

All given are an important muscle proteins that help in movement. Actin is a contractile protein found in muscle tissue, in which it occurs in the form of filaments known as thin filaments. Each filaments consists of two chains of globular actin molecules, around which is twisted a strand of tropomyosin and interspersed troponin. Units of muscle fibre consists of actin myosin filaments, which interact to bring about muscle contraction.

3

by immobilizing pathogen

4

Adrenaline and noradrenaline collectively known as catecholamines are two hormones secreted from adrenal medulla in response to stress and emergency. They directly and positively affect the SA node to increase rate of heart beat and strength of heart contraction. Hypersecretion of thyroxine (secreted from thyroid gland), potentiates the action of catecholamines leading to increased rate of heart beat.

Oxytocin (a hormone secreted from posterior lobe of pituitary gland) causes contraction of smooth muscles of uterus during parturition and expulsion of milk from mammary glands suckling and it has no effect on heart beat.

5

Ti plasmid (tumour inducing) from the soil bacterium *Agrobacterium tumefaciens* is effectively used as vector for transfer of gene to plant cells. The part of Ti plasmid transferred into plant cell DNA, is called 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.

6

AIDS is a viral disease caused by HIV (Human Immunodeficiency Virus). Such common means are:

- i) Infected blood transfusion
- ii) Sexual intercourse with an infected partner without a condom
- iii) From infected mother to child through placenta
- iv) Use of contaminated needles, razors and syringes
- v) Artificial insemination
- vi) Organ transplantation

7

Addison's disease is caused by the deficiency of mineralocorticoids and glucocorticoids and is also caused by the destruction of adrenal cortex in disease such as tuberculosis. Its symptoms include low blood sugar, low plasma Na^+ , high K^+ plasma, increased urinary Na^+ , nausea, vomiting, diarrhea and a bronze-like pigmentation of skin. Severe dehydration is also common in the person suffering from this disease.

8

Dialysis is basically used to provide an artificial replacement for lost kidney function in people with renal failure. There are two types; haemodialysis and peritoneal dialysis. Peritoneal dialysis uses a natural filter inside the body, i.e., peritoneal membrane to remove wastes and extra fluid from the body. The dialysis fluid fills the belly and pulls out extra minerals and fluids from the blood stream.

9

A-8th sternum, B-anal cercus, C-10th tergum, D-anal style

10

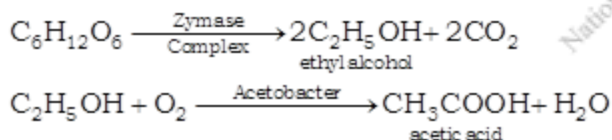
Unlimited resources result in exponential growth. In nature, a given habitat has limited resources to support only a certain number of individuals of a population, beyond this no further growth is possible. This limit is called as nature's carrying capacity (K) for that species in that habitat.

Therefore, a population growing in a natural habitat with limited resources shows initially a lag phase, followed by phases of increase and decrease and finally the population density reaches the carrying capacity. This type of growth results in sigmoid growth curve and is called logistic growth.

As resources for growth for most animal population become limiting sooner or later, the logistic growth model is more realistic. It is also known as S or sigmoid growth form.

11

Acetobacter microorganism is used for commercial production of acetic acid. Acetobacter aceti (acetic acid bacteria) are used for the manufacture of acetic acid from fermented alcohol. Alcoholic fermentation is anaerobic process, but the conversion of alcohol to acetic acid is aerobic one.



12

NA

13

Ti plasmid (tumour inducing) from the soil bacterium Agrobacterium tumefaciens is most widely used as vector for gene transfer to plant cells. The part of Ti plasmid transferred into plant cell DNA, is known as 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.

14

G.N. Ramchandran

15

Deamination is the removal of surplus protein or amino acid or removal of amino group from carboxyl group with the formation of ammonia and keto acid. Process deamination takes place in liver.

