INDIAN ASSOCIATION OF PHYSICS TEACHERS
NATIONAL STANDARD EXAMINATION IN JUNIOR SCIENCE (NSEJS) 2018 – 19
Question Paper Code: JS513
Held on: November 18, 2018

ANSWER KEYS

1.	**(*)**	2.	**b**	3.	**c**	4.	**c or d**
5.	**d**	6.	**c or d or (*)**	7.	**a**	8.	**d**
9.	**a**	10.	**b**	11.	**b**	12.	**a**
13.	**d**	14.	**a**	15.	**b**	16.	**c**
17.	**b**	18.	**c**	19.	**d**	20.	**(*)**
21.	**a**	22.	**a**	23.	**b**	24.	**d**
25.	**d**	26.	**d**	27.	**c**	28.	**a**
29.	**c**	30.	**a**	31.	**c**	32.	**b**
33.	**a**	34.	**c**	35.	**b**	36.	**d**
37.	**a**	38.	**b**	39.	**a**	40.	**b**
41.	**c**	42.	**d**	43.	**c**	44.	**a**
45.	**a**	46.	**b**	47.	**c**	48.	**a**
49.	**b**	50.	**b**	51.	**b**	52.	**b**
53.	**b**	54.	**c**	55.	**a**	56.	**b**
57.	**c**	58.	**b**	59.	**b**	60.	**b**
61.	**b**	62.	**a**	63.	**c**	64.	**c**
65.	**c**	66.	**b**	67.	**d**	68.	**a**
69.	**a**	70.	**a**	71.	**a**	72.	**d**
73.	**b**	74.	**b**	75.	**a**	76.	**c**
77.	**c**	78.	**d**	79.	**a**	80.	**c**

1. (*) Answer is b if numerator is considered as 2ab
6. (*) Possible answers are : 8, 10, 12 and 18.
20. (*) Correct answer is 11

1.

SOLUTIONS

1. The value of $\frac{\sqrt{a+x}-\sqrt{a-x}}{\sqrt{a+x}+\sqrt{a-x}}$, when $x=\frac{2a}{b^2+1}$ is:

(a) a (b) b (c) x (d) 0

1. (*) Answer is b if numerator is considered as 2ab

1. $\frac{\sqrt{a+x}-\sqrt{a-x}}{\sqrt{a+x}+\sqrt{a-x}}=k$

$\frac{k+1}{k-1}=\frac{2\sqrt{a+x}}{-2\sqrt{a-x}}$

$\left(\frac{k+1}{k-1}\right)^2=\frac{a+x}{a-x}$

$\frac{(k+1)^2+(k-1)^2}{(k+1)^2-(k-1)^2}=\frac{a+x+a-x}{a+x-a+x}=\frac{a}{x}$

$\frac{k^2+1}{2k}=\frac{a\left(b^2+1\right)}{2ab}$

$\frac{k^2+1}{2k}=\frac{b^2+1}{2b}$

$b\left(k^2+1\right)=k\left(b^2+1\right)$

$kb(k-b)-1(k-b)=0, k=\frac{1}{b}$ or b

2. Two regular polygons of different number of sides are taken. In one of them, its sides are coloured red and diagonals are coloured green; in the other, sides are coloured green and diagonals are coloured red. Suppose there are 103 red lines and 80 green lines. The total number of sides the two polygons together have is

(a) 23 (b) 28 (c) 33 (d) 38

2. b

2. First polygon has sides = m, and another = n

In first polygon number of diagonals $=\frac{m(m-3)}{2}$

In second polygon number of diagonal $=\frac{n(n-3)}{2}$

$m+\frac{n(n-3)}{2}=103 \Rightarrow 2m+n^2-3n=206$

$n+\frac{m(m-3)}{2}=80 \Rightarrow 2n+m^2-3m=160$

equation (i) – (ii)

$2(m-n)+n^2-m^2-3n+3m=46$

$n^2-m^2-5n+5m=46$

$(n-m)(n+m-5)=46$

Different possible case $1\times 46=46$

$2\times 23=46$

Considering, $n-m=2$

$n+m-5=23$

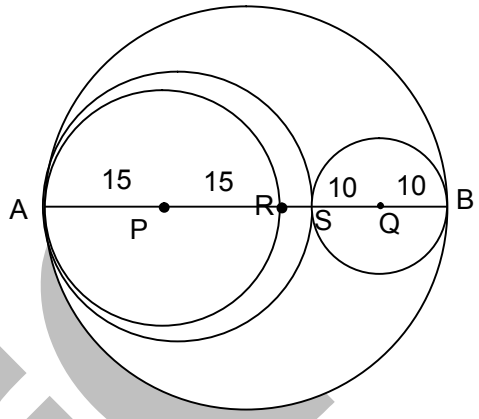
So, $n=15$ and $m=13$

$m+n=28$

3. Let AB be a diameter of a circle C_1 of radius 30 cm and with center O. Two circles C_2 and C_3 of radii 15 cm and 10 cm touch C_1 internally at A and B respectively. A fourth circle C_4 touches C_1, C_2 and C_3. What is the largest possible radius of C_4?
(a) 12 cm (b) 15 cm (c) 20 cm (d) 30 cm

3. c

3. AB = 60 cm
As is clear from the figure, RS = 10 cm
Therefore,
AS = 40 cm
So, the required radius is 20 cm



4. A person kept rolling a regular (six faced) die until one of the numbers appeared third time on the top. This happened in 12th throw and the sum of all the numbers in 12 throws was 46. Which number appeared least number of times?
(a) 6 (b) 4 (c) 2 (d) 1

4. c or d

4. There can be two cases:

	Thrice	Twice	Once
Case 1 →	6	5, 4, 3, 1	2
Case 2 →	5	6, 4, 3, 2	1

So, answer will be option C or option D

5. A 5 × 5 × 5 cube is built using unit cubes. How many different cuboids (that differ in at least one unit cube) can be formed using the same number of unit cubes?
(a) 1000 (b) 1728 (c) 2730 (d) 3375

5. d

5. Total number of cuboids $= \left({}^{6}C_{2}\right)^{3}$

$= 15^3 = 3375$

6. Let n be a positive integer not divisible by 6. Suppose n has 6 positive divisors. The number of positive divisors of 9n is
(a) 54 (b) 36 (c) 18 (d) 12

6. c or d or (*)

6. If n has 6 positive divisors then n can be of form $n = x^2y$ or $n = z^5$

Case 1:

$9n = 3^2x^2y$

If $x \neq 3$, $y \neq 3$, number of factors = 18
If $x \neq 3$, $x \neq 2$, $y = 3$, number of factors = 12
If $y \neq 3$, $y \neq 2$, $x = 3$, number of factors = 10
Case 2:

$9n = 3^2z^5$

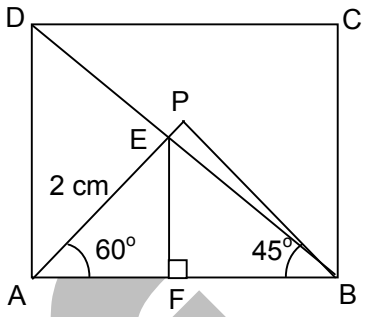
If $z \neq 3$, number of factors = 18
If $z = 3$, number of factors = 8

So possible answers are : 8, 10, 12 and 18.

7. In a square ABCD, a point P is inside the square such that ABP is an equilateral triangle. The segment AP cuts the diagonal BD in E. Suppose AE = 2. The area of ABCD is
(a) $4+2\sqrt{3}$ (b) $5+2\sqrt{3}$ (c) $4+4\sqrt{3}$ (d) $5+4\sqrt{3}$

7. a

7. In ΔEFA, AF = 1 and FB = EF = $\sqrt{3}$
Side of square $=\sqrt{3}+1$
area $=4+2\sqrt{3}$



8. What is the largest value of the positive integer k such that k divides $n^2(n^2-1)(n^2-n-2)$ for every natural number n?
(a) 6 (b) 12 (c) 24 (d) 48

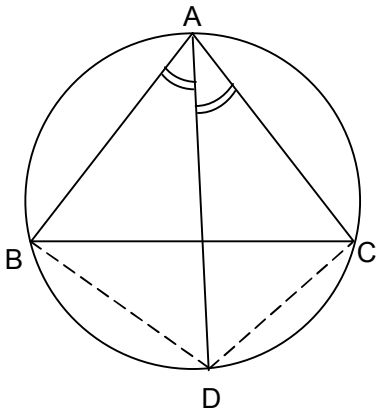
8. d

8. $n^2\left(n^2-1\right)\left(n^2-n-2\right)=n^2(n-1)(n+1)(n+1)(n-2)$
Since $(n-2)(n-1)n(n+1)$ is divisible by 4! and either n or $n+1$ is even.
So, $n^2\left(n^2-1\right)\left(n^2-n-2\right)$ is divisible by 48.

