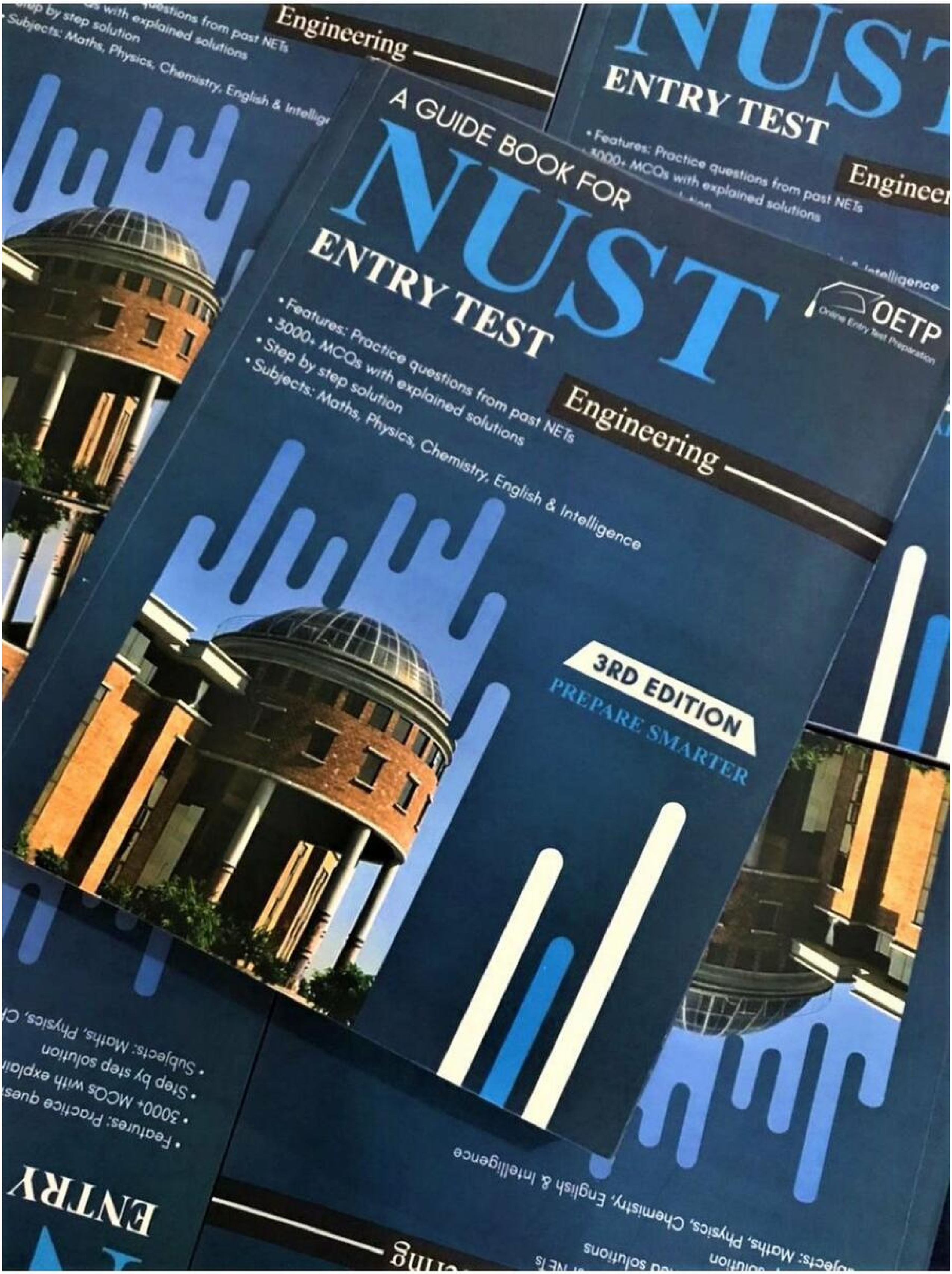

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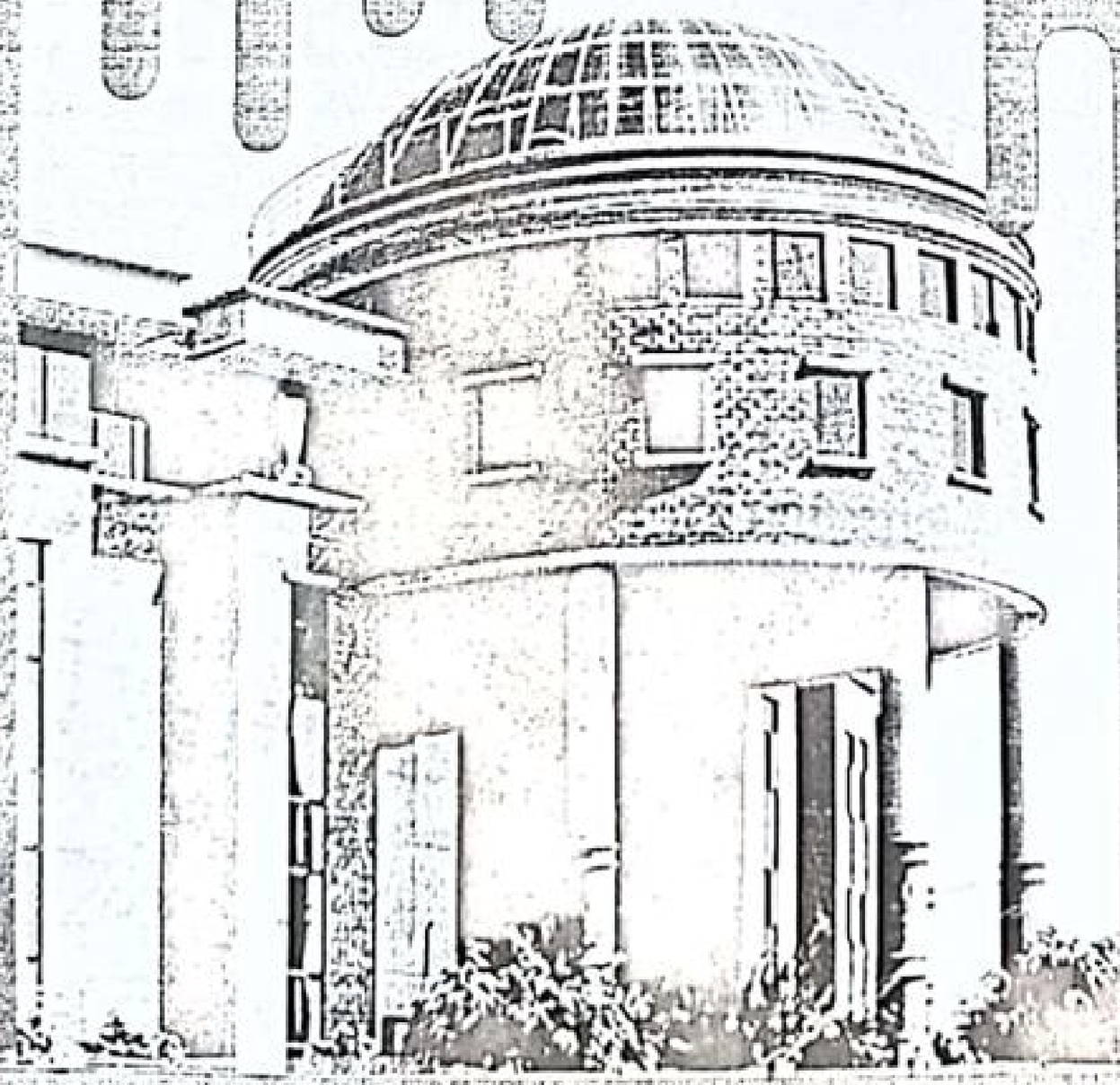

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About OETP and its Team

OETP (Online Entry Test Preparation) started in 2015 with an aim to help the students to prepare for the Entry Tests in a more effective, reliable, and economical way. We offer a wide range of services like Online Entry Test Preparation Sessions, Solved Past Papers, Mock Exams, Vocabulary lists, Guides, Videos, Tips and Tricks to help the students in securing admission in their desired institute and field.

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Past Paper Questions from Math Portion of NETs

The number of Math questions in various NETs out of 200 are:

- NET Engineering and Computer Science: 80 MCQs
- NET Architecture and Industrial Design : 60 MCQs
- NET BS Mathematics : 170 MCQs

Math Portion carries the maximum weightage in NET and should be given maximum time durin preparation. The key to performing well in this section is revision and practice. Each and every form the textbook must be learned. A formula sheet is attached to this book for your assistance. Make su learn all the formulas before you start practicing the MCQs from this book.

The Questions in the Math portion are from both FSc 1st year and FSc 2nd year. So, every chapter mu prepared. However, some chapters are more important than the rest and you will find more quest from these chapters in your NET. List of important chapters for Math are:

FSc First Year:

- **Chapter 3 – Matrices and Determinants**
- **Chapter 6 – Sequences and Series**
- **Chapter 9 – 14 – Trigonometry**
  (Pay more attention to chapter 10 and chapter 12 in Trigonometry)

FSc Second Year:

- **Chapter 1 – Functions and Limits**
- **Chapter 4 – Introduction to Analytic Geometry**
- **Chapter 6 – Conic Section**

The following pages contain the Math Questions from **Past Papers of NUST** (2013 Onwards) along their answers and solutions.

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Questions from 1st Year Mathematics

Chapter 1 – Number Systems

1) Modulus of iota is equal to:
a) i b) $-i$ c) 1 d) -1

2) Additive inverse of a complex number (a, b) is written as:
a) (-a, b) b) (a, -b) c) (-a, -b) d) (1/a , 1/b)

3) If a > b, then according to addition properties of inequalities a + c _____ c +b
a) > b) < c) = d) None of these

4) What is the area of a rectangular room with length of 5 – 3i and width of 2i?
a) 6 + 10i b) 5 – i c) 16 d) 8

5) Real component of $(4 - i)^2$ is:
a) 8 b) 15 c) 23 d) 7

6) Real part of $(2 - 3i)^6$ is
a) 64 b) 2035 c) 828 d) 132

7) Additive inverse of $2 + \sqrt{3}i$ is:
a) $2 - \sqrt{3}i$ b) $-2 + \sqrt{3}i$ c) $-2 - \sqrt{3}i$ d) $-0.5 - \sqrt{3}i$

8) What is the real component of the complex number $(4 - i)^2$?
a) -8 b) 17 c) 15 d) None of these

9) iota expressed in the form of coordinates is:
a) (0,1) b) (1,0)
c) (0,0) d) It is impossible to express a complex number in the form of coordinates

10) Which one of the following is the real part of the complex number: 6(2 - 3i)?
a) 2 b) 12 c) -3 d) 6

11) Simplify the expression $(1 + i)^8$
a) -16 b) 16 c) 32 d) -3

12) Additive identity of complex number
a) (1, 0) b) (0, 1) c) (0, 0) d) (-1, 0)

13) Find the imaginary part of $(2 + 3i)^3$
a) $44i$ b) $9i$ c) -46 d) $-27i$

14) If a > b, then ax > bx, when x
a) < 1 b) = 0 c) > 0 d) < 0

15) If a and b are two non-negative numbers such that $a < b$, then:
$\frac{\frac{1}{a} - \frac{1}{b}}{\frac{1}{a} + \frac{1}{b}}$ is:
a) > 0 b) < 0 c) = 0 d) None of these

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16) If a and b are two non-negative numbers such that $a > b$, then:
$\frac{\frac{1}{a}-\frac{1}{b}}{\frac{1}{a}+\frac{1}{b}}$ is:
a) > 0 b) < 0 c) = 0 d) None of these

17) Associative property of Multiplication is applicable on:
a) 2 x 2 matrices b) Rational numbers c) Complex Numbers d) All of these

18) Find the multiplicative inverse of complex number $z = 5 + i$
a) (-5, -1) b) $\left(\frac{5}{6}, \frac{1}{6}\right)$ c) $\left(\frac{5}{26}, -\frac{1}{26}\right)$ d) $5 - i$

19) The absolute value of $z = \frac{1+i}{3-i}$ is:
a) $\sqrt{1/10}$ b) $\sqrt{5}/5$ c) $\sqrt{5}$ d) $\sqrt{10}$

20) For De Moivre's Theorem, n belongs to which of the following sets?
a) Z b) Q c) R d) N

21) Find the real part in $(\cos\theta - i\sin\theta)^2$, for $\theta = 45°$
a) 0 b) 1 c) -1 d) 90

22) Find $(\bar{z})^2$ if $z = 2 + \sqrt{3}\,i$
a) $4 - 3i$ b) $4 + 3i$ c) $1 - 4\sqrt{3}i$ d) $1 + 4\sqrt{3}i$

23) If $\frac{a}{b} = \frac{c}{d}$ then $\frac{a+b}{a-b} = \frac{c+d}{c-d}$ represents _____ property
a) Convertendo b) Componendo-Dividendo
c) Componendo d) Dividendo

Answers of Chapter 1 – Number Systems

1) 1
Modulus of complex number = $\sqrt{x^2 + y^2}$, where x is the real part and y is the complex part. In this case, real part is zero and complex part is 1. So, modulus will be equal to: $\sqrt{0^2 + 1^2} = 1$

2) (-a, -b)
Every complex number (a, b) has the additive inverse (-a, -b) i.e. (a, b) + (-a, -b) = (0, 0)

3) >

4) $6 + 10i$
Area = Length x Width = (5 – 3i) x 2i = 10i – 6i² = 10i +6

5) 15
$(4 - i)^2 = 16 + i^2 - 8i = 15 - 8i$
So the real part is 15 and the imaginary part is $-8i$

6) 2035
$(2 - 3i)^6$

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$= ((2-3i)^2)^3$
$= (4+9i^2-12i)^3 = (4-9-12i)^3$
$= (-5-12i)^3$
$= (-1)^3(5+12i)^3$ (Taking -1 out as common)
$= -(5+12i)^2(5+12i)$
$= -(25+144i^2+120i)(5+12i) = -(25-144+120i)(5+12i)$
$= -(-119+120i)(5+12i)$
$= -(-595-1428i+600i+1440i^2)$
$= -(-595-828i-1440)$
$= -(-2035-828i)$
$= 2035+828i$

7) $-2-\sqrt{3}i$

8) 15
$(4-i)^2 = 16+i^2-8i = 16-1-8i = 15-8i$

9) (0, 1)

10) 12

11) 16
$(1+i)^8 = [(1+i)^2)^4] = (1+i^2+2i)^4 = (1-1+2i)^4 = (2i)^4 = 16i^4 = 16(1) = 16$

12) (0, 0)
The additive identity of complex numbers is (0, 0). Adding this identity to any complex number will leave it unchanged.
The multiplicative identity of complex numbers is (1, 0). Multiplying any complex number (other than 0) to the identity (1, 0) will leave it unchanged.