16

Autonomic nervous system

17

Emphysema is an inflation or abnormal distension of the bronchioles or alveolar sacs of the lungs. Many of the septa between the alveoli are destroyed and much of the elastic tissue of the lungs is replaced by connective tissue. As the alveolar septa collapse, the surface area for gas exchange is greatly reduced and there is loss of elasticity in the walls of bronchioles or alveolar sacs. As a result the alveolar sacs remain filled with air even after expiration and the exhalation becomes more difficult. The lungs remain inflated. Major causes of emphysema are cigarette smoking and the inhalation of smoke or other toxic substances over a period of time.

18

In a muscle portion of myofibril between two successive 'Z' lines is the functional unit of contraction. Each muscle fibre contains many myofibrils that have characteristic striations (stripes). A myofibril has dark and light bands in which the dark bands are also known as A-bands (anisotropic bands) and the light bands are also known as I-bands (isotropic bands). At the centre of A-band, a comparatively less dark zone called H-zone (Hensen zone) is present. At the centre of the H-zone is the M-line. Each I-band has at its centre a dark membrane called Z-line and it is also called Z-disc, or Krause's membrane or Krause's membrane or Dobie's line. The part of the myofibril between two successive Z-lines is called sarcomere which is the functional unit of myofibril. The sarcomere comprises A-band and half of each adjacent I-band. Each sarcomere is a bundle of thick and thin myofilaments. While muscle contraction, whereas thin myofilaments slide over thick myofilaments. The length of the sarcomere decreases during contraction, lengths of the thick and thin myofilaments do not change during contraction.

19

Calcium level decreases in the blood because of hyposecretion of parathyroid hormone. Parathyroid hormone is a peptide hormone secreted by the parathyroid gland in response to low levels of calcium in the blood and the hyposecretion of parathyroid hormone leads to decrease in the level of calcium in the blood.

20

Progestasert is an IUD which makes the uterus unsuitable and cervix hostile to the sperms as they are hormone releasing IUDs. Intra Uterine Devices (IUDs) are inserted in the uterus through vagina. Intra Uterine Devices are the most widely accepted method of contraception in India. These are presently available as the non- medicated IUDs (e.g., Lippes loop), copper releasing IUDs (CuT, Cu7, Multiload 375) and the hormone releasing IUDs (Progestasert, LNG-20). The hormone releasing IUDs make the uterus unsuitable for implantation and the cervix hostile to the sperms.

21

The first antibiotic Penicillin was discovered by Alexander Fleming in 1928. He observed that fungus *Penicillium notatum* or its extract could inhibit the growth of bacterium *Staphylococcus aureus*. Its full potential as an effective antibiotic was established much later by Ernst Chain and Howard Florey. This antibiotic was extensively used to treat American soldiers wounded in the World War II. Fleming, Chain and Florey were awarded the Nobel prize in 1945, for this discovery.

22

Urine formation comprises three main processes that are glomerular filtration, reabsorption and secretion, that takes place in different parts of the nephron. A comparison of the volume of the

filtrate formed per day (180 litres per day) with that of the urine released (1.5 litres), suggest that nearly 99 per cent of the filtrate is reabsorbed by the renal tubules and the descending limb of loop of Henle is permeable to water but almost impermeable to electrolytes. The ascending limb is impermeable to water but allows transport of electrolytes actively or passively. Conditional reabsorption of Na^+ and water takes place in distal convoluted tubule. It is also capable of reabsorption of HCO_3^- .

23

Bioreactors are large culture vessels. In bioreactor raw materials are biologically converted into specific products, using microbial, plant, animal or human cells or their enzymes. A bioreactor provides the optimal condition for achieving the desired product by providing optimum growth conditions i.e. temperature, pH , substrate, salts, vitamins, oxygen, etc. and helps in processing large volumes (100-1000 litres) of culture.