9. Let ABC be an equilateral triangle. The bisector of $\angle BAC$ meets the circumcircle of ABC in D. Suppose DB + DC = 4. The diameter of the circumcircle of ABC is
(a) 4 (b) $3\sqrt{3}$ (c) $2\sqrt{3}$ (d) 2

9. a

9. $DB+DC=4$
$\therefore DB=DC=2$ [DB and DC subtend equal angles]
$\angle BAD=30^\circ$
As ΔABC is equilateral, AD is the perpendicular bisector of BC.
$\therefore$ AD is the diameter.
In ΔABD,
$$AD=\frac{BD}{\sin 30^\circ}=\frac{2}{\frac{1}{2}}=4$$



10. A box contains some red and some yellow balls. If one red ball is removed, one seventh of the remaining balls would be red; if one yellow ball is removed, one-sixth of the remaining balls would be red. If n denotes the total number of balls in the box, then the sum of the digits of n is
(a) 6 (b) 7 (c) 8 (d) 9

10. b

10. Red balls = x, yellow balls = y
$\therefore n=x+y$
According to the question, $\frac{1}{7}(x+y-1)=x-1$
$\Rightarrow x+y-1=7x-7$
$\Rightarrow 6x-y-6=0$ (i)

and $\frac{1}{6}(x+y-1)=x$

$\Rightarrow x+y-1=6x$

$\Rightarrow 5x-y+1=0$ (ii)

equation (i) – (ii) $\Rightarrow x=7$

$\therefore y=36$

$\therefore n=x+y=43$

$\therefore$ Sum of digits of $n=7$

11. For a regular k-sided polygon, let $\alpha(k)$ denotes its interior angle. Suppose n > 4 is such that $\alpha(n-2)$, $\alpha(n)$, $\alpha(n+3)$ forms an arithmetic progression. The sum of digits of n is
(a) 2 (b) 3 (c) 4 (d) 5

11. b

11. $\alpha(k)=\frac{180(k-2)}{k}$

$\alpha(n-2)=\frac{180(n-4)}{n-2}$

$\alpha(n)=\frac{180(n-2)}{n}$

$\alpha(n+3)=\frac{180(n+1)}{n+3}$

According to the question

$\frac{180(n+1)}{n+3}+\frac{180(n-4)}{n-2}=2\left(\frac{180(n-2)}{n}\right)$

$\frac{n+1}{n+3}+\frac{n-4}{n-2}-\frac{2n-4}{n}=0$

$\Rightarrow n=12$

$\therefore$ Sum of digits of n = 3

12. If $\sin\theta$ and $\cos\theta$ are roots of the equation $px^2 + qx + r = 0$, then:
(a) $p^2 - q^2 + 2pr = 0$ (b) $(p+r)^2 = q^2 - r^2$
(c) $p^2 + q^2 - 2pr = 0$ (d) $(p-r)^2 = q^2 + r^2$

12. a

12. $\sin\theta+\cos\theta=\frac{-q}{p}$

$\sin\theta\cos\theta=\frac{r}{p}$

$\sin^2\theta+\cos^2\theta=1$

$(\sin\theta+\cos\theta)^2-2\sin\theta\cos\theta=1$

$\frac{q^2}{p^2}-\frac{2r}{p}=1$

$q^2-2pr=p^2$

$p^2-q^2+2pr=0$

13. The number of distinct integers in the collection $\left[\frac{10^2}{1}\right],\left[\frac{10^2}{2}\right],\left[\frac{10^2}{3}\right],.....,\left[\frac{10^2}{20}\right]$, where [x] denotes the largest integer not exceeding x, is
(a) 20 (b) 18
(c) 17 (d) 15

13. d

13. $\left[\frac{10^2}{1}\right]=100,\quad \left[\frac{10^2}{2}\right]=50,\quad \left[\frac{10^2}{3}\right]=33,\quad \left[\frac{10^2}{4}\right]=25,$

$\left[\frac{10^2}{5}\right]=20,\quad \left[\frac{10^2}{6}\right]=16,\quad \left[\frac{10^2}{7}\right]=14,\quad \left[\frac{10^2}{8}\right]=12,$

$\left[\frac{10^2}{9}\right]=11,\quad \left[\frac{10^2}{10}\right]=10,\quad \left[\frac{10^2}{11}\right]=9,\quad \left[\frac{10^2}{12}\right]=8,$

$\left[\frac{10^2}{13}\right]=\left[\frac{10^2}{14}\right]=7,\quad \left[\frac{10^2}{15}\right]=\left[\frac{10^2}{16}\right]=6,\quad \left[\frac{10^2}{17}\right]=\left[\frac{10^2}{18}\right]=\left[\frac{10^2}{19}\right]=\left[\frac{10^2}{20}\right]=5$

So, 15 distinct integers.

14. The integer closet to $\sqrt{111...1-222...2}$, where there are 2018 ones and 1009 twos, is

(a) $\frac{10^{1009}-1}{3}$ (b) $\frac{10^{1009}-1}{9}$

(c) $\frac{10^{2018}-1}{3}$ (d) $\frac{10^{2018}-1}{9}$

14. a

14. $x=\sqrt{\underbrace{(1111..11)}_{2018\text{ times}}-2\underbrace{(111.....111)}_{1009\text{ times}}}$

$$x=\sqrt{10^{1009}\times\underbrace{(1111....11)}_{1009\text{ times}}-\underbrace{(1111...111)}_{1009\text{ times}}}$$

$$=\sqrt{(10^{1009}-1)\underbrace{(111--111)}_{1009\text{ times}}}$$

$$=(10^{1009}-1)\times(10^{1008}+10^{1007}+.....+10+1)$$

$$=\sqrt{\frac{(10^{1009}-1)^2}{9}}=\frac{10^{1009}-1}{3}$$

15. Let ABCD be a rectangle. Let X and Y be points respectively on AB and CD such that AX : XB = 1: 2 = CY : YD. Join AY and CX; let BY intersect CX in K; let DX intersect AY in L. If m/n denotes the ratio of the area of XKYL to that of ABCD, then m + n equals

(a) 9 (b) 11 (c) 13 (d) 15

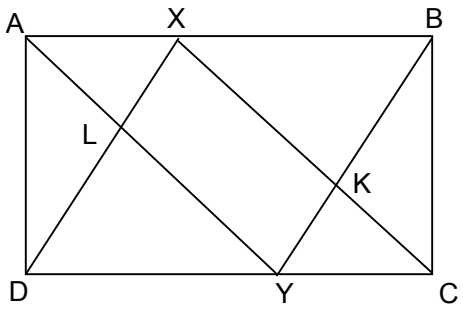
15. b

15. Let area of rectangle ABCD is 'a'

Then $ar(DXC)=\frac{a}{2}$

Now, $\Delta DLY \sim \Delta XLA$

$\Rightarrow \frac{AL}{LY}=\frac{XL}{LD}=\frac{1}{2}$



Now $ar(ADY)=\frac{a}{3}\Rightarrow ar(DLY)=\frac{2a}{9}$

Now $\frac{ar(ALX)}{ar(DLY)}=\frac{1}{4}\Rightarrow ar(ALX)=\frac{a}{18}$

Now,

$ar(XKYL)=\frac{a}{2}-\frac{2a}{9}-\frac{a}{18}=\frac{2a}{9}\Rightarrow\frac{m}{n}=\frac{2}{9}\Rightarrow m+n=11$

16. Let T_k denote the k-th term of an arithmetic progression. Suppose there are positive integers $m \neq n$ such that $T_m = 1/n$ and $T_n = 1/m$. Then T_{mn} equals

(a) $\frac{1}{mn}$ (b) $\frac{1}{m}+\frac{1}{n}$ (c) 1 (d) 0

16. c

16. Let first term be a and common difference be d

$a+(m-1)d=\frac{1}{n}$ …….(i)

$a+(n-1)d=\frac{1}{m}$ …….(ii)