13) $9i$
Using the formula:
$(a+b)^3 = a^3+b^3+3ab(a+b)$
$(2+3i)^3 = (2)^3+(3i)^3+3(2)(3i)(2+3i)$
$= 8+27i^3+18i(2+3i)$
$= 8+27(i^2)(i)+36i+54i^2$
$= 8-27i+36i-54$
$= -46+9i$

14) > 0
Remember that when an inequality is multiplied or divided by a negative number, the signs of inequality will change. For example,
$5 > 3$
Multiplying by -1, the inequality will be:
$-5 < -3$
If the inequality is multiplied by a positive number, the sign of inequality remains the same. In given question the sign of inequality remains the same after multiplying the inequality with "x", this means "x" must be positive i.e., greater than 0.

15) > 0

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$$\frac{\frac{1}{a}-\frac{1}{b}}{\frac{1}{a}+\frac{1}{b}}=\frac{\frac{b-a}{ab}}{\frac{b+a}{ab}}=\frac{b-a}{b+a}$$

If $a < b$, then the result of $b - a$ will always be positive as both a and b are two non-negative numbers.
This means the numerator of the fraction will always be positive.
Denominator involves addition, and addition of 2 non-negative numbers also results in a positive number.
On dividing a positive number with another positive number, the result will always be a positive number.
Therefore, we can conclude that the given expression will always be greater than 0.

16) < 0

$$\frac{\frac{1}{a}-\frac{1}{b}}{\frac{1}{a}+\frac{1}{b}}=\frac{\frac{b-a}{ab}}{\frac{b+a}{ab}}=\frac{b-a}{b+a}$$

If $a > b$, then the result of $b - a$ will always be negative as both a and b are two non-negative numbers.
Subtracting a larger number from a smaller number always return a negative answer. This means the numerator of the fraction will always be negative.
Denominator involves addition, and addition of 2 non-negative numbers also results in a positive number.
On dividing a negative number with a positive number, the result will always be a negative number.
Therefore, we can conclude that the given expression will always be less than 0.

17) All of these
Associative property of multiplication is applicable on all given choices including matrices. For any 3 matrices A, B and C:
$A \times (BC) = (AB) \times C$
Do not confuse the associative property with commutative property. Commutative property does not hold true for Matrix Multiplication i.e., in general for any 2 matrices:
$AB \neq BA$
In associative property we do not change the order of matrices, the order stays the same we just change which matrices are multiplied first.

18) $\left(\frac{5}{26}, -\frac{1}{26}\right)$

The multiplicative inverse of a complex number (a, b) is calculated as:

$$\left(\frac{a}{a^2+b^2}, \frac{-b}{a^2+b^2}\right)$$

Here, a represents the real part and b represents the imaginary part of the complex number. The given complex number in ordered pair is (5,1). Using the above formula, the multiplicative inverse will be:

$$\left(\frac{5}{5^2+1^2}, \frac{-1}{5^2+1^2}\right)=\left(\frac{5}{26}, -\frac{1}{26}\right)=\frac{5}{26}-\frac{1}{26}i$$

19) $\sqrt{5}/5$

$$\frac{1+i}{3-i}$$

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We have to first rationalize the denominator by multiplying and dividing the expression by conjugate of denominator.

$$\frac{1+i}{3-i} \times \frac{3+i}{3-i}$$

$$= \frac{3+i+3i+i^2}{3^2-i^2}$$

$$= \frac{3+4i-1}{9+1}$$

$$= \frac{2+4i}{10}$$

$$= \frac{1}{5} + \frac{2}{5}i$$

Now we can find the modulus or absolute value of the complex number. The absolute value of a complex number $z = x + iy$ is given as:

$$|z| = \sqrt{x^2 + y^2}$$

So, the absolute value of given complex number will be:

$$|z| = \sqrt{\left(\frac{1}{5}\right)^2 + \left(\frac{2}{5}\right)^2} = \sqrt{\frac{1}{25} + \frac{4}{25}} = \sqrt{\frac{5}{25}} = \frac{\sqrt{5}}{5}$$

20) Z

De Moivre's Theorem states:

$(\cos\theta + i\sin\theta)^n = \cos n\theta + i\sin n\theta$ where n belongs to set of integers. i.e., $\forall\, n \in Z$

De Moivre's Theorem does not hold for fractions or for complex numbers in the exponents. N in option d stands for Natural Number. The exponent in De Moivre's Theorem can be a Natural number, but this set does not include all the possible values of "n". So, the best possible answer would be Z, set of Integers.

21) 0

According to the De Moivre's Theorem

$(\cos\theta + i\sin\theta)^n = \cos n\theta + i\sin n\theta$

Using this rule on the given expression, we get:

$(\cos\theta - i\sin\theta)^2 = \cos 2\theta - i\sin 2\theta$

For $\theta = 45°$, the above equation becomes:

$(\cos 45 - i\sin 45)^2 = \cos 90 - i\sin 90 = 0 - i = -i$

Thus, the real part of complex number would be 0.

22) $1 - 4\sqrt{3}i$

$(\bar{z})^2$ means we have to find the square of conjugate of the given complex number. For any complex number $z = a + bi$, its conjugate is given as:

$\bar{z} = a - bi$

So, conjugate of given complex number will be:

$\bar{z} = 2 - \sqrt{3}i$

Squaring both sides:

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$(\bar{z})^2 = \left(2 - \sqrt{3}i\right)^2$
$= (2)^2 - 2(2)\left(\sqrt{3}i\right) + \left(\sqrt{3}i\right)^2$
$= 4 - 4\sqrt{3}i + 3i^2$
$= 4 - 4\sqrt{3}i - 3$
$= 1 - 4\sqrt{3}i$

23) Componendo-Dividendo
For this type of questions, remember these 6 properties of ratios and proportions:

a) Invertendo Property:
For four numbers a, b, c, d:
If a : b = c : d, then b : a = d : c; that is, if two ratios are equal, then their inverse ratios are also equal.

b) Alternendo Property:
For four numbers a, b, c, d:
If a : b = c : d, then a : c = b : d; that is, if the second and third term interchange their places, the resultant ratios will still be equal.

c) Componendo Property:
For four numbers a, b, c, d:
if a : b = c : d then (a + b) : b = (c + d) : d.

d) Dividendo Property
For four numbers a, b, c, d:
If a : b = c : d then (a - b) : b = (c - d) : d

e) Convertendo Property
For four numbers a, b, c, d:
If a : b = c : d then a : (a - b) = c : (c - d)

f) Componendo-Dividendo Property
For four numbers a, b, c, d:
If a : b = c : d then (a + b) : (a - b) = (c + d) : (c - d).
From these properties, we can see the question statement shows the Alternendo Property.

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Chapter 2 – Sets, Functions and Groups

1) Which of the following is the associative law for the sets
a) $A \cup (B \cup C) = (A \cup B) \cap C$
b) $A \cup (B \cup C) = A \cap (B \cup C)$
c) $A \cup (B \cup C) = (A \cup B) \cup C$
d) None of these

2) If A and B, B and C are overlapping sets while A and C are disjoint sets. Which of the following can represent the sets A, B and C:
a) A = Set of Natural Numbers, B = Set of Even Integers, C = Set of Odd Integers
b) A = Set of squares of natural number, B = Set of Even Natural Numbers, C = Set of Rational Numbers
c) A = Set of Rational Numbers, B = Set of Real Numbers, C = Set of Irrational Numbers
d) None of these

3) If $A \cap B = A \cup B$, what you can say about sets A and B?
a) A and B are disjoint sets
b) A and B are overlapping sets
c) A is subset of B
d) A and B are equal sets

4) Which of the following shows that {A} is a subset of the other set?
a) A = [0, A, B]
b) A = [0, B]
c) A = [A, B]
d) None of these

5) If A is subset of B then B is super set of A, this condition holds true for which option?
a) A = B
b) $A \subseteq B$
c) $B \subseteq A$
d) None of these

6) Which one of the following properties of sets is said to be the commutative property?
a) A U B = B U A
b) A = B
c) A U (B U C) = (A U B) U C
d) A' = U – A

7) {A} = {a, b, c}. Number of subsets of set A will be?
a) 4
b) 6
c) 8
d) 12

8) If A = {1, 2, 3}, B = {0, 4, 5}, find the number of subsets of A U B.
a) 64
b) 8
c) 6
d) 32

9) A statement which is always false is termed as
a) Contingency
b) Tautology
c) Absurdity
d) Negation

10) $A \cap B = A \cap C$, will always be true if:
a) B = C
b) $B \subset C$
c) $C \subset B$
d) All of these

11) If A and B are non-empty sets, then which of the following must be incorrect:
a) $A \cap B = A$
b) $A \cup B = \emptyset$
c) $A \subset B$
d) $B \subset A$

12) If x = {1, 2, 3, 4} and y = {a, b, c, d} and f(x, y) = (1, a), (2, b), (3, c), (4, d) . The relation between x and y is:
a) Onto
b) Into
c) (1 – 1) and Into
d) (1 – 1) and Onto

13) Which of the following is equal to universal set?
a) $A \cup A$
b) $A \cap U$
c) $A \cup U$
d) None of these

14) If A = {1, 3, 9, 2}, B = {2, 8 , 5}, then $A \cap B$ = ?
a) {2}
b) 2
c) {1, 5}
d) None of these

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Answers of Chapter 2 – Sets, Functions and Groups

1) A ∪ (B ∪ C) = (A ∪ B) ∪ C

2) A = Set of Rational Numbers, B = Set of Real Numbers, C = Set of Irrational Numbers

3) A and B are equal sets

When two sets are equal, the result of their intersection and union will be the same i.e., the set itself.

4) None of these

None of these shows that {A} is subset of the other set. These represent that A belong to the other set. There is a difference between A and {A}. A represents an element while {A} represents a set and only a set can be a subset of the other set.

The correct relation will be: $\{A\} \subseteq \{Other\ Set\}$

5) A ⊆ B

6) A U B = B U A

7) 8

Number of subsets = 2^n, where n = number of elements in the set

There are 3 elements in the given set. So, number of possible subsets of A = $2^3 = 8$

8) 64

A U B = {0, 1, 2, 3, 4, 5}

Number of elements in A U B is 6, so the number of subsets in A U B = $2^6 = 64$

9) Absurdity

A statement which is always false is called an absurdity or a contradiction. A statement which is always true for all the possible values of the variables involved is called tautology. A statement which can be either true or false depending on the values of the variables involved is known as contingency.

10) B = C

We are given that A ∩ B = A ∩ C and we have to find the relation between B and C, so that this equation must be true for all values of A, B and C.

2nd and 3rd choices can be true but, in some cases, not for all cases. For example, if A = {1, 3, 5}, B = {2,3,4} and C = {3}. In this case: A ∩ B = {3} and A ∩ C = {3} and C ⊂ B

Another example:

A = {2, 5, 6, 7,} , B = {2,3,4} and C = {3}

A ∩ B = {2} and A ∩ C = ∅ and C ⊂ B

Though C ⊂ B , the given equation is not true. Same goes for B ⊂ C.

B = C will make the given equation always true. So, this would be correct answer.

11) A ∪ B = ∅

Note that A and B are non-empty sets. Union of two sets contain all the elements that are present in both sets. So, union of two non-empty sets can never be an empty set. This means, A ∪ B = ∅ is an incorrect expression. Rest of the 3 choices can be correct depending on the values of A and B.

12) (1 – 1) and Onto

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Notice that each element of set x is paired exactly with one element of set y. This means there is 1 – 1 correspondence between both sets. Such a relation between sets is known as Bijective function or (1 – 1) and Onto Function.