24

Spermatogenesis initiates the formation of four haploid spermatids from each spermatogonium (diploid). Spermatid is non-motile, become functional, motile male gamete, i.e., spermatozoan, it has to undergo spermiogenesis. It includes changes like distinguishing of centrioles into proximal and distal, spiral coiling of mitochondria, formation of axial filament by distal centriole and formation of acrosome from Golgi complex, etc.

25

Oparin and Fox

26

Homoiothermal organisms can maintain their internal body temperature at a relatively constant value by using metabolic processes to counteract fluctuations in the temperature of the environment, e.g., birds and mammals. The hypothalamus in their brain monitors blood temperature and controls thermoregulation by both nervous and hormonal means. This produces both short- term (shivering, seating) and long-term adjustments according to seasonal changes in climate and they have relatively high internal temperature which permits fast action of muscles and nerves and enables them to lead highly active lives.

27

Oral contraceptive pills comprises either progesterone only or a combination of progesterone and estrogen. Pills act in four ways:

- (1) Inhibition of ovulation.
- (2) Inhibition of motility and secretory activity of oviducts (Fallopian tubes).
- (3) Changes in cervical mucus impairing its ability to allow passage and transport of sperms.
- (4) Alternation in uterine endometrium to make it unsuitable for implantation.

28

In gene transfer process biolistic technique is used.

The payload is an elemental particle of a heavy metal such as gold or tungsten coated with plasmid DNA. The device is used to transform almost any type of cell including plants, and is not limited to genetic material of the nucleus : it can also transform organelles, including plastids.

29

B lymphocyte cells respond to antigens through production of antibodies. These pass to blood and other body fluids and thus, provide humoral immunity. (The term humor here is used in its ancient sense, referring to a body fluid). But T cells (lymphocytes) do not secrete antibodies but directly attach on the cells that carry the specific antigens. These cells are thus, described as producing cell-mediated immunity.

30

Vitamin may be fat soluble, e.g., vitamins A, D, E and K, or water soluble, e.g., vitamins B-complex, C and P. Water soluble vitamins dissolve easily in water and they are easily broken down and excreted by the body and are not stored for future use. Excess water soluble vitamins which are not stored by the body are generally excreted in urine. On the other hand, fat soluble vitamins dissolve in fat before they can be absorbed into the bloodstream. They are not normally excreted in urine. Niacin (vitamin B_3), ascorbic acid (vitamin C) and thiamine (vitamin B_1) are water soluble vitamins, and are excreted in urine. Cholecalciferol (vitamin D_3) is a fat soluble vitamin and so does not get excreted in urine.

31

SA node - pacemaker

32

Rhinitis is the inflammation and irritation of the mucous membrane inside the nose. It may be caused by virus infection (acute rhinitis) or an allergic reaction (allergic rhinitis). Common symptoms of rhinitis are stuffy nose, runny nose, and post-nasal drip. The most common type of rhinitis is allergic rhinitis, which is usually triggered by airborne such as pollen and dander. Allergic rhinitis may cause additional symptoms, such as sneezing and nasal itching, coughing, headache, fatigue, malaise, and cognitive impairment. The allergens may also affect the eyes, causing watery, reddened or itchy eyes and puffiness around the eyes.

33

Between breaths the intrapleural pressure is approximately 4 in mmHg less than atmospheric pressure. The intrapleural pressure is always below atmospheric pressure due to the connection between the two pleurae which is similar to two wet pieces of paper adhered to each other, the negative intrapleural pressure helps to expand the lungs during ventilation. If intrapleural pressure is equal to atmospheric pressure, the lungs would collapse.

34

Mucin is a glycoprotein of saliva.

35

In stratum lucidum keratohyaline granules are dissolved and transformed into eleiden. It makes cells semitransparent shiny and waterproof.

36

Carpometacarpal joint of human thumb is an example of saddle joint. It allows movement in two planes back and forth and side to side, but movements are free. It is biaxial joint.