Subtracting (ii) from (i), we get,

$(m-n)d=\frac{1}{n}-\frac{1}{m}$

$d=\frac{1}{mn}$

$a=\frac{1}{n}-(m-1)\frac{1}{mn}$

$=\frac{1}{n}-\frac{1}{n}+\frac{1}{mn}$

$=\frac{1}{mn}$

$\therefore T_{mn}=a+(mn-1)d$

$=\frac{1}{mn}+(mn-1)\frac{1}{mn}$

= 1

17. The sum of 5 numbers in geometric progression is 24. The sum of their reciprocals is 6. The product of the terms of the geometric progression is

(a) 36 (b) 32

(c) 24 (d) 18

17. b

17. Let the numbers be $\frac{a}{r^2}, \frac{a}{r}$, a, ar, ar^2

Sum $\Rightarrow \frac{a}{r^2}+\frac{a}{r}+a+ar+ar^2=24$

$a\left(\frac{1}{r^2}+\frac{1}{r}+1+r+r^2\right)=24$ ----------(i)

Sum of reciprocals $\Rightarrow \frac{r^2}{a}+\frac{r}{a}+\frac{1}{a}+\frac{1}{ar}+\frac{1}{ar^2}=6$

$\frac{1}{a}\left[r^2+r+1+\frac{1}{r}+\frac{1}{r^2}\right]=6$ ----------(ii)

Dividing (i) by (ii), we get

$a^2=4$

$a=2$

$\therefore$ Product of the terms $=a^5=2^5=32$

18. In a triangle ABC, let AD be the median from A; let E be a point on AD such that AE : ED = 1 : 2; and let BE extended meets AC in F. The ratio of AF/FC is

(a) 1/6 (b) 1/5 (c) 1/4 (d) 1/3

18. c

18. Construct $DX \parallel BF$

$\frac{AE}{ED} = \frac{1}{2}$

$\Rightarrow \frac{AF}{FX} = \frac{1}{2}$ ……(i)

[by Basic proportionality theorem]

In ΔCFB,

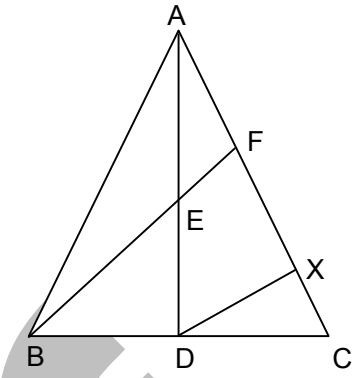
$\frac{BD}{DC} = \frac{1}{1}$

$\Rightarrow \frac{FX}{XC} = \frac{1}{1}$ [By basic proportionality theorem]

$\Rightarrow \frac{FX}{FC} = \frac{1}{2}$ ……(ii)

Multiplying (i) and (ii), we get,

$\frac{AF}{FC} = \frac{1}{2} \times \frac{1}{2} = \frac{1}{4}$



19. In a triangle ABC, a point D on AB is such that AD : AB=1 : 4 and DE is parallel to BC with E on AC. Let M and N be the mid points of DE and BC respectively. What is the ratio of the area of the quadrilateral BNMD to that of triangle ABC?

(a) 1/4 (b) 9/32

(c) 7/32 (d) 15/32

19. d

19. $\frac{AD}{AB} = \frac{1}{4}$

and $\Delta ADE \sim \Delta ABC$

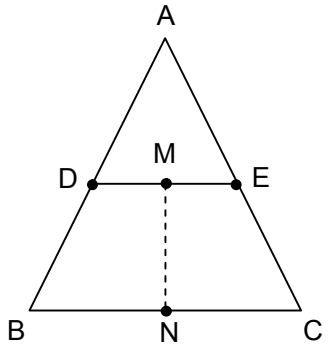
$\Rightarrow \frac{ar(\Delta ADE)}{ar(\Delta ABC)} = \frac{1}{16}$

Now, $\frac{ar(quad DECB)}{ar(\Delta ABC)} = \frac{15}{16}$ ……..(i)

Also, $\frac{ar(quad\ BNMD)}{ar(quad\ DECB)} = \frac{1}{2}$ ……..(ii)

Multiplying (i) and (ii), we get,

$\frac{ar(quad\ BNMD)}{ar(\Delta ABC)} = \frac{15}{32}$



20. Digit a and b are such that the product $\overline{4a1} \times \overline{25b}$ is divisible by 36 (in base 10). The number of ordered pairs (a, b) is

(a) 15 (b) 8

(c) 6 (d) 4

20. (*)

20. Factor pairs of 36 : (1, 36), (2, 18), (3, 12), (4, 9), (6, 6)

Out of this both numbers cannot be both even or both odd, as 4a1 is odd $\Rightarrow$ 25b is even.

So, we will consider (1, 36), (3, 12) and (4, 9)

Case : 1

$4a1 \rightarrow$ divisible by 9, $25b \rightarrow$ divisible by 4

$a \rightarrow 4$ $b \rightarrow 2, 6$

Case : 2

$4a1 \rightarrow$ divisible by 3, 25b divisible by 12

$a \rightarrow 1, 4, 7$ $b \rightarrow 2$

Case : 3
$4a1 \rightarrow$ divisibly by, 25b divisible by 36
$a \rightarrow 0,1,2,.....,9 \qquad b \rightarrow 2$

$\therefore$ Total Number of pairs are $= 2 + 3 + 10 = 15$ but some pairs are repeating.
So, the distinct pairs are (0,2), (1,2), (2,2), (3,2), (4,2), (5,2), (6,2), (7,2), (8,2), (9,2), (4,6)
Number of disctinct pairs = 11, which is not there in options.

21. A scientist observed few cells under a microscope with following characters:
(i) Cells divided by binary fission or fragmentation, or budding
(ii) Cells moved with the help of flagella
(iii) Ether lipids were observed in cell membranes
(iv) Peptidoglycans were noted in the cell walls
Which of the following category do the cells belong to?
(a) Archaea (b) Plant cells
(c) Unicellular eukaryotes (d) Cyanobacteria

21. a

21. All the mention characteristics belongs to Archaea bacteria.

22. True coelom is not present in animals of
(a) Platyhelminthes (b) Annelida
(c) Echinodermata (d) Arthropoda

22. a

22. True coelom is not present in animals of phylum Platyhelminthes.

23. The intracellular organelle that is responsible for formation of acrosomal vesicle is:
(a) Endoplasmic reticulum (b) Golgi apparatus
(c) Mitochondrion (d) None of the above

23. b

23. The intracellular organelle that is responsible for formation of acrosomal vesicle is Golgi apparatus.

24. Character(s) of acquired immunity is (are):
(a) differentiation between self and non-self (b) specificity of antigen
(c) retains memory (d) all of the above

24. d

24. Characters of acquired immunity are differentiation between self and non-self, specificity of antigen and retains memory.

25. Instead of using chemical fertilizers in a paddy field, a farmer thought of employing nitrogen fixation technique. Amongst the following which would be beneficial for his cause?
(a) Glycine max – Rhizobium (b) Cycas – Nostoc
(c) Casuarina – Frankia (d) Azolla – Anabaena

25. d

25. Azolla – Anabaena are beneficial for paddy field.

26. A geneticist was studying the pathway of synthesis of an amino acid 'X' in an organism. The presence (either synthesized *de novo* or externally added) of 'X' is a must for the survival of that organism. She isolated several mutants that required 'X' to grow. She tested whether each mutant would grow when different additives, P, Q, R, S and T were used. '+' indicates growth and '–' indicates the inability to grow in the mutants tested. Find out the correct sequence of additives in the biosynthetic pathway of 'X'.

Organisms	**Additives**				
	P	Q	R	S	T
Wild-type	+	+	+	+	+

Mutant 1	–	–	–	–	+
Mutant 2	–	+	+	+	+
Mutant 3	–	–	+	–	+
Mutant 4	–	+	+	–	+

(a) $P \rightarrow Q \rightarrow R \rightarrow S \rightarrow T$ (b) $P \rightarrow R \rightarrow S \rightarrow Q \rightarrow T$
(c) $T \rightarrow P \rightarrow Q \rightarrow S \rightarrow R$ (d) $P \rightarrow S \rightarrow Q \rightarrow R \rightarrow T$

26. d
26. The correct sequence of additives in the biosynthetic pathway of 'X' is
$P \rightarrow S \rightarrow Q \rightarrow R \rightarrow T$

27. What would be the length of a polypeptide translated from mRNA which is encoded by 2988 bp of a bacterial gene?
(a) 989 (b) 992
(c) 995 (d) 998

27. c
27. According to Genetic code, Codon is triplet.
Number of bp = 2988
Therefore, 2988/3 = 996
1 stop codon is present so 996 – 1 = 995. Hence, the length of polypeptide translated from mRNA is 995.