13) A ∪ U

Intersection of two sets return the elements that are common to both sets. While union of two sets returns the elements of both the sets combined. A denotes some random set and U denotes the Universal set. So, we can evaluate the given expressions as:

A ∪ A = A

A ∩ U = A

A ∪ U = U

14) {2}

A ∩ B means we have to find the intersection of sets A and B. Remember that intersection of two sets return the elements that are common to both sets. A = {1, 3, 9, 2}, B = {2, 8 , 5}

The only common member to both sets is 2. The intersection of two sets will also be a set, so we have to enclose the answer in brackets. Therefore, the correct answer will be {2}

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Chapter 3 – Matrices and Determinants

1) Find the values of x if $\begin{vmatrix} 3 & 1 & x \\ -1 & 3 & 4 \\ x & 1 & 0 \end{vmatrix} = -30$

a) -2, 3 b) 3, -4 c) 2, -3 d) 4, -3

2) Determinant of $\begin{bmatrix} 4 & 5 & 4 \\ 2 & 1 & 2 \\ 3 & 7 & 3 \end{bmatrix}$ is:

a) 24 b) 12 c) -44 d) None of these

3) $Inverse\ of\ A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}\ is$:

a) $\begin{bmatrix} -ad & bc \\ c & d \end{bmatrix}$ b) $\frac{1}{ad-bc}\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ c) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ d) None of these

4) $Inverse\ of\ A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}\ is$

a) $\begin{bmatrix} 1 & -2 \\ 3 & 0 \end{bmatrix}$ b) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ c) $\begin{bmatrix} -2 & 1 \\ 1.5 & -0.5 \end{bmatrix}$ d) None of these

5) Null matrix of order 1 x 2 is :

a) $\begin{bmatrix} 0 & 0 \end{bmatrix}$ b) $\begin{bmatrix} 0 \\ 0 \end{bmatrix}$ c) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ d) Both a and b

6) Orders of some matrices are given below. Which one of them cannot be multiplied?

a) m x n, n x p where m, n and p are all positive integers
b) a x b, b x c where a, b and c are all positive integers
c) 1 x 2, 2 x 6
d) 3 x 5, 4 x 1

7) Find the cofactor of 1 in the matrix A = $\begin{bmatrix} 1 & 3 \\ 2 & 4 \end{bmatrix}$

a) 1 b) -1 c) 4 d) – 4

8) If $A = \begin{bmatrix} 4 & 12 \\ 5 & 15 \end{bmatrix}$, find $|A^{-1}|$:

a) 60 b) 0 c) 120 d) None of these

9) What is the Determinant of Null matrix?

a) 1 b) 0 c) ∞ d) None of these

10) If A is symmetric, then $A - A^t =$

a) 2A b) A c) 0 d) None of these

11) Find the product BA for following matrices:

$A = \begin{bmatrix} 2 & 1 \\ -3 & 7 \end{bmatrix}$ $B = \begin{bmatrix} 4 & -3 \\ 0 & 1 \end{bmatrix}$

a) $\begin{bmatrix} 8 & -5 \\ -12 & 16 \end{bmatrix}$ b) $\begin{bmatrix} 17 & -17 \\ -3 & 7 \end{bmatrix}$ c) $\begin{bmatrix} 8 & -3 \\ 0 & 7 \end{bmatrix}$ d) None of these

12) Find the inverse of the following matrix:

$\begin{bmatrix} -3 & 0 & 0 \\ 0 & 9 & 0 \\ 0 & 0 & 5 \end{bmatrix}$

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a) $\begin{bmatrix} -1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ b) $\begin{bmatrix} -\frac{1}{3} & 0 & 0 \\ 0 & \frac{1}{9} & 0 \\ 0 & 0 & \frac{1}{5} \end{bmatrix}$ c) $\begin{bmatrix} 5 & 0 & 0 \\ 0 & 9 & 0 \\ 0 & 0 & -3 \end{bmatrix}$ d).Inverse does not Exist

13) If A and B are two matrices, then adjoint(AB) is equal to:
a) adjoint(A) adjoint(B) b) adjoint(B) adjoint(A) c) adjoint(BA) d) None of these

14) If A is singular, then α =
$A = \begin{bmatrix} 4 & \alpha & 3 \\ 7 & 3 & 6 \\ 2 & 3 & 1 \end{bmatrix}$
a) 0 b) – 5 c) 3 d) 7

15) Which of the following set of matrices can be multiplied?
a) $[1 \quad 1][11]$ b) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}[0 \quad 0]$ c) $[1 \quad 0]\begin{bmatrix} 0 \\ 1 \end{bmatrix}$ d) All of these

16) Find the minor of 7 : $\begin{bmatrix} 1 & 8 & 9 \\ 2 & 3 & 4 \\ 7 & 5 & 6 \end{bmatrix}$
a) 8 b) 9 c) 5 d) 6

17) Find the determinant of $A = \begin{bmatrix} 9 & 7 & 0 & 8 \\ 12 & 0 & 0 & 10 \\ 3 & 1 & 2 & 6 \\ 6 & 0 & 0 & 5 \end{bmatrix}$
a) 28 b) 156 c) 720 d) None of these

Answers of Chapter 3 – Matrices and Determinants

1) -2, 3

$$\begin{vmatrix} 3 & 1 & x \\ -1 & 3 & 4 \\ x & 1 & 0 \end{vmatrix} = -30$$

Expanding through 1st row we can get the determinant of the matrix as:

$$3(0 - 4) - 1(0 - 4x) + x(-1 - 3x) = -30$$

$$-12 + 4x - x - 3x^2 = -30$$

$$-3x^2 + 3x - 12 + 30 = 0$$

$$-3x^2 + 3x + 18 = 0$$

$$3x^2 - 3x - 18 = 0$$

$$x^2 - x - 6 = 0$$

$$x^2 - 3x + 2x - 6 = 0$$

$$x(x - 3) + 2(x - 3) = 0$$

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$(x-3)(x+2)=0$

$x=3, x=-2$

2) None of these
Since two rows (1st and 3rd row) of the given matrix are equal, the determinant of the matri to zero.

3) None of these
Determinant of A = ad – bc
Adjoint of A = $\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$

$$Inverse\ of\ Matrix = \frac{Adjoint}{Determinant} = \frac{\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}}{ad-bc}$$

4) $\begin{bmatrix} -2 & 1 \\ 1.5 & -0.5 \end{bmatrix}$
Determinant = 1(4) – 2(3) = - 2
Adjoint = $\begin{bmatrix} 4 & -2 \\ -3 & 1 \end{bmatrix}$

$$Inverse\ of\ Matrix = \frac{Adjoint}{Determinant} = \frac{\begin{bmatrix} 4 & -2 \\ -3 & 1 \end{bmatrix}}{-2} = \begin{bmatrix} -2 & 1 \\ 1.5 & -0.5 \end{bmatrix}$$

5) [0 0]

6) 3 x 5, 4 x 1
Two matrices can be multiplied only if the number of columns of the first matrix equal the number of of the second matrix.

7) 4
Cofactor is calculated as:
$A_{ij} = (-1)^{i+j} \times M_{ij}$
where M_{ij} is the minor of the element. Minor is the determinant of the matrix obtained by deleting i^{th} and j^{th} column. Minor for 1 is 4. So, the cofactor of 1 will be:
$Cofactor\ of\ 1 = (-1)^{1+1} \times 4 = 4$

8) None of these
We have to find the determinant of Inverse of matrix A. For this, first we need to find the inverse of A

$$A^{-1} = \frac{Adjoint\ A}{|A|}$$

$$|A| = 4(15) - 12(5) = 60 - 60 = 0$$

The determinant of A is equal to 0. This means matrix A is a singular matrix. Inverse of a singular matrix does not exist. Since, we cannot find the inverse, we cannot find its determinant either. The correct answer will be $|A^{-1}|$ does not exist. So, from given choices, None of these would be the correct answer.

9) 0
A Null Matrix is defined as a matrix with all its elements equal to 0. Since, all the elements are equal to 0, the determinant of such a matrix of any order will always be 0.

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10) 0
Remember these properties:
For a symmetric matrix: $A^t = A$
For a skew-symmetric matrix: $A^t = -A$
Since, A is given to be symmetric, we can write:
$A - A^t = A - A = 0$
If A were skew-symmetric, the result would be:
$A - A^t = A - (-A) = A + A = 2A$

11) $\begin{bmatrix} 8 & -5 \\ -12 & 16 \end{bmatrix}$

Notice that we have to find the product BA, and not AB. In general, the matrix multiplication is not commutative. This means in general BA ≠ AB. If you compute AB, this will lead to a wrong answer.

$$BA = \begin{bmatrix} 4 & -3 \\ 0 & 1 \end{bmatrix}\begin{bmatrix} 2 & 1 \\ -3 & 7 \end{bmatrix}$$

$$= \begin{bmatrix} 4(2) + (-3)(-3) & 4(1) + (-3)(7) \\ 0(2) + 1(-3) & 0(1) + 1(7) \end{bmatrix}$$

$$= \begin{bmatrix} 8 + 9 & 4 - 21 \\ 0 - 3 & 0 + 7 \end{bmatrix}$$

$$= \begin{bmatrix} 17 & -17 \\ -3 & 7 \end{bmatrix}$$

12) $\begin{bmatrix} -\frac{1}{3} & 0 & 0 \\ 0 & \frac{1}{9} & 0 \\ 0 & 0 & \frac{1}{5} \end{bmatrix}$

Detailed Method:
Let the matrix be named as matrix A.

$$A = \begin{bmatrix} -3 & 0 & 0 \\ 0 & 9 & 0 \\ 0 & 0 & 5 \end{bmatrix}$$

Since, A is a diagonal matrix, the determinant of A will be equal to the product of elements in its main diagonal. i.e.,

$$|A| = -3 \times 9 \times 5 = -135$$

To find the Adjoint of A, we have to find the cofactors of the elements of A.

$$A_{11} = (-1)^{1+1}\begin{vmatrix} 9 & 0 \\ 0 & 5 \end{vmatrix} = 45$$

$$A_{12} = (-1)^{1+2}\begin{vmatrix} 0 & 0 \\ 0 & 5 \end{vmatrix} = 0$$

$$A_{13} = (-1)^{1+3}\begin{vmatrix} 0 & 9 \\ 0 & 0 \end{vmatrix} = 0$$

$$A_{21} = (-1)^{2+1}\begin{vmatrix} 0 & 0 \\ 0 & 5 \end{vmatrix} = 0$$

$$A_{22} = (-1)^{2+2}\begin{vmatrix} -3 & 0 \\ 0 & 5 \end{vmatrix} = -15$$

$$A_{23} = (-1)^{2+3}\begin{vmatrix} -3 & 0 \\ 0 & 0 \end{vmatrix} = 0$$

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$A_{31} = (-1)^{3+1}\begin{vmatrix} 0 & 0 \\ 9 & 0 \end{vmatrix} = 0$ $\qquad$ $A_{32} = (-1)^{3+2}\begin{vmatrix} -3 & 0 \\ 0 & 0 \end{vmatrix} = 0$

$A_{33} = (-1)^{3+3}\begin{vmatrix} -3 & 0 \\ 0 & 9 \end{vmatrix} = -27$

The cofactor matrix of A will be:

$$[A_{ij}] = \begin{bmatrix} 45 & 0 & 0 \\ 0 & -15 & 0 \\ 0 & 0 & -27 \end{bmatrix}$$

Adjoint of A = Transpose of the Cofactor matrix.

$$Adj\ A = \begin{bmatrix} 45 & 0 & 0 \\ 0 & -15 & 0 \\ 0 & 0 & -27 \end{bmatrix}$$

Since, cofactor matrix is symmetric, the transpose is equal to the same matrix. Now, we can calculate the inverse matrix.

$$A^{-1} = \frac{Adj\ A}{|A|} = -\frac{1}{135}\begin{bmatrix} 45 & 0 & 0 \\ 0 & -15 & 0 \\ 0 & 0 & -27 \end{bmatrix}$$

$$= \begin{bmatrix} -\frac{45}{135} & 0 & 0 \\ 0 & \frac{15}{135} & 0 \\ 0 & 0 & \frac{27}{135} \end{bmatrix}$$

$$= \begin{bmatrix} -\frac{1}{3} & 0 & 0 \\ 0 & \frac{1}{9} & 0 \\ 0 & 0 & \frac{1}{5} \end{bmatrix}$$

Shortcut Method:

To find the inverse of a diagonal matrix, replace each element in the diagonal with its reciprocal.

Note: This method will work only on a diagonal matrix, with non-zero elements in the main diagonal. The order of matrix does not matter here. Even if you are given a 5 x 5 or higher order diagonal matrix, using this shortcut you can directly find the answer in 1 step.

13) adjoint(B) adjoint(A)

14) 3

Matrix A is given to be singular. Singular matrix is defined as the matrix whose determinant is zero. This means, determinant of A is zero. So, finding the determinant of A and setting it equal to 0 will give us the value of α.

$$|A| = \begin{vmatrix} 4 & \alpha & 3 \\ 7 & 3 & 6 \\ 2 & 3 & 1 \end{vmatrix}$$

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Expanding by 1st column, we get:
$|A| = 4(3-18) - \alpha(7-12) + 3(21-6)$
$|A| = -60 + 5\alpha + 45$
$|A| = 5\alpha - 15$
Setting the determinant equal to 0:
$5\alpha - 15 = 0 \qquad \rightarrow \alpha = 3$

15) $\begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \end{bmatrix}$
2 Matrices can be multiplied only if the number of columns of the 1st matrix are equal to the number of rows of the 2nd matrix.

For option a) $\begin{bmatrix} 1 & 1 \end{bmatrix}\begin{bmatrix} 1 \\ 1 \end{bmatrix}$, first matrix has 2 columns while second matrix has 1 row. So, these cannot be multiplied.

For option b) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} 0 & 0 \end{bmatrix}$, first matrix has 2 columns while second matrix has 1 row. So, these cannot be multiplied.

For option c) $\begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} 0 \\ 1 \end{bmatrix}$, first matrix has 2 columns, and second matrix has 2 rows. So, these can be multiplied.