37

In echolocation, animal which produces high frequency sounds is bat. Bats have a highly developed sonar or echoapparatus, a kind of radar. Their vocal cords produce ultrasonic sounds, inaudible to human ears. When striking objects, their reflected echos are caught by the highly sensitive ears, and utilized to avoid objects during flight.

38

A = 3, B = 1, C = 5, D = 2

39

A = Membrana granulosa

B = Theca interna

C = Ovum

D = Cumulus oophorus

E = Anturm

F = Theca externa

40

Lactational amenorrhoea (absence of menstruation) method is based on the fact that ovulation and therefore the cycle do not occur during the period of intense lactation following parturition. So, as long as the mother breast-feeds the child, chances of conception are almost nil. However, this method has been reported to be effective only upto a maximum period of six months following parturition. As no medicines or devices are used in these methods, side effects are almost nil.

41

Neisseria gonorrhoeae bacteria causes gonorrhoea. It spreads through sexual contact, common toilets and under-clothes. Both male and female genitals are affected by gonorrhoea. The bacterium lives in genital tubes, produces pus-containing discharge, pain around genitalia and burning sensation during urination. It damages the eyes of babies born of infected mothers.

42

Surfactant decreases the surfaces tension of the fluid lining the alveoli. Surfactant is a wetting agent and a complex mixture of compounds including lipids, protein, and carbohydrates that prevents the air sacs (alveoli) of the lungs from collapsing by reducing surface tension. It is secreted by pneumocytes in lungs. In its absence, as in the immature lungs of premature babies, respiratory distress syndrome will develop.

43

Alveoli of lungs (such as villi of intestine in mammals) provide a large surface for gaseous exchange.

44

Aldosterone hormone secreted by the outer layer of the adrenal gland (cortex part). Decreased blood volume and interstitial fluid level, results in decreased blood pressure, trigger aldosterone secretion. When aldosterone is present in the blood, reabsorption of Na^+ in the filtrate is increased by the epithelial cells of the collecting duct and retaining Na^+ , raises the osmotic pressure of the blood and reduces water loss from the body. When aldosterone is absent, some Na^+ remains in the filtrate and is excreted with the urine.

45

In human female the blastocyst gets implanted in endometrium by the trophoblast cells. Implantation in endometrial uterine wall takes place at blastocyst stage of embryonic development. Before implantation, the blastomeres of early blastocyst get arranged into an outer layer called trophoblast and an inner group of cells attached to trophoblast called inner

cell mass. It is the trophoblast layer through which blastocyst gets attached to the endometrium and the inner cell mass gets differentiated as the embryo.

46

Thigh is striated and voluntary is correct location and type. Cardiac muscles are found in the wall of the heart and it is involuntary and slightly striated. Smooth muscles are found in gastrointestinal tract. These are non-striated and involuntary. Striated (or skeletal) muscles are found in the limbs and body walls. These muscles are voluntary (under the control of animal's will) and show dark and light bands thus are striated.

47

'Roquefort cheese' is ripened by using fungus. Adding lactic acid bacteria (LAB) to milk, results in formation of curd, due to coagulation of milk proteins. This curd is further processed to form cheese. It can be classified on the basis of their texture or hardness and ripening. Roquefort cheese is a semisoft cheese. In this cheese, spores of fungus *Penicillium roqueforti* are added to the curd before final stages of cheese production.

48

Birth rate is the number of babies produced per thousand individuals while mortality is the death rate per thousand individuals.

49

Gonadotropin releasing hormone is released from hypothalamus which stimulates secretion of gonadotropins by anterior pituitary which are of two types, FSH and LH. FSH (follicle stimulating hormones) stimulates growth of ovarian follicles and secretion of estrogens in female and spermatogenesis in males. Whereas LH (luteinizing hormone) stimulates progesterone secretion from corpus luteum in females and androgen secretion from Leydig's cells in males.

50

4