28. It was observed in a group of tadpoles of a mutant frog reared in a laboratory that their development was arrested at a particular stage. The exact tissue that was affected by the mutation is unknown. The development was then resumed and accelerated by injecting the tadpoles with the extracts prepared from various tissues of the wild type frogs. The observations of the experiment are given below:

Experiment No.	Tissue Extract	Observations
1	Anterior lobe of pituitary	Development resumed
2	Posterior lobe of pituitary	Development did not resume
3.	Thyroid gland	Development resumed
4.	Anterior lobe of pituitary + Thyroid gland	Development resumed
5.	Anterior + posterior lobe of pituitary	Development resumed
6.	Posterior lobe of pituitary + Thyroid gland	Development did not resume

From the above observations, find out the tissue that is affected by the mutation.
(a) Anterior lobe of pituitary (b) Posterior lobe of pituitary
(c) Thyroid gland (d) Both pituitary and thyroid gland

28. a
28. The exact tissue that was affected by mutation is Anterior Lobe of pituitary.

29. An action potential in the nerve fibre is produced when positive and negative charges on outside and inside of the axon membrane are reserved because:
(a) all potassium ions leave the axon
(b) more potassium ions enter the axon as compared to sodium ions leaving it
(c) more sodium ions enter the axon as compared to potassium ions leaving it
(d) all sodium ions enter the axon

29. c
29. An action potential in the nerve fibre is produced when positive and negative charges on outside and inside of the axon membrane are reversed because more sodium ions enter the axon as compared to potassium ions leaving it.

30. A patient was administered a chemical agent called Guanfacine hydrochloride after the patient showed the symptoms like shortness of breath and headache. Guanfacine hydrochloride is a known stimulant of central α_2 – adrenergic receptors of the medulla regulating the sympathetic nervous system. The patient in this case must be suffering from ___.

(a) Hypertension
(b) Hyperstimulation
(c) Hyperpolarization
(d) None of the above

30. a

30. This patient is suffering from hypertension.

31. In a case of mammalian coat color, the principal gene identified is 'C' which codes for a tyrosinase enzyme. In case of rabbits four different phenotypes are observed *Full Color* > *Chinchilla* > *Himalayan* > Albino (in order of the expression of gene 'C' and its alleles). In a progeny obtained after crossing two rabbits, the percentages of *Chinchilla, Himalayan* and *Albino* rabbits were 50, 25 and 25 respectively. What must have been the genotypes of the parent rabbits?

(a) $C^{ch}C^{ch}$ X $C^{ch}c$
(b) $C^{ch}C^{ch}$ X $C^{ch}c$
(c) $C^{ch}c$ X $C^{h}c$
(d) $C^{ch}C^{ch}$ X $C^{ch}C^{ch}$

31. c

31. The genotypes of coat colour in Rabbit

(a) Chinchilla $\rightarrow$ C^{ch}

(b) Himalayan $\rightarrow C^{h}$

(c) Albino $\rightarrow$ c

Therefore, if the percentage of Chinchilla is 50%, Himalayan is 25% and Albino is 25% then the genotypes of parent rabbit obtain from the below mention punnet square.

$C^{ch}c$ X $C^{h}c$

	C^{h}	c
C^{ch}	$C^{ch}C^{h}$	$C^{ch}c$
c	$C^{h}c$	cc

32.

Group A	Group B
Salmon	Alpine salamander
Bullfrog	Spiny anteater
Platyptus	Common toad
Bull shark	Crocodile

Identify the odd ones from each group (A and B) based on same criterion.

(a) Platypus, Alpine Salamander
(b) Bull shark, Alpine salamander
(c) Bullfrog, Crocodile
(d) Platypus, Common toad

32. b

32. Both Bull shark and Alpine salamander are viviparous.

33. A student recorded the data for five types of cells as given below:

Character	P	Q	R	S	T
Cell wall	+	+	–	–	+
Centrioles	–	–	–	+	-
Chloroplast	–	+	–	–	–
Mitochondrion	–	+	–	+	+
Nucleus	–	+	–	+	+
Plasma membrane	+	+	–	+	+
RNS / DNA	+	+	+	+	+
Vaculoes	+	+	–	+	+

The five cell types P, Q, R, S and T are:

(a) P – Bacterium, Q – Plant, R – Virus, S – Animal, T – Fungus

(b) P – Bacterium, Q – Plant, R – Virus, S – Fungus, T – Animal
(c) P – Fungus, Q – Plant, R – Bacterium, S – Animal, T – Virus
(d) P – Plant, Q – Bacterium, R – Virus, S – Animal, T – Fungus

33. a

33. The five cell types P, Q, R, S and T are
P – Bacterium, Q – Plant, R – Virus, S – Animal, T – Fungus

34. A bacterial dsDNA molecule, 2988 bp in length, was found to have the following composition.

	T	C	A	G
Strand I	348	X		1400
Strand II	650			Y

The respective values of X and Y are
(a) 1400 and 590 (b) 590 and 1400
(c) 590 and 590 (d) None of the above

34. c

34. Chargaff's Rule state that DNA helices contain equal molar ratios of A to T and C to G. This is because DNA found as double stranded helix in which A and T and G and C bases pair complementarily.

	T	C	A	G
Strand I	348	590 (X)	650	1400
Strand II	650	1400	348	590 (Y)

According to Chargaff's rule X and Y both are 590.

35. The genetically modified (GM) brinjal in India has been developed for:
(a) enhancing shelf life (b) insect-resistance
(c) drought-resistance (d) enhancing mineral content

35. b

35. The genetically modified (GM) brinjal in India has been developed for insect-resistance.

36. A bacterium has a generation time of 50 minutes. A culture containing 10^8 cells per mL is incubated for 300 minutes. What will be the number of cells after 300 minutes?
(a) 64×10^3 cells (b) 6.4×10^8 cells
(c) 64×10^9 cells (d) 6.4×10^9 cells

36. d

36. $N = \dfrac{\text{Total time for division}}{\text{Time taken for one division}}$

$\therefore \dfrac{300}{50} = 6$

$F = i \times 2^n$

F = Final number of bacteria
i = initial number of bacteria
n = number of generations

$F = 10^8 \times 2^6$

The number of cells after 300 minutes will be = 6.4×10^9

37. In an experiment, a scientist discovered a darkly stained chromatin body on the periphery of nucleus of epithelial cells obtained from an eight year old boy. This is indicative of a particular syndrome. Find out the best possible chromosome combination of their parents from the options given below; which have the highest probability of producing the child under investigation. 'A' indicates autosome. 'X' and 'Y' represent the sex chromosome.
(a) 22AA + XY, 22AA + XXX (b) 22AA + XXY, 22AA + XXX

(c) 22aa + XY, 22AA + XX (d) 22AA + XXY, 22AA + XX

37. a

37. Best possible combination of parent is
22AA + XY, 22AA + XXX

38. The blood grouping system is an example of 'multiple allelism'. In order to find out the gene products of various gene variants, different enzymes (codes used for the purpose of experimentation are X and Y) from four blood samples were assayed. The enzymes were quantified and the information obtained from theses experiments is given in percentages in the following table. '+' indicates presence of an enzyme and '–' indicates the absence of that enzyme from the blood sample. The standard codes for dominant and recessive alleles are considered. Identify the blood groups of subjects and choose the correct option of their genotypes from given options. (In table: P means present, A means absent)

Subjects→	Ramesh		Ali		Sophia		Balwinder	
Enzymes↓	P / A	%	P /A	%	P / A	%	P / A	%
X	+	50	+	50	+	100	–	–
Y	–	–	+	50	–	–	+	100

(a) I^Ai, ii, I^Bi, I^AI^B (b) I^Ai, I^AI^B, I^AI^A, I^BI^B

(c) I^Bi, I^AI^B, ii, I^Bi (d) I^Bi, ii, I^AI^B, I^Ai

38. b

38. The blood group of subjects are as follows:

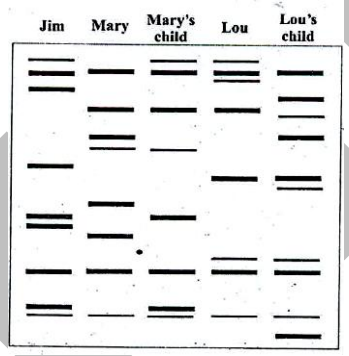
(a) Ramesh $\rightarrow I^Ai$

(b) Ali $\rightarrow I^AI^B$

(c) Sophia $\rightarrow I^AI^A$

(d) Balwinder $\rightarrow I^BI^B$

39



A millionaire Mr. Jim, died recently. Two women, Mary and Lou claiming to have a child by Jim approached the police demanding a share in his wealth. Fortunately Jim's semen sample was cryopreserved. The scientists used NDA fingerprinting technique to study the three highly variable chromosome regions. The results obtained that shown in the adjoining figure.