16) 5
Minor of an element in a matrix is defined as the determinant obtained by deleting the row and column in which that element lies. Element 7 lies in 3rd row and 1st column. So, we delete the 1st row and 3rd column and find the determinant of the remaining matrix. This will be the minor of element 7.
Minor of 7 will be = $\begin{vmatrix} 8 & 9 \\ 3 & 4 \end{vmatrix} = 32 - 27 = 5$

17) None of these
Do not be confused because of the 4 x 4 order of this matrix. When a higher order matrix is given in the test, in almost all cases it would be solved using the properties of matrices/determinants. The key is just to observe the matrix carefully and have all the properties in mind.

$$|A| = \begin{vmatrix} 9 & 7 & 0 & 8 \\ 12 & 0 & 0 & 10 \\ 3 & 1 & 2 & 6 \\ 6 & 0 & 0 & 5 \end{vmatrix}$$

Taking out 2 as common from the 2nd row we get:

$$|A| = 2\begin{vmatrix} 9 & 7 & 0 & 8 \\ 6 & 0 & 0 & 5 \\ 3 & 1 & 2 & 6 \\ 6 & 0 & 0 & 5 \end{vmatrix}$$

Notice that 2nd and 4th row of the determinant matrix are now equal. If a matrix has 2 identical rows or 2 identical columns, the determinant of such a matrix is always equal to 0.
So,
$|A| = 2(0) = 0$
This means, None of these would be the correct answer.

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Chapter 4 – Quadratic Equations

1) $ax^2 + bx + c = 0$ has only one root if
a) $a = 0$ b) $b = 0$ c) $c = 0$ d) $ab = 0$

2) If $x = 3y$ and $3x - 2y = 7$, which of the following is the value of y that satisfies both equations
a) 1 b) 1.5 c) 2.5 d) 3

3) Sum of reciprocals of 4th roots of unity is?
a) 0 b) 1 c) i d) 2

4) Real fourth roots of unity are:
a) 0, 1 b) 1, -1 c) 1, -1, i, $-i$ d) 0, 1, i

5) The sum of all fourth roots of unity is
a) 1 b) 0 c) -1 d) w

6) What will be the value of "a" in $x^4 + x^3 + ax + 1$ if 1 is the root of the expression?
a) 0 b) 1 c) -3 d) -2

7) Which of the following are the roots of the equation $x^2 - 3x - 4 = 0$?
a) 1, 4 b) 3, 4 c) -1, 4 d) -3, 4

8) Cube roots of unity are?
a) 1, w, w^2 b) -1, 1, w c) -1, 1, w^2 d) None of these

9) If $x^4 - 3x^2 - 4 = 0$ then its roots are:
a) 2, -2, i and –i b) 1, -1, i and –i c) i d) None of these

10) Product of cube roots of unity is
a) 1 b) 0 c) -1 d) w

11) $w^{-23} + w^{-28}$
a) w^2 b) 0 c) 2w d) 1

12) The equation which does not change by replacing x with 1/x is known as :
a) Linear b) Quadratic c) Proportional d) None of these

13) If n is any real number and $w^n = w^2$ where w is cube root of unity, which of the following can be possible value of n?
a) 4 b) 6 c) -2 d) -1

14) If α and β are the roots of the equation $ax^2 + bx + c = 0$, then the equation with roots 1/α and 1/β is :
a) $x^2/a + x/b + 1/c = 0$ b) $cy^2 + by + a = 0$
c) $ay^2 + by + c = 0$ d) $ax^2 + bx + c = 0$

15) Simplify the following expression:
$$\sqrt[3]{\frac{a^x}{b^x}} \times \sqrt[3]{\frac{b^x}{c^x}} \times \sqrt[3]{\frac{c^x}{a^x}}$$
a) $\sqrt[3]{abc}$ b) $(abc)^{\frac{x}{3}}$ c) $a^x b^x c^x$ d) 1

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16) Find the square of $\frac{-1+\sqrt{3}i}{2}$
a) $\frac{-1-\sqrt{3}i}{2}$ b) $\frac{1+\sqrt{3}i}{2}$ c) $\frac{1-\sqrt{3}i}{2}$ d) None of these

17) $\alpha + \beta = 10$, and $2x^2 - kx + 1 = 0$, find the value of k.
a) 5 b) -5 c) 20 d) -20

18) $w^7 + w^{12}$ can be simplified to:
a) $-\frac{1}{w^2}$ b) w^2 c) $w^2 + 1$ d) $-\frac{1}{w}$

19) Factors of $x^2 - 2x + 1$ are:
a) $(x-2)(x+1)$ b) $(x+2)(x-1)$ c) $(x-1)(x-1)$ d) $(x+1)(x-1)$

20) Factors of $x^2 + 5x + 6$ are:
a) $(x+6)(x+1)$ b) $(x+5)(x+1)$ c) $(x+3)(x+2)$ d) $(x-6)(x-1)$

21) If diagonal of a square measures 20 units, then the length of its sides is:
a) 10 b) $\frac{10}{\sqrt{2}}$ c) $10\sqrt{2}$ d) None of these

22) Find three consecutive integers such that when twice of second number is subtracted from the sum of first and three times the third number, the result is 44.
a) 8, 9 , 10 b) 13, 14, 15 c) 13, 15, 16 d) 20, 21, 22

23) If $f(x) = x^7 + x^6 + x^5 + x^3 + x + 1$ is divided by $x + 1$, then the remainder is:
a) 6 b) -6 c) 2 d) -2

24) For the equation: $x^2 - 2x + 16 = 0$, the product of roots is:
a) 16 b) 2 c) 3 d) None of these

25) The point of intersection of $x + 2y = 8$, and $2x + 5y = -9$ is:
a) (2, 3) b) (-7 , 1) c) (-27, 58) d) (58, -27)

26) $ax^2 + bx + c = 0$ has only 1 root when:
a) a = 0 b) b = 0 c) c = 0 d) All of these

27) The sum of roots $ax^2 + bx + c = 0$ is zero when
a) a = c b) a = 0 c) b = 0 d) c = 0

28) For what value of z will the average of 3, 8 and z be equal to 10?
a) 9 b) 15 c) 19 d) 27

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Answers of Chapter 4 – Quadratic Equations

1) a = 0
When a = 0, the equation ($ax^2 + bx + c = 0$) will be reduced to a linear equation $bx + c = 0$ with only one root i.e. $x = -b/c$

2) 1
$x = 3y$ (i)
$3x - 2y = 7$ (ii)
Substituting the value of x from equation (i) in equation (ii), we get:
$3(3y) - 2y = 7 \rightarrow 7y = 7 \rightarrow y = 1$

3) 0
Fourth roots of unity are 1, -1, i and –i. Their reciprocals are 1, -1, 1/i, -1/i which add up to zero.

4) 1, -1

5) 0
The fourth roots of unity are +1, -1, i and –i. These roots add up to give zero.

6) -3
Since 1 is the root of the equation so replacing x = 1 in the equation should result in an answer equal to zero. i.e.
$(1)^4 + (1)^3 + 1(a) + 1 = 0$
$a + 3 = 0$ $a = -3$

7) -1, 4
$x^2 - 3x - 4 = 0$ $x^2 - 4x + x - 4 = 0$
$x(x-4) + 1(x-4) = 0$ $(x+1)(x-4) = 0$ $x = -1$ or $x = 4$

8) 1, w, w^2

9) 2, -2, i and –i
An easy way to check for the correct option is by placing the given values one by one in the given equation.
Checking for x = 2
$(2)^4 - 3(2)^2 - 4 = 0$
$16 - 12 - 4 = 0$
$0 = 0$
Thus 2 is a root of equation. This way, perform a check for all the options. Another way is to change the given equation to a quadratic equation by substitution and solve the equation.
Placing $x^2 = y$, we get the equation as:
$y^2 - 3y - 4 = 0$
Solving this equation, we get y = 4, -1
This means:
$x^2 = 4$ or $x^2 = -1$
$x = 2, -2$ or $x = i, -i$

10) 1

11) 2w
$w^{-23} + w^{-28} = w^{-27}(w^4 + w) = 1(w^4 + w) = w^4 + w = w^3.w + w = w + w = 2w$

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If w is raised to any number which is a multiple of 3, the answer will always be 1. For example:

$w^3 = 1$ $w^{-3} = 1$ $w^{-27} = 1$

12) None of these

An equation which remains unchanged when x is replaced by 1/x is called a reciprocal equation.

13) -1

$$w^{-1} = \frac{1}{w} = w^2$$

14) $cy^2 + by + a = 0$

α and β are the roots of the equation $ax^2 + bx + c = 0$.

So, $\alpha + \beta = -b/a$ and $\alpha\beta = c/a$

The new roots are $1/\alpha$ and $1/\beta$.

Sum of New Roots = $1/\alpha + 1/\beta = (\beta + \alpha)/\alpha\beta$

Using the value of $\beta + \alpha$ and $\alpha\beta$, we get:

Sum of new roots = $\frac{-\frac{b}{a}}{\frac{c}{a}} = -\frac{b}{c}$

Product of New Roots = $1/\alpha\beta = a/c$

Required Equation is given by:

y^2 - (Sum of roots)y + Product of roots = 0

$y^2 - (-b/c)y + a/c = 0$

$cy^2 + by + a = 0$

15) 1

$$\sqrt[3]{\frac{a^x}{b^x}} \times \sqrt[3]{\frac{b^x}{c^x}} \times \sqrt[3]{\frac{c^x}{a^x}}$$

$$= \left(\frac{a^x}{b^x}\right)^{\frac{1}{3}} \times \left(\frac{b^x}{c^x}\right)^{\frac{1}{3}} \times \left(\frac{c^x}{a^x}\right)^{\frac{1}{3}}$$

$$= \frac{a^{\frac{x}{3}}}{b^{\frac{x}{3}}} \times \frac{b^{\frac{x}{3}}}{c^{\frac{x}{3}}} \times \frac{c^{\frac{x}{3}}}{a^{\frac{x}{3}}}$$

$$= 1$$

16) $\frac{-1 - \sqrt{3}i}{2}$

$$\left(\frac{-1 + \sqrt{3}i}{2}\right)^2$$

$$= \frac{(-1)^2 + 2(-1)(\sqrt{3}i) + (\sqrt{3}i)^2}{4}$$

$$= \frac{1 - 2\sqrt{3}i + 3i^2}{4}$$

$$= \frac{1 - 2\sqrt{3}i - 3}{4}$$

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$$= \frac{-2-2\sqrt{3}i}{4}$$

$$= \frac{2(-1-\sqrt{3}i)}{4}$$

$$= \frac{-1-\sqrt{3}i}{2}$$

17) 20

α and β represent the roots of an equation. $\alpha + \beta = 10$ means the sum of roots of the given equat

10.

We also know that sum of roots of q quadratic equations $ax^2 + bx + c = 0$ is given as:

$$\alpha + \beta = -\frac{b}{a}$$

For the given equation, the sum of roots will be:

$$\alpha + \beta = \frac{-(-k)}{2} = \frac{k}{2}$$

Comparing both the equations, we can write:

$$\frac{k}{2} = 10$$

$$\rightarrow k = 20$$

18) $-\frac{1}{w}$

$$w^7 + w^{12} = w^6 w + (w^3)^4 = (w^3)^2 w + (w^3)^4$$

Using the fact that $w^3 = 1$, we can write:

$$(w^3)^2 w + (w^3)^4 = (1)w + 1 = w + 1$$

Using the fact that: $1 + w + w^2 = 0$ $\rightarrow 1 + w = -w^2$

The above equation changes to:

$$w + 1 = -w^2$$

Since, $w^3 = 1$

$$\rightarrow w.w^2 = 1$$

$$\rightarrow w^2 = \frac{1}{w}$$

$$\rightarrow -w^2 = -\frac{1}{w}$$

Therefore, the given expression can be simplified to:

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$w^7 + w^{12} = -\frac{1}{w}$

19) $(x-1)(x-1)$
We can find the factors using mid-term split method.
$x^2 - 2x + 1 = x^2 - x - x + 1$
$= x(x-1) - 1(x-1)$
$= (x-1)(x-1) = (x-1)^2$

20) $(x+3)(x+2)$
We can find the factors using mid-term split method.
$x^2 + 5x + 6 = x^2 + 2x + 3x + 6$
$= x(x+2) + 3(x+2)$
$= (x+2)(x+3)$

21) $10\sqrt{2}$
Let x represents the sides of the square and d represents its diagonal. The relation between side length and diagonal will be:
$x^2 + x^2 = d^2$

$2x^2 = d^2$

$\sqrt{2x^2} = \sqrt{d^2}$

$\sqrt{2}x = d$
Using the given value of d, we get:
$\sqrt{2}x = 20$

$x = \frac{20}{\sqrt{2}} = \frac{2 \times 10}{\sqrt{2}}$

$x = \sqrt{2} \times 10 = 10\sqrt{2}$

22) 20, 21, 22
Let the smallest integer be x. Since, the integers are consecutive, the 2nd integer will be $x + 1$ and the 3rd integer will be $x + 2$
Transforming the given sentence into equation:
(1st Number + Thrice of 3rd Number) – Twice of 2nd Number = 44
Using the assumed values in the above equation we get:
$x + 3(x+2) - 2(x+1) = 44$
$x + 3x + 6 - 2x - 2 = 44$
$2x + 4 = 44$
$2x = 40 \rightarrow x = 20$
This means, the first integer is 20, second integer is 21 and the 3rd integer is 22.

23) -2
According to the Remainder Theorem, the remainder obtained when a polynomial $f(x)$ is divided by $x - a$ is the same as the value of polynomial $f(x)$ at $x = a$
$f(x) = x^7 + x^6 + x^5 + x^3 + x + 1$ is to be divided by $x + 1$.
$x + 1$ can be written as $x - (-1)$
So, according to the Remainder theorem, instead of dividing $f(x)$ by $x - (-1)$, we can substitute

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$x = -1$ in $f(x)$. The resulting answer will be the remainder.
Substituting $x = -1$ in $f(x)$ we get:
$f(-1) = (-1)^7 + (-1)^6 + (-1)^5 + (-1)^3 + (-1) + 1$
$f(-1) = -1 + 1 - 1 - 1 - 1 + 1$
$f(-1) = -2$
Therefore, the remainder is – 2.

24) 16
The product of roots of a quadratic equation $ax^2 + bx + c = 0$ is given by:

$$P = \frac{c}{a} = \frac{Constant\ Term}{Coefficient\ of\ x^2}$$

Constant term in given equation is 16, and the coefficient of x^2 is 1. So the product of roots will be:

$$P = \frac{c}{a} = \frac{16}{1} = 16$$

25) (58, -27)
The given equations are linear equations in two variables. Solving these equations simultaneously will give us the point where both the lines meet i.e., the point of their intersection.
$x + 2y = 8$ Equation 1
$2x + 5y = -9$ Equation 2
Multiplying "Equation 1" by two, and subtracting it from "Equation 2", gives us:
$2x + 5 - 2(x + 2y) = -9 - 2(8)$
$2x + 5y - 2x - 4y = -9 - 16$
$y = -25$
Using $y = -27$ in Equation 1, we get:
$x + 2(-25) = 8$
$x - 50 = 8 \rightarrow x = 58$
In ordered pair the answer would be: $(58, -27)$

26) a = 0
When the coefficient of x^2 is 0, the given Quadratic Equation will be reduced into a Linear Equation and the Linear Equation has always only 1 root or solution. So, a must be equal to 0.

27) b = 0
Sum of roots of a quadratic equation $ax^2 + bx + c = 0$ is calculated as:

$$S = -\frac{b}{a}$$

This sum will be equal to 0 if the numerator is equal to 0. This means, for the sum to be equal to 0, "b" i.e., the coefficient of x must be equal to 0.

28) 19
Average is defined as:

$$Average = \frac{Sum\ of\ Numbers}{Count\ of\ Numbers}$$

We have three numbers 3, 8 and z. Their average is 10. Using these values in the above formula, we get:

$$10 = \frac{3 + 8 + z}{3}$$

$30 = 11 + z \rightarrow 19 = z$

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Chapter 5 – Partial Fractions

1) $\frac{1}{x(x+1)} = \frac{A}{x+1} + \frac{B}{x}$ *then* $A + B = ?$

a) 2 b) 0 c) -2 d) 1

2) *If* $\frac{4x}{(x-1)(x+1)} = \frac{A}{x-1} + \frac{B}{x+1}$ *then the values of 'A' and 'B' are:*

a) 2 and 2 b) 2 and -2 c) 1 and -1 d) None of these

Answers of Chapter 5 – Partial Fractions

1) 0

$$\frac{1}{x(x+1)} = \frac{A}{x+1} + \frac{B}{x}$$

Multiplying both sides by $x(x+1)$ *we get:*

$1 = A(x) + B(x+1)$

Putting $x = -1$ *we get:*

$1 = A(-1) + B(0) \quad \rightarrow A = -1$

Putting $x = 0$, *we get:*

$1 = A(0) + B(1) \quad \rightarrow B = 1$

So, A + B = 1 + (-1) = 0

2) 2 and 2

$$\frac{4x}{(x-1)(x+1)} = \frac{A}{x-1} + \frac{B}{x+1}$$

Multiplying both sides by $(x-1)(x+1)$ *we get:*

$4x = A(x+1) + B(x-1)$

Putting $x = 1$, *we get:*

$4 = A(2) \quad \rightarrow A = 2$

Putting $x = -1$, *we get:*

$-4 = B(-2) \quad \rightarrow B = 2$

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Chapter 6 – Sequences and Series

1) For an A.P. if t_1 is 3 and t_{10} is 39 then S_{10} is
a) 210 b) 212 c) 216 d) 214

2) What is the geometric mean between 9 and 4?
a) 6 b) 6i c) -6i d) 7.5

3) Next number of the series 5, 8, 11, 14, 17... is
a) 20 b) 19 c) 21 d) 18

4) 9th number of the following series is?
1, 4, 8, 13, 19...
a) 53 b) 34 c) 43 d) 54

5) Two A.Ms between 5 and 11 are:
a) 7, 8 b) 7, 9 c) 6, 8 d) 6.5, 8.5

6) $\sum_{n=1}^{\infty}(-e)^{-2n} =$
a) ∞ b) 0 c) $(e^2-1)^{-1}$ d) e^2

7) If 2 and 32 are in G.P. Find their geometric mean
a) 8 b) -8 c) 16 d) -16

8) $\sum_{n=1}^{5}\left(\frac{1}{i}\right)^n = ?$
a) 0 b) 1 c) i d) $-i$

9) $\sum_{n=1}^{\infty}\left(-\frac{3}{7}\right)^{2n} = ?$
a) 9/40 b) ∞ c) 0 d) 3/7

10) For an AP, if $a_{12} = 19$ and $a_{17} = 29$, what will be the value of common difference?
a) 1 b) 2 c) 3 d) 4

11) $\sum_{n=2}^{30}\left(-\frac{1}{i}\right)^n = ?$
a) i b) $-i$ c) -1 d) 1

12) 1, 1/3, 1/5, 1/7... Is _____ Series:
a) Geometric b) Arithmetic c) Harmonic d) None of these

13) Calculate exact value of the repeating decimal 0.4545...
a) 5/11 b) 50/11 c) 0.5/11 d) None of these

14) 2, 2, 2, 2, 2, 2 is an arithmetic sequence with a common difference
a) 0 b) 2
c) 4 d) Not an arithmetic sequence

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15) Sum of the series 0.2 + 0.02 + 0.002 ... up to infinite terms is:
a) 1/3 b) 1/6 c) 2/9 d) 3/12

16) If $S_n = n^3$ for an A.P. then a_n=?
a) $n^3 - a_1$ b) $n^3 + a_1$ c) $2n^2 - a_1$ d) $n^2.a_1$

17) 1 + 2 + 3 + 4 + ... +100
a) 5050 b) 5000 c) 2550 d) 4500

18) 2 + 4 + 6 + ... + 100
a) 2250 b) 2550 c) 1275 d) 1775

19) A.M of 1/4 and 3/8 is:
a) 10/8 b) 5/16 c) 6/16 d) 5/8

20) 2 + 4 + 8 + 16 + ... + till n/2 terms =?
a) 2^n b) $2^{\frac{n+2}{2}} - 2$ c) $2^{\frac{n}{2}} + 2$ d) *None of these*

21) *If* $t_n = \left(-\frac{1}{3}\right)^n t_{n-1}$ *and* $t_1 = 1$, *the series represented by* t_n *is:*
a) AP b) GP c) HP d) None of these

22) Which of the following series has r = 0.5?
a) 1, 1.5, 2, 2.5 ... b) 2, 4, 8, 16 ... c) 256, 128, 64, 32 ... d) All of these

23) The series 1 + 1 + 1 + 1 + ... is:
a) Convergent
b) Divergent
c) Neither convergent nor divergent
d) Both convergent and divergent

24) What is the sum of the following series?
8 + 4 + 2 + ... + 1/32
a) 495/32 b) 625/32 c) 511/32 d) None of these

25) What is the difference between the arithmetic mean and the geometric mean of 5 and 7?
a) 0.8 b) 0.08 c) 0.008 d) 0.0008

26) What is the nth term of the sequence: 1, 3, 5, 7...?
a) 2n - 1
b) 2n + 3
c) 2n
d) It is impossible to find the nth term for such a sequence

27) What is the sum of the first 50 natural numbers?
a) 500 b) 1275 c) 1200 d) 8900

28) What are three AMs between -18 and 4?
a) 12.5, 7 and 1.5
b) AM can't be found between a negative and a positive number
c) -12.5, -7 and -1.5
d) 1, 2 and 3

29) Sum the series upto n terms. : 1+3+5+ ...
a) n^2 b) ln e^2 c) 2^n d) n^e

30) What is the G.M of 32 and 64
a) 48 b) 45.12 c) -48 d) -45.12

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31) $\sum_{n=0}^{\infty} \frac{1}{2^n} =$

a) 1/2 b) 2 c) 4 d) 1

32) The 11th Term of the Series will be: 2, 5/2, 3 ...

a) 11/2 b) 14/2 c) 22/2 d) 17/2

33) Calculate S_8 given: $t_1 = 8$ and $r = -1/2$

a) -25/2 b) 85/16 c) 55/8 d) -95/32

34) $\sum_{n=0}^{\infty} \left(\frac{1}{2^{n-1}}\right) = ?$

a) 2 b) 4 c) -2 d) 16

35) Which of the following series converges?

a) S = - 1 - 1 - 1 - ...
b) S = 1 + 1/2 + 1/4 + ...
c) S = 1 + 1 + 1 + 1 + ...
d) S = 2 + 4 + 8 + ...

36) Find the sum of following series:

$1^2 + 3^2 + 5^5 + \cdots + n^2$

a) $\frac{n}{6}(n+1)(2n+1)$ b) $\frac{n}{3}(4n^2 - 1)$ c) $\frac{n}{2}(n+1)$ d) $\frac{n}{2}(6n^2 + 3n - 1)$

37) The H.M between 1/2 and 1/8 is:

a) 16/5 b) 1/5 c) 5 d) 5/16

38) 5, -15, 45, ...

What will be the sign of the 84563214th term?

a) Positive
b) Negative
c) Either positive or negative
d) Cannot be determined

39) Find the 10th term of the sequence:

$\frac{1}{8}, \frac{1}{3}, -\frac{1}{2}, -\frac{1}{7}, \cdots$

a) 37 b) 1/37 c) -37 d) -1/37

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Answers of Chapter 6 – Sequences and Series

1) 210

$t_1 = a_1 = 3$

$t_{10} = 39 = a_1 + 9d = 3 + 9d$

$39 = 3 + 9d$

$\rightarrow d = 4$

$S_n = \frac{n}{2}(2a_1 + (n-1)d)$

$S_{10} = \frac{10}{2}(2(3) + 9(4)) = 5(6 + 36) = 5(42) = 210$

2) 6

$G.M = \sqrt{(9)(4)} = \sqrt{36} = 6$

3) 20

The given series is an A.P. with common difference 3. We are to find a_6

$a_6 = a_1 + 5d = 5 + 5(3) = 20$

4) 53

The difference of the consecutive terms is in the following order:

3, 4, 5, 6, ...

So, the difference between 19 and next term will be 7. Thus, the next number (6th term) in the sequence will be 26. 7th term will be 26 + 8 = 34. 8th term will be 34 + 9 = 43. 9th term will be 43 + 10 = 53.

5) 7, 9

Let A_1 and A_2 be two A.Ms between 5 and 11. Then:

5, A_1, A_2, 11 will be in an A.P

We have the first term of A.P which is 5. We need to find the common difference. Since 11 is the 4th term of the sequence, we can write:

11 = First Term + 3d

11 = 5 + 3d

d = 2

So,

$A_1 = 5 + 2 = 7$

$A_2 = 5 + 2(2) = 9$

6) $(e^2 - 1)^{-1}$

$\sum_{n=1}^{\infty}(-e)^{-2n} =$

On expanding the given summation, we get a G.P i.e.

$$\sum_{n=1}^{\infty}(-e)^{-2n} = (-e)^{-2} + (-e)^{-4} + (-e)^{-6} + \cdots$$

$Common\ ratio = r = (-e)^{-2} = e^{-2}$

Sum of the terms on right side of the above equation will be:

$$Sum = \frac{a_1}{1-r} = \frac{(-e)^{-2}}{1-e^{-2}} = \frac{\frac{1}{e^2}}{1-e^{-2}} = \frac{1}{e^2-1} = (e^2-1)^{-1}$$

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7) 8

$G.M = \pm\sqrt{2(32)} = \pm 8$

Both 8 and -8 are given in the options. In this case we will always go for the positive Geometric Mean. 8 will be the correct answer.

8) $-i$

$$\sum_{n=1}^{5}\left(\frac{1}{i}\right)^n = \left(\frac{1}{i}\right)^1 + \left(\frac{1}{i}\right)^2 + \left(\frac{1}{i}\right)^3 + \left(\frac{1}{i}\right)^4 + \left(\frac{1}{i}\right)^5$$

$$= \frac{1}{i} + \frac{1}{i^2} + \frac{1}{i^3} + \frac{1}{i^4} + \frac{1}{i^5}$$

$$= \frac{i}{i^2} + \frac{1}{(-1)} + \frac{1}{(-i)} + \frac{1}{1} + \frac{1}{i}$$

$$= -i - 1 + \frac{i}{(-i^2)} + 1 - i$$

$$= -i + i - i = -i$$

9) 9/40

$$\sum_{n=1}^{\infty}\left(-\frac{3}{7}\right)^{2n} = \left(-\frac{3}{7}\right)^2 + \left(-\frac{3}{7}\right)^4 + \left(-\frac{3}{7}\right)^6 + \left(-\frac{3}{7}\right)^8 + \cdots$$

So the series is an infinite G.P with common difference $\left(-\frac{3}{7}\right)^2$

$$Sum = \frac{a_1}{1-r} = \frac{\left(-\frac{3}{7}\right)^2}{1-\left(-\frac{3}{7}\right)^2} = \frac{\frac{9}{49}}{\frac{49-9}{49}} = \frac{\frac{9}{49}}{\frac{40}{49}} = \frac{9}{40}$$

10) 2

$a_{12} = 19 = a_1 + 11d$

$a_{17} = 29 = a_1 + 16d$

Subtracting 1st equation from 2nd, we get:

$29 - 19 = 5d$

$10 = 5d \qquad \rightarrow d = 2$

11) -1

$$\sum_{n=2}^{30}\left(-\frac{1}{i}\right)^n = \left(-\frac{1}{i}\right)^2 + \left(-\frac{1}{i}\right)^3 + \left(-\frac{1}{i}\right)^4 + \left(-\frac{1}{i}\right)^5 + \cdots$$

The above series is a G.P with a common ratio $\left(-\frac{1}{i}\right)$.

$$Sum = \frac{a_1(1-r^n)}{1-r} = \frac{\left(-\frac{1}{i}\right)^2\left(1-\left(-\frac{1}{i}\right)^{29}\right)}{1-\left(-\frac{1}{i}\right)} = \frac{-1\left(1-\left(-\frac{1}{i^{28}.i}\right)\right)}{1+\frac{1}{i}}$$

$$Sum = \frac{-1\left(1+\frac{1}{i}\right)}{1+\frac{1}{i}} = -1$$

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Here n = 29 is used because there are 29 terms in the given series.