After studying the DNA profile, which of the alleged heirs are children of Jim?

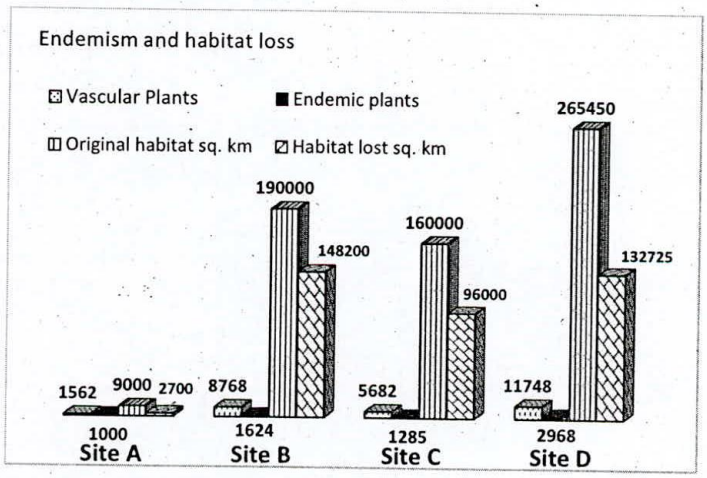
(a) Mary's child (b) both are children of Jim

(c) Lou's child (d) none are children of Jim

39. a

39. After studying the DNA profile, Mary's child considered as child of Jim.

40. An environment conservation group performed a survey of some diverse locations in the country and represented it as under:



Which amongst these sites should be included as a biodiversity hotspot?

(a) Site A (b) Site B

(c) Site C (d) Site D

40. b

40. Site B (as high number of endemics species) should be included as biodiversity hotspots.

41. A metal rod of length L at temperature T, when heated to temperature T', expands to new length L'. These quantities are related to $L' = L\left(1 + \alpha\left[T' - T\right]\right)$ where α is a constant for that material and called as coefficient of linear expansion. Correct SI unit at α is ___

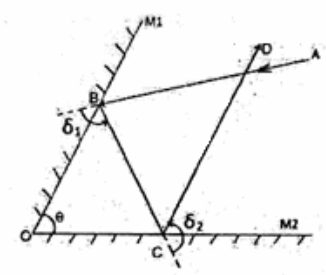
(a) $m - K^{-1}$ (b) m – K

(c) K^{-1} (d) α is a pure number

41. c

41. SI unit of α is K^{-1}.

42.



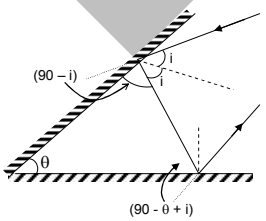
Two plane mirror M_1 or M_2 have their reflecting faces inclined at θ. Mirror M_1 receives a ray AB, reflects it at B and sends it a BC. It is now, reflected by mirror M_2 along CD, as shown in the figure. Total angular deviation δ suffered by the incident ray AB is:

(a) $\delta = 90^0 + 2\theta$ (b) $\delta = 180^0 + 2\theta$

(c) $\delta = 270^0 - 2\theta$ (d) $\delta = 360^0 - 2\theta$

42. d

42.



$\delta_1 = 2(90 - i) + 2(90 - \theta + i)$

$= 180 - 2i + 180 - 2\theta + 2i$

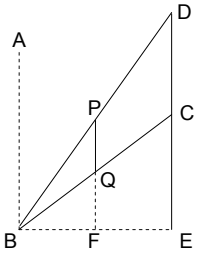
$= 360 - 2\theta$

43. 

In the adjacent figure, line AB is parallel to screen S. A linear obstacle PQ between the two is also parallel to both. AB,PQ and screen S are coplanar. A point source is carried from A to B, along the line AB. What will happen to the size of the shadow of PQ (cast due to the point source) on the screen S?

(a) It will first increase and then decrease
(b) It will first decrease and then increase
(c) It will be of the same size for any position of the point source on the line AB
(d) Umbra will increase and penumbra will decree till central position

43. c

43. 

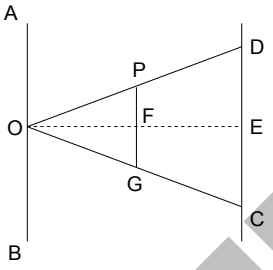
By similarity of ΔBFQ & ΔBFC

$$\frac{BF}{BE}=\frac{QF}{CE}$$

By similarity of ΔBDE & ΔBPF

$$\frac{BF}{BE}=\frac{PF}{DE}=\frac{PQ+QF}{DC+CE}=\frac{PQ}{DC}$$

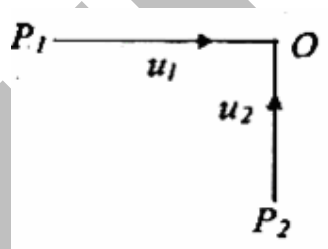
$$\therefore \quad \frac{\text{Distance between line AB \& obstacle}}{\text{Distance between AB \& screen}}=\frac{\text{Size of obstacle}}{\text{Size of shadow}}$$



By similarity of ΔODE & ΔOPF

$$\frac{OF}{OE}=\frac{PF}{DE}$$

$$\frac{\text{Distance between line AB \& obstacle}}{\text{Distance between AB \& screen}}=\frac{\frac{1}{2}\text{size of obstacle}}{\frac{1}{2}\text{size of shadow}}$$

44. 

Two particle P_1 and P_2 move towards origin O, along X and Y – axes at constant speeds u_1 and u_2 respectively as shown in the figure. At t = 0, the particles P_1 and P_2 are at distances a and b respectively from O. Then the instantaneous distance s between the two particles is given by the relation:

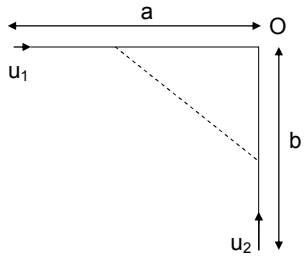
(a) $s=\left[a^2+b^2+\left(u_1^2+u_2^2\right)t^2-2t\left(au_1+bu_2\right)\right]^{1/2}$

(b) $s=\left[a^2+b^2+\left(u_1^2+u_2^2\right)t^2-2t\left(bu_1+au_2\right)\right]^{1/2}$

(c) $s=\left[a^2+b^2+\left(u_1^2+u_2^2\right)t^2+2t\left(au_1+bu_2\right)\right]^{1/2}$

(d) $s=\left[a^2-b^2+\left(u_1^2+u_2^2\right)t^2-2t\left(au_1+bu_2\right)\right]^{1/2}$

44. a

44. 