12) Harmonic
The reciprocal of the given terms form an Arithmetic series so the given series is a Harmonic series

13) 5/11
Method 1:
An easy way to get the answer is to multiply the denominator of a fraction with the given decimal and check if it gives the numerator of that fraction or not.
11 x 0.4545 = 4.9995 approximately equal to 5.
Remember the decimal is never ending. We only multiplied upto 4 decimals so we got an approximate answer. If the number with infinite decimal digits is multiplied, it will give the exact answer.
So the correct answer in this case is 5/11
Method 2:
The other way is to solve using the sum of infinite geometric series:

$$0.45454545\ldots\ldots = 0.45 + 0.0045 + 0.000045 + \cdots$$
$$= 45(0.01 + 0.0001 + 0.000001 + \cdots)$$
$$= 45\left(\frac{1}{100} + \frac{1}{10000} + \frac{1}{1000000} + \cdots\right)$$
$$= 45\left(\frac{\frac{1}{100}}{1 - \frac{1}{100}}\right)$$
$$= 45\left(\frac{\frac{1}{100}}{\frac{99}{100}}\right) = 45\left(\frac{1}{99}\right) = \frac{5}{11}$$

14) 0

15) 2/9
0.2 + 0.02 + 0.002 ...
The above series is a G.P with r = 0.1

$$S = \frac{a_1}{1-r} = \frac{0.2}{1-0.1} = \frac{0.2}{0.9} = \frac{2}{9}$$

16) $2n^2 - a_1$

$$S_n = \frac{n}{2}(a_1 + a_n)$$
$$n^3 = \frac{n}{2}(a_1 + a_n)$$
$$2n^2 = a_1 + a_n$$
$$a_n = 2n^2 - a_1$$

17) 5050
Sum of first n natural numbers is given be:

$$Sum = \frac{n(n+1)}{2}$$

So in this case:

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$$Sum = \frac{100(101)}{2} = 5050$$

18) 2550

Let x = 2 + 4 + 6 + ... + 100

The above series is an A.P with d = 2

So,

$$x = S_{50} = \frac{50}{2}(2 + 100) = 25(102) = 2550$$

Formula used:

$$S_n = \frac{n}{2}(a_1 + a_n)$$

19) 5/16

$$A.M = \frac{\frac{1}{4} + \frac{3}{8}}{2} = \frac{\frac{2+3}{8}}{2} = \frac{5}{16}$$

20) $2^{\frac{n+2}{2}} - 2$

The given series is a G.P with $r = 2$

$$S_n = \frac{a_1(1 - r^n)}{1 - r}$$

Sum till $\frac{n}{2}$ *terms will be:*

$$S_{\frac{n}{2}} = \frac{2\left(1 - 2^{\frac{n}{2}}\right)}{1 - 2} = \frac{2\left(1 - 2^{\frac{n}{2}}\right)}{-1} = 2\left(2^{\frac{n}{2}} - 1\right) = 2^{\frac{n}{2}+1} - 2 = 2^{\frac{n+2}{2}} - 2$$

21) None of these

A way to check is by evaluating a few terms from the given data

$$t_1 = 1$$

$$t_2 = \left(-\frac{1}{3}\right)^2 t_1 = \frac{1}{9}$$

$$t_3 = \left(-\frac{1}{3}\right)^3 t_2 = \frac{1}{27} \cdot \frac{1}{9} = \frac{1}{243}$$

$$t_4 = \left(-\frac{1}{3}\right)^4 t_3 = \frac{1}{81} \cdot \frac{1}{243} = \frac{1}{19683}$$

The terms obtained are not in any of the given sequences.

22) 256, 128, 64, 32 ...

r denotes the common ratio for a G.P. From the given options only option c has a common ratio of 0.5

Common ratio can be obtained by dividing any term of the sequence by its previous term.

23) Divergent

The common ratio of given series is 1.

For a geometric series:

If $|r| < 1$ the geometric series converges.

If $|r| \geq 1$ the geometric series diverges.

24) 511/32

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$is\ a\ G.P. with\ r = \frac{1}{2}$

ind the number of terms:

$\rightarrow Total\ number\ of\ terms = 9$

$$\frac{8\left(1-\frac{1}{2^9}\right)}{1-\frac{1}{2}} = \frac{2^3\left(\frac{2^9-1}{2^9}\right)}{\frac{1}{2}} = 2^4\left(\frac{2^9-1}{2^9}\right) = \frac{2^9-1}{2^5} = \frac{512-1}{32} = \frac{511}{32}$$

G.M = Square root (35) ≈ 5.92 Difference = 6 – 5.92 = 0.08

$)d = 1 + (n-1)2 = 1 + 2n - 2 = 2n - 1$

$ıtural\ numbers = \frac{n(n+1)}{2}$

$ıatural\ numbers = \frac{50(51)}{2} = 25(51) = 1275$

ı.5

be A_1, A_2 and A_3.

ll be in an A.P.

.5 $A_2 = -12.5 + 5.5 = -7$ $A_3 = -7 + 5.5 = -1.5$

an A. P. So we can use the sum formula of an A. P:

$- 1)d) = \frac{n}{2}(2 + 2n - 2) = \frac{n}{2}(2n) = n^2$

$: = \sqrt{32 \times 32 \times 2} = 32\sqrt{2} = 32 \times 1.41 = 45.12$

/e and negative geometric means are given in the options, we choose the positive one.

s an option of both, then definitely that will be chosen.

$$\frac{1}{2^0} + \frac{1}{2^1} + \frac{1}{2^2} + \frac{1}{2^3} + \cdots$$

$is\ a\ G.P\ with\ r = \frac{1}{2}$

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$$So, x = \frac{a_1}{1-r} = \frac{1}{1-\frac{1}{2}} = \frac{1}{\frac{1}{2}} = 2$$

32) 14/2

The given series is an A.P with d = 0.5

So, 11th term will be = 2 + 10(0.5) = 7 = 14/2

33) 85/16

$$S_8 = \frac{a_1(1-r^n)}{1-r} = \frac{8\left(1-\left(-\frac{1}{2}\right)^8\right)}{1-\left(-\frac{1}{2}\right)} = \frac{8\left(1-\frac{1}{256}\right)}{\frac{3}{2}} = \frac{16\left(\frac{255}{256}\right)}{3} = \frac{85}{16}$$

34) 4

$$x = \sum_{n=0}^{\infty}\left(\frac{1}{2^{n-1}}\right) = \frac{1}{2^{-1}} + \frac{1}{2^0} + \frac{1}{2^1} + \frac{1}{2^2} + \cdots$$

The above series is a G.P with $a_1 = 2$ *and* $r = \frac{1}{2}$

$$So, \quad x = \frac{a_1}{1-r} = \frac{2}{1-\frac{1}{2}} = 4$$

35) S = 1 + 1/2 + 1/4 + ...

For a geometric series:

If |r| < 1 the geometric series converges.

If |r| ≥ 1 the geometric series diverges.

The only series with |r| < 1 is the series in option B.

36) $\frac{n}{3}(4n^2 - 1)$

First, we need to find the general term for this series. Note that the terms 1, 3, 5, ... form an A.P. with common difference 2 and first term 1. So, the general term would be:

$T_k = (1 + (k-1) \times 2)^2$

$T_k = (1 + 2k - 2)^2$

$T_k = (2k-1)^2$

$T_k = 4k^2 - 2(2k)(1) + 1$

$T_k = 4k^2 - 4k + 1$

Let S_n denote the sum of n terms of the given series, then:

$$S_n = \sum_{k=1}^{n} T_k$$

$$= \sum_{k=1}^{n}(4k^2 - 4k + 1)$$

$$= \sum_{k=1}^{n} 4k^2 - \sum_{k=1}^{n} 4k + \sum_{k=1}^{n} 1$$

$$= 4\sum_{k=1}^{n} k^2 - 4\sum_{k=1}^{n} k + \sum_{k=1}^{n} 1$$

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$$= 4\left(\frac{n(n+1)(2n+1)}{6}\right) - 4\left(\frac{n(n+1)}{2}\right) + n$$

$$= \frac{2n(n+1)(2n+1)}{3} - 2n(n+1) + n$$

$$= \frac{2n(n+1)(2n+1)}{3} - 2n^2 - 2n + n$$

$$= \frac{2n(n+1)(2n+1)}{3} - 2n^2 - n$$

$$= \frac{(2n^2+2n)(2n+1) - 6n^2 - 3n}{3}$$

Taking "n" common from the numerator.

$$= \frac{n[(2n+2)(2n+1) - 6n - 3}{3}$$

$$= \frac{n}{3}(4n^2 + 2n + 4n + 2 - 6n - 3)$$

$$= \frac{n}{3}(4n^2 - 1)$$

37) 1/5

The Harmonic mean between two numbers a and b is given as:

$$H = \frac{2ab}{a+b}$$

Using the given values, the Harmonic mean between 1/2 and 1/8 becomes:

$$H = \frac{2\left(\frac{1}{2}\right)\left(\frac{1}{8}\right)}{\frac{1}{2}+\frac{1}{8}}$$

$$H = \frac{\frac{1}{8}}{\frac{4+1}{8}} = \frac{\frac{1}{8}}{\frac{5}{8}} = \frac{1}{5}$$

38) Negative

Note that the terms at odd position are positive and the term at even position is positive. The given sequence is a G.P with common ratio of – 3. If you find few next terms, the same trend will continue with odd and even terms.

5, - 15 , 45, - 135, 405, ...

84563214th term is the term at even position and like the other terms at even position this term will also be negative.

39) -1/37

The given sequence is an H.P. The corresponding A.P will be:

$8, 3, -2, -7, \ldots$

First term of this A.P = $a_1 = 8$

Common difference = $d = 3 - 8 = -5$

10th term of this A.P will be = $a_1 + 9d = 8 + 9(-5) = -37$

So, the corresponding term of the given H.P will be $-\frac{1}{37}$

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Chapter 7 – Permutation, Combination and Probability

1) Two dies are thrown simultaneously. What is the probability that the sum of numbers shown at the top is 5?
a) 1/3 b) 4/5 c) 1/7 d) 1/9

2) How many diagonals can be formed in a 7-sided polygon figure?
a) 14 b) 21 c) 19 d) 23

3) The probability of picking rotten apples in a box is 1/100. If there are 6 boxes containing 1200 apples, then how many rotten apples would be obtained?
a) 2 b) 24 c) 6 d) 12

4) If $^nP_4 \times {}^nC_3 = 96$, then n=?
a) 1 b) 3 c) 4 d) 6

5) If a die is rolled twice, what is the probability that the numbers shown on top add up to 8?
a) 2/36 b) 2/4 c) 4/36 d) 5/36

6) Total number of 5 digits formed from 1, 2, 3, 4, 5 such that 1 and 5 never come next to each other is:
a) 24 b) 48 c) 72 d) 120

7) Probability of picking a diamond card in a deck of 52 cards is:
a) 1/13 b) 1/4 c) 13/26 d) 12/53

8) In how many ways can letters of the word COCOCOLA be arranged when all letters are to be used?
a) 280 b) 40320 c) 1120 d) 6720

9) What is the probability of picking a queen or a face card from a set of 52 cards?
a) 14/3 b) 3/13 c) 4/13 d) 1/4

10) $\frac{(n-1)!}{(n+1)!} = ?$
a) n + 1 b) n/2 c) n – 1 d) None of these

11) Probability of any event cannot have the value of:
a) 1/5 b) 1/8 c) 1/2 d) 3/2

12) Tickets numbered 1 to 20 are mixed up and then a ticket is drawn at random. What is the probability that the ticket drawn has a number which is a multiple of 3 or 5?
a) 1/2 b) 2/5 c) 8/15 d) 9/20

13) How many 6-digit numbers can be formed without repeating any digit from the digits 0, 1, 2, 3, 4 and 5?
a) 600 b) 720 c) 96 d) 120

14) If two dice are thrown, what is the probability that the sum of dots will add up to an odd number?
a) 0.25 b) 0.5 c) 0.75 d) 1

15) Find the number of possible arrangements if 6 officers sit on a round table.
a) 720 b) 120 c) 60 d) 6

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16) If a coin is tossed 4 times in a row, what is the probability that no tail shows up?
a) 1/16 b) 5/16 c) 3/16 d) 0

17) If a coin is tossed 4 times in a row, what is the probability that at least one tail shows up?
a) 9/16 b) 11/16 c) 13/16 d) 15/16

18) There are 12 boys and 8 girls in a class. A team of 5 students is to be formed. Find the probability that the team consists of 3 boys and 2 girls.
a) $\frac{12C3 \times 8C2}{20P5}$ b) $\frac{12P3 \times 8P2}{20P5}$ c) $\frac{12C3 \times 8C2}{20C5}$ d) $\frac{12P2 \times 8P3}{20C5}$

19) Find the number of ways of selecting 11 players from a team of 15 players in which the captain is always included.
a) 3003 b) 1001 c) 1365 d) 165

20) Simplify: $\frac{n!}{(n-2)!} =$
a) $n-1$ b) n^2 c) $n(n-1)!$ d) $n^2 - n$

Answers of Chapter 7 – Permutation, Combination and Probability

1) 1/9
Total possible outcomes when two dice are thrown = 36
Favorable Outcomes which can result in a sum equal to 5 are: (1, 4), (4, 1) , (2, 3), (3, 2)
Total number of favorable outcomes = 4
Probability of the said event = 4/36 = 1/9

2) 14
Number of diagonals of an n-sided polygon = $^nC_2 - n$
For 7-sided figure, n is 7 so the number of diagonals will be = $^7C_2 - 7 = 21 - 7 = 14$

3) 12
Number of rotten apples per 100 = 1
Multiply both sides by 12, we get:
Number of rotten apples in 12 x 100 (1200) apples = 12 x 1 =12 apples

4) 4
The better and easy way to solve such questions is by substituting the values from options and check which of them satisfy the given equation.
$^nP_4 \times {}^nC_3 = 96$
In the formula of ^nP_r , r must always be equal to or less than n. So in this case n cannot be 1 or 3 because this would make r greater than n. So, we are left with two options: 4 and 6.
For n = 4, we get:
$^4P_4 \times {}^4C_3 = 96$
24 x 4 = 96 which is true. So, 4 is the correct answer.