After time t positions of particles will become $(a - u_1t)$ & $(b - u_2t)$

Instantaneous distance = $\sqrt{(a-u_1t)^2+(b-u_2t)^2}$

$= [a^2 + b^2 + ((u_1^2+u_2^2)t^2 - 2(bu_2 + au_1)t]^{\frac{1}{2}}$

45. Two sound waves in air have wavelengths differing by 2 m at a certain temperature T. Their notes have musical interval 1.4, Period of the lower pitch note is 20 ms. Then, speed of sound in air at this temperature (T) is
(a) 350 m/s (b) 342 m/s
(c) 333 m/s (d) 330 m/s

45. a

45. Musical interval = $\frac{(\text{frequency})_1}{(\text{frequency})_2}$ $\left[f_2 = \frac{1}{20\times10^{-3}}\text{Hz} = 50\,\text{Hz}\right]$

$1.4 = \frac{f_1}{50} \quad \Rightarrow \quad f_1 = 1.4 \times 50$

Two wavelengths are (λ) & $(\lambda + 2)$

Speed will remain same $v = \lambda f$

$\Rightarrow \quad \lambda.\ (1.4 \times 50) = (\lambda + 2) \times 50$

$\Rightarrow \quad 70\lambda = 50\lambda + 100$

$20\lambda = 100$

$\lambda = 5m$

$v = 5 \times 1.4 \times 50 = 350$ m/s

46. Image is obtained on a screen by keeping an object at 25 cm and at 40 cm in front of a concave mirror. Image in the former case is four times bigger than in the latter. Focal length of the mirror must be ___
(a) 12 cm (b) 20 cm
(c) 24 cm (d) 36 cm

46. b

46. Say focal length of mirror = f

Object distances $u_1 = 25$; $u_2 = 40$

Using $m = \frac{f}{f-u}$

$\frac{m_1}{m_2} = 4 = \frac{f-u_2}{f-u_1}$

$3f = 4u_1 - u_2$

$= 100 - 40$; $f = 20$

47. An electric generator consumes some oil fuel and generates output of 25 kW. Calorific value (amount of heart released per unit mass) of oil fuel is 17200 kcal / kg and efficiency (output to input ratio) of the generator is 0.25. Then, mass of the fuel consumed per hour and electric generated per ton of fuel burnt are respectively.
(a) 0.5 kg, 20000 kWh (b) 0.5 kg, 5000 kWh
(c) 5 kg, 5000 kWh (d) 5 kg, 20000 kWh

47. c

47. Efficiency = $\frac{\text{Output}}{\text{Input}}$

$\text{Input} = \frac{25\,\text{kW}}{0.25} = 10^5$ J/s $= 3600 \times 10^5$ J/hour

17200×4184 J of heat is released on burning 1 kg

3600×10^5 J of heat is released on burning = $\frac{3600 \times 10^5}{17200 \times 4184}$ = 5 kg.

On burning 5 kg fuel energy generated = 25 kWh
On burning 10^3 kg fuel energy generated = 5000 kWh.

48. A paramedical staff nurse improvises a second's pendulum (time period 2 s) by fixing one end of a string of length L to a ceiling and the other end to a heavy object of negligible size. Within 60 oscillations of this pendulum, she finds that the pulse of a wounded soldier beats 110 times. A symptom of bradycardia is pulse < 60 per minute and that of tachycardia is > 100 per minute. Then the length of the string is nearly ___ and soldier has symptoms of ___

(a) 1 m, bradycardia (b) 4 m, bradycardia
(c) 1 m, tachycardia (d) 4 m, tachycardia

48. a

48. Time taken in 60 oscillations of second's Pendulum = 120 s = 2 min.
In 2 min pulse beats 110 times
So, pulse frequency = 55 per minute.

$T = 2\pi\sqrt{\frac{L}{g}}$; $L = \frac{T^2}{4\pi^2} \cdot g$ putting values

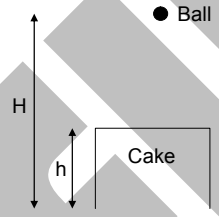
$L \cong 1$ m.

49. A tiny ball of mass m is initially at rest at height H above a cake of uniform thickness h. At some moment the particle falls freely, touches the cake surface and then penetrates in it at such a constant rate that its speed becomes zero on just reaching the ground (bottom of the cake). Speed of the ball at the instant it touches the cake surface and its retardation inside the cake are respectively.

(a) $\sqrt{2gh}$ and $g\left(\frac{H}{h}-1\right)$ (b) $\sqrt{2g(H-h)}$ and $g\left(\frac{H}{h}-1\right)$

(c) $\sqrt{2gh}$ and $g\left(\frac{h}{H}-1\right)$ (d) $\sqrt{2g(H-h)}$ and $g\left(\frac{h}{H}-1\right)$

49. b

49. 

Speed of ball as it touches cake
$v = \sqrt{2g(H-h)}$

Retardation $a = \frac{v^2}{2h} = 2g\left(\frac{H}{h}-1\right)$

50. A glass cube of refractive index 1.5 and edge 1 cm has a tiny black sport at its center. A circular dark sheet is to kept symmetrically on the top surface so that the central spot is not visible from the top. Minimum radius of the circular sheet should be

(Given: $\left(\frac{1}{\sqrt{2}} = 0.707, \frac{1}{\sqrt{3}} = 0.577, \frac{1}{\sqrt{5}} = 0.447\right)$

(a) 0.994 cm (b) 0.447 cm
(c) 0.553 cm (d) 0.577 cm

50. b

50. $R = \frac{h}{\sqrt{n^2-1}} = \frac{\frac{1}{2}}{\sqrt{(1.5)^2-1}}$

= 0.447

51. A block of wood floats on water with $\left(\frac{3}{8}\right)^{th}$ of its volume above water. It is now made to float on a salt solution of relative density 1.12. The fraction of its volume that remains above the salt solution now, is nearly ___

(a) 0.33 (b) 0.44
(c) 0.67 (d) 0.56

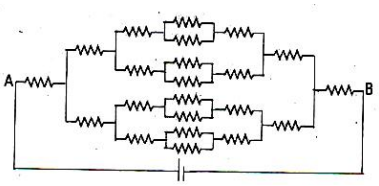
51. b

51. $\left(1-\frac{V_{out}}{V}\right)=\frac{\rho_{solid}}{\rho_{liq}}$

$\frac{5}{8}=\frac{\rho_b}{1} \Rightarrow \rho_b=\frac{5}{8}$

$\frac{V_{out}}{V}=1-\frac{\rho_b}{1.12}$

$= 1 - 0.56 = 0.44$

52. 

Each resistance in the adjacent circuit is R Ω. In order to have an integral value for equivalent resistance between A & B, the minimum value of R must be::

(a) 4 Ω (b) 8 Ω
(c) 16 Ω (d) 29 Ω

52. b

52. Req. of ckt = $\frac{29R}{8}\Omega$

For Req. to be integer R = 8Ω.

53. Suppose our scientific community had chosen force, speed and time as the fundamental mechanical quantities instead of length, mass and time respectively and they chose the respective units of magnitudes 10 N, 100 m/s and $\frac{1}{100}$ s. Then the unit of mass in their system is equivalent to ___ in our system.

(a) 10^3 kg (b) 10^{-3} kg
(c) 10 kg (d) 10^{-1} kg

53. b

53. $m=\frac{F\times t}{v} \Rightarrow 1kg = \frac{1N\times 1s}{1m/s}$

In new system

$m=\frac{10N\times\frac{1}{100}s}{100\,m/s}=10^{-3}\frac{N\times s}{m/s}$ = 10^{-3} kg

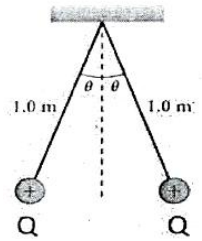
54. Three objects of the same material coloured white, blue and black can withstand temperatures up to 2000° C. All these are heated to 1500° C and viewed in dark. Which option is correct?

(a) White object will appear brightest
(b) Blue object will appear brightest
(c) Black object will appear brightest
(d) Being at the same temperature, all will look equally bright

54. c

54. Good absorber is good emitter.

55.

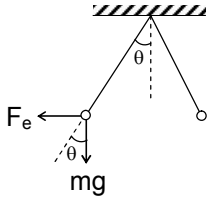


Two equally charged identical pith balls are suspended by identical massless strings as shown in the adjacent figure. If this set up is on Mercury (g = 3.7 m/s^2), Earth (g = 9.8 m/s^2) and Jupiter (g = 24.5 m/s^2), then angle 2θ will be _____

(a) maximum on Mercury
(b) maximum on Earth, as it has atmosphere
(c) Maximum on Jupiter
(d) the same on any planet as Coulomb force is in independent of gravity

55. a

55.



$$\tan\theta = \frac{F_e}{mg}$$

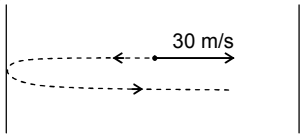
56. A car running with a velocity of 30 m/s reaches midway between two vertical parallel walls separated by 360 m, when the driver sounds the horn for a moment. Speed of sound in air is 330 m/s. After blowing horn, the first three echoes will be heard by the driver respectively at
(a) 1.2 s, 2.4 s, 3.0 s (b) 1.0 s, 2.4 s, 3.0 s
(c) 1.0 s, 2.0 s, 3.0 s (d)1.2 s, 2.4 s, 3.6 s

56. b

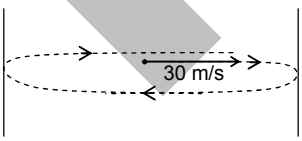
56.

Sound reflected from first wall
Say 1st echo is heard after time t_1
$30t_1 + 330t_1 = 360$
$t_1 = 1$ sec.

Sound reflected from second wall
Say sound reaches from second wall after time t_2
$330 \times t_2 = 360 + 30 \times t_2$
$\Rightarrow \quad t_2 = 1.2$ sec



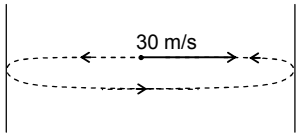
First wave when reflected from second wall will reach observer after time t_4.



$$330\,t_4 = 720 + 30\,t_4$$

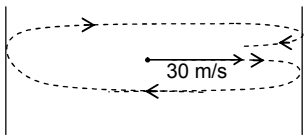
$$t_4 = 2.4 \text{ sec}$$

Second sound wave reaches after reflection in time t_3
$330 \times t_3 + 30 \times t_3 = 720$
$360\ t_3 = 720$
$t_3 = 2$s



The third echo will be heard when this ray will strike to the first wall again and come back to the observer in time t_5.

The time is less than time of persistence of sound. So, they will not produce echo.



$330t_5 + 30t_5 = 1080$

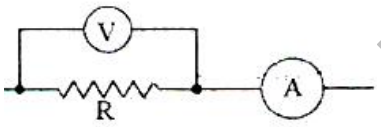
$t_5 = 3$ sec

57. A beaker is completely filled with water at 4^0 C. Consider the following statements:
(I) Water will overflow if the beaker is cooled for some time.
(II) Water will overflow if the beaker is heated for some time.

Select correct option regarding (I) and (II).
(a) Only (I) is correct
(b) Only (II) is correct
(c) Both (I) and (II) are correct
(d) Neither (I) nor (II) is correct

57. c

57. Water has maximum density at 4°C.

58. 

Refer the adjacent circuit. The voltmeter reads 117 V and ammeter reads 0.13 A. If the resistance of voltmeter and ammeter are $9k\Omega$ and 0.015Ω respectively, the value of R is _____

(a) 500Ω
(b) $1k\Omega$
(c) $1.5k\Omega$
(d) $2k\Omega$

58. b

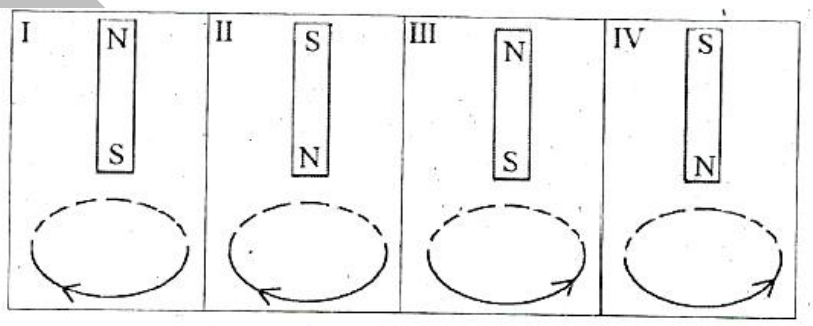
58. V = 117 V ; I = 0.13 A

$$Req = \frac{117}{0.13} = 900 = \frac{R \times R_V}{R + R_V}$$

$R_V = 9 \times 10^3\ \Omega$ using the value

$R = 10^3\ \Omega$.

59. A bar magnet is allowed to fall freely from the same height towards a current carrying loop along its axis, as shown in the four situations I to IV. Arrows show direction of conventional current. Choose the situations in which the potential energy of the magnet coil interaction is maximum_____.



(a) I, III
(b) I, IV
(c) II, IV
(d) II, III

59. b

59. In 1st and 4th case system is experiencing repulsion hence potential energy is maximum.

60. Choose correct option from the following statements from electrostatics:
(I) If two copper spheres of same radii, one hollow and the other solid are charged to the same electrical potential, the solid sphere will have more charges
(II) A charged body can attract another uncharged body.
(III) Electrical lines of force originating from like charges will exert a lateral force on each other, while those originating from opposite charges can intersect each other.
(a) Only (I) is correct (b) Only (II) is correct
(c) Only (I) and (II) are correct (d) All (I), (II) and (III) are correct

60. b

60. (i) Both spheres will have same charge.
(ii) is true
(iii) Electric line of force never intersect.

61. A substance is dissolved in water, forming a 0.5 molar solution. If 4.0 L of solution contains 240 g of the substance, what is the molecular mass of the substance?
(a) 60 g/mole (b) 120 g/mole
(c) 240 g/mole (d) 480 g/mole

61. b

61. $\text{Molarity} = \dfrac{\text{Mass}}{\text{Molar mass} \times \text{Volume}(\text{L})}$

$0.5 = \dfrac{240}{M \times 4}$

M = 120 g/Mole

62. Element "X" with atomic mass 10 was allowed to react completely with element "Y" of atomic mass 20 to form a compound. When this compound was analysed it was found that it contains 60% of X and 40% of Y by weight. The simplest formula of this compound will be _____.
(a) X_3Y (b) X_2Y_3
(c) Y_3X (d) X_6Y_4

62. a

62. $X = \dfrac{60}{10} = 6 \qquad Y = \dfrac{40}{20} = 2$

X_6Y_2 or X_3Y

63. A car battery was kept for charging and after getting fully charged density of the battery acid (H_2SO_4) was measured and found to be 1.28 g cm^3. If initial molarity of battry acid was 4.2 M then mass percentage will be around _____.
(a) 28% (b) 30%
(c) 32% (d) 34%

63. c

63. $\text{Molarity} = \dfrac{x \times \text{density} \times 10}{\text{Molecular mass of solute}}$

$4.2 = \dfrac{x \times 1.28 \times 10}{98}$

X = 32.15% $\simeq$ 32%

64. 4.095 X 10^{24} nitrogen atoms are filled in an enclosed gas cylinder of capacity two litre. The number of moles of nitrogen gas in the cylinder is _____
(a) 14.7 (b) 6.8
(c) 3.4 (d) 2.9

64. c

64. Given no. of nitrogen atoms = 4.095×10^{24}

No. of nitrogen molecules = $\frac{4.095 \times 10^{24}}{2}$

No. of moles of nitrogen gas in the cylinder = $\frac{4.095 \times 10^{24}}{2 \times 6.022 \times 10^{23}} = 3.4\,\text{moles}$

65. Deepa was studying properties of gases. She took a flask and filled it with sulphur dioxide gas, and weighed it at temperature T and pressure P. The weight of the flask containing the gas was found to be W_1. She then flushed the flask, cleaned and filled it with methane at the same temperature and pressure. The weight of the flask containing oxygen was found to be W_2. She repeated the process with oxygen under the same conditions and found to be W_3. The ratio of the weight $W_1 : W_2 : W_3$ is

(a) 2 : 1 : 4 (b) 4 : 2 : 1
(c) 4 : 1 : 2 (d) 1 : 2 : 4

65. c

65. Number of moles of sulphur dioxide gas = $\frac{W_1}{64}$

Number of moles of methane gas = $\frac{W_2}{16}$

Number of moles of oxygen gas = $\frac{W_3}{32}$

According to Avogadro hypothesis, Equal volumes of all gases under similar conditions of temperature and pressure contains equal no. of molecules and hence equal number of moles.

$$\frac{W_1}{W_2} = \frac{64}{16} = \frac{4}{1}$$

$$\frac{W_2}{W_3} = \frac{16}{32} = \frac{1}{2}$$

$\therefore$ Ratio of weights $W_1 : W_2 : W_3$ is 4 : 1: 2

66. Four gas jars filled with sulphur dioxide gas were inverted into troughs of water by four students P, Q, R, S. The following observations and inference were reported by them.