5) 5/36
Total number of outcomes = 36
Outcomes which result in a sum equal to 8 are: (2, 6), (3, 5), (4, 4), (5, 3), (6, 2)
So, Total favorable outcomes = 5

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Probability of the said event = 5/36

6) 72
Total Numbers formed from 5 digits = 5! = 120
Considering 1 and 5 (15) as a single unit, total digits formed = 4! = 24
Considering 5 and 1 (51) as a single unit, total digits formed = 4! = 24
So, the number in which 1 and 5 are not next to each other = Total Numbers – Numbers in which they are next to each other = 120 – 24 – 24 = 72

7) 1/4
Total Number of cards in a deck = 52
Number of diamond cards in a deck = 13
Probability of picking a diamond card = 13/52 = 1/4

8) 1120
Total Number of letters = 8
C occurs 3 times
O occurs 3 times
Number of arrangements of word COCOCOLA = $\frac{8!}{3! \times 3!} = 1120$

9) 3/13
Total number of cards = 52
Number of queens in a deck = 4
Probability of picking a queen = 4/52 = 1/13
Number of Face Cards which are Queen Cards= 4
Probability of picking a face card that is also queen = 4/52 = 1/13
Number of face cards in a deck = 12
Probability of picking a face card = 12/52 = 3/13
Using the formula of union of two sets we can write:
Probability of picking a queen or face card = 1/13 + 3/13 – 1/13 = 3/13

10) None of these
$$\frac{(n-1)!}{(n+1)!} = \frac{(n-1)!}{(n+1)(n)(n-1)!} = \frac{1}{n(n+1)}$$

11) 3/2
Probability of an event can only be between 0 and 1. Minimum value of probability can be 0 and maximum can be 1.

12) 9/20
Total number of tickets = 20
Tickets that are multiple of 3 = 6 tickets (3, 6, 9, 12 , 15, 18)
Tickets that are multiple of 5 = 4 tickets (5, 10, 15, 20)
Tickets that are multiple of 3 and 5 = 1 (15)
Probability of a number which is multiple of 3 or 5 = 6/20 + 4/20 – 1/20 = 9/20

13) 600
The first digit place can be filled by any digit except 0. So, there are 5 ways to fill the first digit place. When first digit is filled, the second-place digit can be filled by any of the remaining 5 digits. Next place can be filled by remaining 4 digits, the next one by remaining 3 digits, the next one by 2 digits and finally 1 digit is left for the last place.
So total number of 6-digit numbers that can be formed are = 5 x 5 x 4 x 3 x 2 x 1 = 600

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14) 0.5

When to dice are thrown the total possible outcomes are 36

The outcomes in which the sum of numbers shown is an odd number are:

(1,2), (1,4), (1,6), (2,1), (2,3), (2,5), (3,2), (3,4),.(3,6), (4,1), (4,3), (4,5), (5,2), (5,4), (5,6), (6,1), (6,3), (6,5)

Total number of favorable outcomes = 18

Probability of getting a sum equal to an odd number = 18/36 = 0.5

15) 120

Fixing one officer at one of the spots, we have to arrange the rest of the 5 officers in remaining 5 places.

Number of arrangements or permutations of 5 objects taken 5 at a time will be = $5P5$

The permutation of n objects taken r at a time is given as:

$$nPr = \frac{n!}{(n-r)!}$$

Using this formula, we get:

$$5P5 = \frac{5!}{0!} = 5! = 120$$

16) 1/16

The number of total possible outcomes for an experiment which is performed "n" times is given as:

Total possible outcomes = x^n

Here, x represents the number of outcomes when the experiment is performed once. In case of a coin toss, there are 2 possible outcomes: Head(H) or Tail(T). So, here x would be 2.

This means, when a coin is tossed 4 times the number of total possible outcomes will be = $2^4 = 16$

Some outcomes from this sample space would be: {HTHH, HHHT, TTTH, TTHH, ...}

We have to find the probability that no tail shows up on tossing the coin. There will be only 1 such event in which no tail shows up on top face i.e., when all the sides that show up are heads. This means, the number of favorable outcomes for this case would be 1.

Probability of an event is defined as the ratio of favorable outcome to the total number of outcomes. For the given case, the probability that no tail shows up on tossing the coin 4 times in a row will be = 1/16

17) 15/16

The event "Atleast One" is the complement of event "None". This means:

Probability that "Atleast one tail shows up" is complement of event that "No tail shows up".

Mathematically we can write this as:

$$P(Atleast\ One\ Tail) = 1 - P(No\ Tail)$$

We calculated the probability of no tail showing up on throwing a coin 4 times in a row. This probability is:

$$P(No\ Tail) = \frac{1}{16}$$

Using this value in the above equation, gives us:

$$P(Atleast\ One\ Tail) = 1 - \frac{1}{16} = \frac{15}{16}$$

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Note: Whenever you are asked to calculate the probability of "Atleast One", calculate the probability of "None" and subtract that from 1 to get the answer. This would be the easiest most approach to the correct answer.

18) $\frac{12C3 \times 8C2}{20C5}$

This problem involves both combinations and probability.
Total number of students = 12 + 8 = 20
Number of students in the team = 5
First, we need to find the total number of possible outcomes. Total number of possible outcomes in this case will be a team of any 5 students from a group of 20 students. Choosing 5 students from a group of 20 students is equivalent to making combination of 20 objects taken 5 at a time.
Therefore, total number of possible outcomes = $20C5$
Now we need to find the number of favorable outcomes. We have to select 3 boys from group of 12 boys and 2 girls from a group of 8 girls.
Number of ways to select 3 boys from 12 boys = 12C3
Number of ways to select 2 girls from 8 girls = 8C2
Total Number of ways to select 3 boys and 2 girls will be = 12C3 x 8C2
Therefore, the number of favorable outcomes = 12C3 x 8C2
Now, we can write the expression for desired probability. The probability of selecting 3 boys and 2 girls from a class of 12 boys and 8 girls will be:

$$\frac{12C3 \times 8C2}{20C5}$$

19) 1001
We have to choose 11 players from the 15 players such that captain is always included. As captain is always included, we do not have to choose 1 player in the 11 players. Therefore, we would have to choose 10 players out of 14 players (As captain is already chosen so we are left with 14 players in total).
Selecting 10 players from 14 players is equivalent to forming combination of 14 objects taken 10 at a time, which will be equal to = $14C10$

$$= \frac{14!}{10! \times (14-10)!} = \frac{14 \times 13 \times 12 \times 11}{4!} = \frac{14 \times 13 \times 12 \times 11}{4 \times 3 \times 2 \times 1} = 7 \times 13 \times 11 = 1001$$

Therefore, the number of ways of selecting 11 players from 15 players in a such a way that captain is always included are 1001 ways.

20) $n^2 - n$

$$\frac{n!}{(n-2)!} = \frac{n(n-1)(n-2)!}{(n-2)!} = n(n-1) = n^2 - n$$

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Chapter 8 – Mathematical Induction and Binomial Theorem

1) Sum of coefficients in expansion of $(x + y)^5$ is?
a) 30 b) 31 c) 32 d) None of these

2) What is the coefficient of a^8b^4 in the expansion $(a + b)^{12}$
a) 494 b) 495 c) 496 d) 497

3) Midterm in the expansion of $(3 - 2x)^7$ is:
a) $540x^3$ b) $-22680x^3$ c) $1040x^4$ d) None of these

4) How many terms are there in the expansion of $(1 + x)^n$?
a) 2^n b) n^2 c) $n + 1$ d) $n - 1$

5) What is the coefficient of fourth power of 'x' in $(2 - x)^6$?
a) 60 b) 10 c) 6/4 d) 2

6) The term which is independent of x in $\left(x^2 - \frac{1}{2x}\right)^7$ *is*:
a) No such term b) Middle Term c) Last Term d) None of these

Answers of Chapter 8 – Mathematical Induction and Binomial Theorem

1) 32
Sum of coefficients in a binomial expansion = 2^n, where n is the exponent.
In the given expression n = 5, so the sum of coefficients = $2^5 = 32$

2) 495
The general term of a Binomial expansion of $(a + x)^n$ is given as:

$$T_{r+1} = \binom{n}{r}(a)^{n-r}(x)^r$$

The given expression is: $(a + b)^{12}$. The general term for the Binomial expansion of this expression would be:

$$T_{r+1} = \binom{12}{r}(a)^{12-r}(b)^r$$

According to this formula, r must be equal to 4 if we want to obtain the term with a^8b^4. Using $r = 4$, we get:

$$T_{4+1} = \binom{12}{4}(a)^{12-4}(b)^4$$

$$T_{r+1} = \binom{12}{4}(a)^8(b)^4$$

So, the coefficient of a^8b^4 is $\binom{12}{4}$

$$\binom{12}{4} = 12C4 = \frac{12!}{4!\,8!} = 495$$

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3) $-22680x^3$
Since there are 7 terms in total, the midterm will be at $(1 + 7)/2 = 4^{th}$ position.
The general term of a Binomial expansion of $(a + x)^n$ is given as:

$$T_{r+1} = \binom{n}{r}(a)^{n-r}(x)^r$$

The 4th term for Binomial Expansion of given expression would be:

$$T_{3+1} = \binom{7}{3}(3)^4(-2x)^3 = -35(81)(8x^3) = -22680x^3$$

4) n + 1
The number of terms in Binomial Expansion are always 1 more than the exponent.

5) 60
The general term of a Binomial expansion of $(a + x)^n$ is given as:

$$T_{r+1} = \binom{n}{r}(a)^{n-r}(x)^r$$

For the given expression, the general term would be:

$$T_{r+1} = \binom{6}{r}(2)^{6-r}(-x)^r$$

The term with 4th power of x will be, when $r = 4$. So,

$$T_{4+1} = \binom{6}{4}(2)^{6-4}(-x)^4 = 15(4)(x^4) = 60x^4.$$

Therefore, the coefficient of 4th power of x is 60

6) No such term
The general term of a Binomial expansion of $(a + x)^n$ is given as:

$$T_{r+1} = \binom{n}{r}(a)^{n-r}(x)^r$$

Replacing n with 7, a with x^2 and x with $-\frac{1}{2x}$ in the above equation, we can write the general term of given expression as:

$$T_{r+1} = \binom{7}{r}(x^2)^{7-r}\left(-\frac{1}{2x}\right)^r$$

$$T_{r+1} = \binom{7}{r}(x^{14-2r})(-2x^{-r})$$

$$T_{r+1} = -2\binom{7}{r}x^{14-2r-r}$$

$$T_{r+1} = -2\binom{7}{r}x^{14-3r}$$

The term will be independent of x, when the exponent of x will be equal to 0. The exponent of x is $14-3r$. This cannot be zero for any positive integer value of r. This means, exponent of x cannot be zero in the given case, and there can not be such term in the expansion which is independent of x.