P : Water did not enter the gas jar and sulphur dioxide is soluble in water.
Q : Water rushed into the gas jar and sulphur dioxide is soluble in water.
R : Water did not enter in the gas jar and sulphur dioxide is insoluble in water
S : A small amount of water entered the gas jar slowly and sulphur dioxide is sparingly soluble in water.
Then the correct set of observations and inference is reported by,

(a) P (b) Q
(c) R (d) S

66. b

66. Correct set of observations is Q
i.e. water rushed into the gas jar and sulphur dioxide is soluble in water.

67. P^{3-} has a larger radius than atom of P because
(a) There is greater coulombic attraction between the nucleus and electrons in the P^{3-} ion.
(b) The core electrons in P^{3-} exert a weaker shielding force than those of a neutral atom
(c) The nuclear charge is weaker in P^{3-} than it is in P
(d) The electrons in P^{3-} have a greater coulombic repulsion than those in P atom.

67. d

67. The electron in P^{3-} have a greater columbic repulsion than those in P-atom. This is the reason that P^{3-} has a larger radius than that of its parent atom.

68. Electrons in the last shell of X, Y, W and Z are 2, 6, 4 and 1 respectively. Which of the following statement is correct?
(a) melting point of compound formed by X and Y is more than that of by W and Z.
(b) compound formed by X and Y is more volatile that that of by W and Z.
(c) melting point of compound formed by X and Z is more than that of by W and Y.
(d) incomplete information so inference cannot be drawn.

68. a

68. Melting point of compound formed by X and Y is more than that of by W and Z.

69. W g of pure coal was combusted in pure dry oxygen. The carbon dioxide gas obtained was absorbed in 0.1 M KOH solution. The complete absorption of CO_2 required 5 cm^3 of 0.1 M KOH. The amount of coal combusted is
(a) 3 mg (b) 6 mg (c) 11 mg (d) 12 mg

69. a

69. $C + O_2 \longrightarrow CO_2$

$CO_2 + 2KOH \longrightarrow K_2CO_3 + H_2O$

2 moles of KOH give 1 mole of CO_2

So, 0.0005 moles of KOH will give 0.00025 moles of CO_2 i.e. Mass of carbon = 0.00025×12 = 0.003 g

$\therefore$ Amount of coal combusted is 3 mg

70. Sonu has N/2 HCl solution and Monu has N/10 HCl solution. They are asked to prepare 2 litres of N/5 HCl solution. What volume of two solutions be mixed?
(a) (0.5 + 1.5) litre (b) (1.0 + 1.0) litre (c) (0.3 + 1.7) litre (d) (0.2 + 1.8) litre

70. a

70. Let volume of Sonu HCl solution be x L

So, volume of Monu HCl solution be (2 - x)L

$\therefore M_1V_1 + M_2V_2 = M_RX$(Total volume)

$$\frac{1}{2} \times x + \frac{1}{10}(2 - x) = \frac{1}{5} \times 2$$

x = 0.5

Volume of two solutions mixed will be (0.5 + 1.5) litre

71. A strip of iron with mass 15.5 g is placed in a solution containing 21.0 g copper sulphate. After some time the reaction stops. Iron strip was found to have mass 8.5 g. The mass of copper formed was found to be 8.60 g. Find the mass of ferrous sulphate formed in this reaction.
(a) 19.40 g (b) 18.40 g (c) 17.40 g (d) 16.40 g

71. a

71. $Fe + CuSO_4 \longrightarrow FeSO_4 + Cu$

Given: 15.5 g 21.0 g 8.60 g

Unreacted mass of iron = 8.5 g

Mass of ferrous sulphate formed in this reaction = 19.4 g

72. When a surface tension experiment with capillary tube is performed, water rises up to 0.1m. If the experiment is carried out in space, water will rise in capillary tube _____.
(a) up to height of 0.1m (b) up to height of 0.2 m
(c) up to height of 0.8 m (d) along its full length

72. d

72. Height of capillary rise liquid is given by

$$h = \frac{2T}{\rho rg}$$

(T = surface tension, r = radius of capillary tube, ρ = density, g = acceleration due to gravity)

When surface tension experiment with capillary tube is performed, water rises up to 0.1 m. if the experiment is carried out in space, water will rise in capillary tube along its full length. As

when experiment is carried out in space, acceleration due to gravity (g) will be negligibly small.

73. A solution of pure aluminimum sulphate containing 0.170 g of aluminimum ions is treated with excess of barium hydroxide solution. Total weight of the precipitate will be:
(a) 0.5 g (b) 2.7 g
(c) 1.7 g (d) 0.54 g

73. b

73. $Al_2(SO_4)_3 + 3Ba(OH)_2 \longrightarrow 3BaSO_4(\downarrow) + 2Al(OH)_3$
Limiting reagent is $Al_2(SO_4)_3$
No. of moles of aluminium ions in 0.170 g = 0.00314
Weight of Barium sulphate (precipitate) = $233 \times 3 \times 0.00314 = 2.1948$ g
Weight of Aluminium hydroxide (precipitate) = $78 \times 2 \times 0.00314 = 0.4898$ g
Total weight of precipitate = 2.68 ~ 2.7 g

74. A region of one square meter area was given to each Suhas, Bobby, Sandy and Kimi in a garden. The daffodil plants grow best in the soil having a pH range of 6.0 to 6.5. If the soil has a pH 4.5, to grow daffodils, Suhas added common salt, Bobby added sodium phosphate, Sandy added aluminium sulphate and Kimi added ammonium chloride in their allotted area. Who was successful in growing daffodil?
(a) Suhas (b) Bobby
(c) Sandy (d) Kimi

74. b

74. Bobby was successful in growing daffodil since sodium phosphate is a basic salt.

75. Sulphur di-oxide gas and ammonia gas were mixed in different proportions. The pair of gases containing same number of molecules at NTP is _____ .
(a) 1120 cm^3 of SO_2 + 0.85 g of ammonia (b) 0.25 g mole of SO_2 + 2240 cm^3 of ammonia
(c) 1680 cm^3 of SO_2 + 1.7 g of ammonia (d) 0.25 g mole of SO_2 + 0.85 g of ammonia

75. a

75. Number of SO_2 = No. of moles $\times N_A$
$= \frac{1120}{22400} \times N_A = 0.05 N_A$
Also, number of moles of ammonia(NH_3) = no. of moles $\times N_A = \frac{0.85}{17} \times N_A = 0.05\ N_A$

76. A solution (P) was prepared by dissolving 6.3 g of oxalic acid in 100 ml water. 25 ml of this solution was taken and was further diluted to 250 ml to prepare solution (Q). What weight of NaOH in ppm will be required to neutralize 10 ml of solution (Q)?
(a) 10 ppm (b) 20 ppm (c) 40 ppm (d) 80 ppm

76. c

76. 40 ppm if mass of oxalic acid is considered as 6.3 mg
$M = \frac{6.3 \times 10^{-3}}{126 \times 0.1} = 0.0005$
Since 25 mL of this solution was taken and was further diluted to 250 mL to prepare solution(Q).
$M_1V_1 = M_2V_2$
$0.0005 \times 25 = M_2 \times 250$
$M_2 = 0.00005$
Now, according to reaction
We, know, 2 moles of NaOH will be neutralized by 1 mole of oxalic acid.
$\therefore$ No. of moles of NaOH required to neutralize 10 mL of solution Q = 0.00001
Weight of NaOH(in g) = $0.00001 \times 40 = 0.0004$ g
Weight of NaOH in ppm = 40 ppm

77. Which of the following is incorrect?
(a) Chalcocite – Copper (b) Magnetite – Iron
(c) Calamine – Aluminium (d) Galena – Lead

77. c

77. Calamine($ZnCO_3$) is an ore of zinc

78. Which of the following can improve the quality of petrol?
(a) n heptane (b) benzene (c) n hexadecane (d) iso-octane

78. d

78. Iso-octane can improve the quality of petrol.

79. $2KBrO_3 + 12H^+ + 10e^- \longrightarrow Br_2 + 6H_2O + 2K^+$
From above reaction the equivalent weight of $KBrO_3$ can be calculated as (M is molecular weight of $KBrO_3$)
(a) M/5 (b) M/10 (c) M/12 (d) M/2

79. a

79. Equivalent weight of $KBrO_3$ = $\frac{\text{Molecular mass}}{\text{n}-\text{factor}} = \frac{M}{5}$

80. Shaila took about 10 cm^3 of a diluted Potassium hydrogen carbonate solution in a test tube. To this solution she added few drops of universal indicator. The colour of the solution turned:
(a) orange (b) green (c) blue (d) yellow

80. c

80. Colour of the solution turned blue