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Chapter 9 – 14 – Trigonometry

1) $\sin(3x)\cos(x) + \cos(3x)\sin(x) = ?$
a) sin 2x b) cos 2x c) sin 4x d) cos 4x

2) If sin(x) = 0.5 where x is in 1st quadrant, find the values of tan(2x)
a) 1 b) -1 c) 1.732 d) -1.732

3) The value of sin 13 cos 77 + cos 13 sin 77 =?
a) 0 b) 1 c) cos 26 d) sin 26

4) The value of cosine of an angle is -0.5. What will be the value for half of that angle for sine?
a) 0.5 b) -0.5 c) 0.866 d) 0.707

5) Period of Sin(3x) is
a) π b) 2π c) π/2 d) 2π/3

6) What is the sine inverse of sin(π /2)?
a) 1 b) π/2 radians c) 90 degrees d) Both b and c

7) What is the domain of the inverse cosecant function?
a) [-1,1] b) R c) R - (-1,1) d) (-1, 1)

8) cos(-Θ) =
a) cos(-Θ) b) -cos(Θ) c) cos(Θ) d) -cos(-Θ)

9) Evaluate: (cos x)(sin x)(tan x)(cot x)(csc x)
a) cos x b) 1/sec x c) Both a and b d) sin x

10) x < 0, y < 0 defines which quadrant?
a) I b) II c) III d) IV

11) Which of the following is the same as sin(-a)?
a) –sin(a) b) sin(a) c) –tan(a)/sec(a) d) Both a and c

12) If in a triangle, a=200, b=120 and γ=150 degrees, what is the area of the triangle?
a) 10932 b) 6000
c) 7050 d) Cannot be determined

13) Evaluate: $(\sin x - 1)^2 + (\sin x + 1)^2$
a) $2(\sin^2 x + 1)$ b) $1 + \sin^2 x$ c) 1 d) $2 + \sin^2 x$

14) If a side length of an equilateral triangle is 10, what will be the area of the triangle?
a) $25\sqrt{3}$ b) 43.30 d) Both a and b d) Missing information

15) sin (π /3) is equal to?
a) 0.866 b) 0.500 c) 0.707 d) 0.966

16) What is the formula for tan θ?
a) sin θ/cos θ b) 1/cot θ c) tan(180+ θ) d) All of these

17) What is the formula for cos 2θ?
a) $\frac{1-\tan^2\theta}{1+\tan^2\theta}$ b) $1 - 2\sin^2\theta$ c) Both a and b d) None of these

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18) What is the formula of cos 3α?
a) cos 2α × cos α b) $4\cos^3\alpha - 3\cos\alpha$ c) (1+cos α)/sin α d) Both a and c

19) Which one of the following pairs has the same period?
a) Tangent function and cotangent function b) Sine function and tangent function
c) Cosine function and cotangent function d) Cosecant function and tangent function

20) What is the cosine inverse of cos(0.5)?
a) 1/6 b) 1/2 c) 1/3 d) 1/4

21) Find the value of cos [$\tan^{-1}(-1)$].
a) 0.766 b) 0.707 c) 0.500 d) 0.087

22) Which of the following is equal to tan (θ/2), where θ is in 1st quadrant:
a) $\sqrt{\frac{1-\cos\theta}{1+\cos\theta}}$ b) $\frac{1}{\cot\left(\frac{\theta}{2}\right)}$ c) tan(π + θ/2) d) All of these

23) Evaluate: $\tan^{-1}\left(\frac{1}{\sqrt{3}}\right)$
a) π/6 radians b) π/3 radians c) 13π/6 radians d) Both a and c

24) What is the domain of tan x?
a) R – (2n + 1)(π/2) where 'n' cannot be zero b) R – (2n + 1)(π/2) where 'n' can be zero
c) R – n(π) where 'n' cannot be zero d) R

25) How many radians are there in a degree?
a) 0.07145 b) 0.06250 c) 0.06145 d) 0.07135

26) 30 degrees, 45 minutes and 47 seconds are equal to _____ degrees:
a) 30.56 b) 30.66 c) 30.67 d) 30.76

27) If cos x = 1, which of the following can be a possible value of x?
a) 180 b) 90 c) 270 d) 360

28) Solution set of $2\sin^2(x) - 1 = 0$ in I and II quadrants [0, 180] is:
a) π/4, 3π/4 , 5π/4, 7π/4 b) π/4, 3π/4
c) 3π/4, 5π/4 d) π/4 + nπ

29) $\sin^{-1}\left(\frac{3}{4}\right) + \sin^{-1}\left(\frac{\sqrt{7}}{4}\right) =$
a) 180° b) 270° c) 90° d) None of these

30) $\sin^{-1}\left(\frac{3}{4}\right) + \sin^{-1}\left(\frac{\sqrt{7}}{4}\right) =$
a) $\cos^{-1}(0)$ b) $\sin^{-1}(1)$ c) $\tan^{-1}(\infty)$ d) All of these

31) How many minutes are there in 360 degree?
a) 36 minutes b) 3600 minutes c) 21600 minutes d) 216000 minutes

32) If tan x= - 3/4, where angle x is in the 4th quadrant. What will be the value of cosine and sine for this angle?
a) -5/4, -3/5 b) 3/5, -5/4 c) 4/5, -3/5 d) -3/5, -5/4

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33) $\tan^{-1} x + \tan^{-1}\left(\frac{1}{x}\right) =$
a) π b) π/2 c) π/4 d) Undefined

34) Value of sin 30° is
a) 0.5 b) 0.866 c) 1 d) 0.707

35) $(\sin^2 x + \cos^2 x)(\sin^2 x - \cos^2 x)$
a) cot 2x b) sin 2x c) – cos 2x d) – tan 2x

36) If $\cos^{-1}(-1/2) = x$, what will be the value of sin (x/2) ?
a) 0.866 b) 0.5 c) 0.707 d) 0

37) $\frac{1+\tan x}{1-\tan x}$ *is the expansion of:*
a) tan(45 + x) b) tan(x + 1) c) tan(45 -x) d) None of these

38) $\cos^{-1}(-1/2)$
a) 120 degrees b) 180 degrees c) 90 degrees d) 270 degrees

39) The period of Cotangent function is
a) π b) 2π c) π/2 d) None of these

40) If tangent for an angle is square root 3. Find the tangent for double of that angle.
a) – square root 3 b) square root 3 c) 1/square root 3 d) -1/square root 3

41) Which of the following is equal to $\sin^{-1}\left(\frac{3}{5}\right)$
a) $\cos^{-1}\left(\frac{4}{5}\right)$ b) $\sec^{-1}\left(\frac{5}{4}\right)$ c) $\csc^{-1}\left(\frac{5}{3}\right)$ d) All of these

42) Sin2α equals:
a) sin α cos α b) 2cos α c) 2sin α cos α d) tan 2α – sec 2a

43) $(1 + \tan^2 x)(1 - \sin^2 x) =$
a) 0 b) 1 c) Undefined
d) Cannot be simplified any further

44) If sin t – cos t = 0, the possible value of t can be:
a) π /2 b) π c) 0 d) π /4

45) If two angles of triangle are 40° and 80° then third angle is?
a) 60 b) 70 c) 80 d) 100

46) f(x) - f(-x) is:
a) Even b) Odd c) Both a and b d) Neither a nor b

47) $\text{Cot}^2 x + 1 =$
a) $\tan^2 x$ b) $\sec^2 x$ c) $\text{cosec}^2 x$ d) $-\tan^2 x$

48) Evaluate the expression: Cos(180) + 4sin(270) + 3cos(270) + sec(180) + 4cosec(270):
a) 0 b) -10 c) 15 d) Undefined

49) The angle subtended at the center of a circle by an arc whose length is equal to the radius of the circle is equal to:
a) 1 degree b) 1 radian c) 1 minute d) 1 second

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50) Two sides of a triangle have a measure of 7 and 9. If the angle between them is 12
the measure of third side.
a) 14.05 b) 15.56 c) 13.89 d) None o

51) $\frac{1-\tan^2 x}{1+\tan^2 x} =$
a) cos (2x) b) sin (2x) c) $\cos^2 x + \sin^2 x$ d) None of

52) A circle touching all 3 vertices of a triangle is termed as:
a) Incircle b) Inscribed c) Circumcircle d) None of

53) If Cosine of an angle is 0.88, what is the measure of that angle?
a) 88 b) 55 c) 28 d) 3

54) Period of tan(x) is
a) 2π b) π c) $\pi/2$ d) 4π

55) Find the values of x in radians that satisfy the equation $sin(x) = cos(x)$ in (0, 360)
a) $3\pi/4$,$5\pi/4$ b) $\pi/4$,$5\pi/4$ c) $\pi/4$,$3\pi/4$ d) $\pi/4$,$7\pi/4$

56) $\tan(-x) =$
a) $\cot x$ b) $-\cot x$ c) $-\tan x$ d) $\tan x$

57) If $\sec^{-1}(2) = x$, find the value of x
a) 60, 120 b) $\pi/3,\ 4\pi/3$ c) $\pi/3, 5\pi/3$ d) 60, 240

58) Find the value of sin(210)
a) 0.5 b) – 0.5 c) 0.866 d) – 0.866

59) $\frac{\sec(\theta)}{1+\sec(\theta)} + \frac{\sec(\theta)}{1-\sec(\theta)} =$
a) $-2\sec(\theta)\tan^2(\theta)$ b) $-2\cot(\theta)\csc^2(\theta)$ c) $-2\cot(\theta)\csc(\theta)$ d) $-2\cos(\theta)$ sin

60) What is the period of $sin(4\theta)$?
a) π b) 4π c) 2π d) $\pi/2$

61) $\sin^{-1}(x) + \cos^{-1}(x) = ?$
a) π b) 4π c) 2π d) $\pi/2$

62) If a line intersects two sides of a triangle in such a way that it divides two sides proportio
then the line will be _____ to the 3rd side.
a) Intersect b) Perpendicular c) Parallel d) None of these

63) $sin(4x) =$
a) $4\sin^2(x)\cos^2(x)$ b) $4\sin(x)\cos^3(x) - 4\sin^3(x)\cos(x)$
c) $4\sin(2x)\cos(2x)$ d) $4\sin^2(x)\cos^3(x) - 4\sin^3(x)\cos^2(x)$

64) Simplify the following expression:
$\frac{\sin(4x) - \cos(4x)}{\sin(4x) + \cos(4x)}$
a) $\frac{\sin(4x)\cos(4x)}{2}$ b) $\frac{\sin(8x)}{\cos(8x)}$ c) $\frac{\cos^2 8x}{\sin^2 8x}$ d) $\frac{-\cos(8x)}{1+\sin(8x)}$

65) $Sin(P) + Sin(Q) =$

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a) $2\sin\left(\frac{P+Q}{2}\right)\cos\left(\frac{P-Q}{2}\right)$
b) $2\cos\left(\frac{P+Q}{2}\right)\sin\left(\frac{P-Q}{2}\right)$
c) $2\cos\left(\frac{P+Q}{2}\right)\cos\left(\frac{P-Q}{2}\right)$
d) $2\sin\left(\frac{P+Q}{2}\right)\sin\left(\frac{P-Q}{2}\right)$

66) Find the period of: $f(x) = \tan(x) + \sin\left(\frac{x}{2}\right)$
a) 8π b) 2π c) 4π d) $\pi/2$

67) Find the solution of $tan(x) = cot(x)$ for interval [0, 360]
a) 0, 45, 225, 315 b) 45, 225, 315 c) 45, 135, 225, 315 d) None of these

68) Which of the following is incorrect?
a) $cos^2(x) = 1 - sin^2(x)$
b) $1 - tan^2(x) = sec^2(x)$
c) $cot^2(x) = \csc^2(x) - 1$
d) None of these

69) If hypotenuse of a Right-Angled Triangle measures 34 units, then circumradius of circumcircle formed will be?
a) 17 b) 68 c) 34 d) None of these

70) If Area of a triangle measures 400 square units, sides a and b measure 20 and 80 units respectively, find the value of angle γ.
a) 15 b) 30 c) 45 d) 60

71) Circle cannot be inscribed in:
a) Square b) Parallelogram c) Triangle d) Rectangle

72) Range of $y = \sec^{-1}(x)$ is:
a) $[0, \pi],\ y \neq \pi/2$
b) $y \geq -1, or\ y \leq 1$
c) $[-\pi/2, \pi/2], y \neq 0$
d) $y \leq -1\ or\ y \geq 1$

73) A ladder is laying against a wall making an angle of 60 degrees. If height of the wall is 30m, find the length of the ladder?
a) 30 b) $20\sqrt{3}$ c) $30\sqrt{2}$ d) $60\sqrt{2}$

74) Which of the following is not periodic?
a) $\sin^2(x)$ b) $4\sin(x)$ c) $\cos(\sqrt{x})$ d) $\cos(2x)$

Answers of Chapter 9 – 14 – Trigonometry

1) sin 4x
$\sin(\alpha + \beta) = \sin\alpha\cos\beta + \cos\alpha\sin\beta$
We are given the right hand side of the equation. So we can write:
$\sin 3x \cos x + \cos 3x \sin x = \sin(3x + x) = \sin 4x$

2) 1.732
Since the angle is in the first quadrant, so the value of x will be 30, as sin(30) = 0.5
Thus, 2x = 60
and tan (60)= 1.732

3) 1
$\sin(\alpha + \beta) = \sin\alpha\cos\beta + \cos\alpha\sin\beta$

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We are given the right-hand side of the equation. So, we can write:
$\sin 13 \cos 77 + \cos 13 \sin 77 = \sin(13 + 77) = \sin 90 = 1$

4) 0.866
Cosine is negative in 2nd and 3rd quadrant. Cos inverse of 0.5 is 60. So, cos inverse of -0.5 is 120 (for 2nd Quadrant) or 240 (for 3rd quadrant).
Half angle of 120 is 60 and sin(60) = 0.866 Half angle of 240 is 120 and sin(120) = 0.866
Therefore, the answer to this question is 0.866

5) 2π/3
To find the period, put the argument of sin function equal to "2π" and find the corresponding value of x. This will give the value of period of the function
$i.e. 3x = 2\pi$
$so, x = \frac{2\pi}{3}$. *Thus the period of given function is* $\frac{2\pi}{3}$

6) Both b and c
The sin inverse and sin function cancel out each other leaving behind π/2 which equals 90 degrees.

7) R - (-1, 1)
All the real numbers which do not lie between -1 and 1 are domain of the inverse cosecant function.

8) cos(Θ)
Cos is an even function and for an even function f(-x) = f(x)
So, in this case cos(-Θ)=cos (Θ)

9) Both a and b
$(\cos x)(\sin x)(\tan x)(\cot x)(\csc x) = (\cos x)(\sin x)(\tan x)\left(\frac{1}{\tan x}\right)\left(\frac{1}{\sin x}\right) = \cos x = \frac{1}{\sec x}$

10) III

11) Both a and c
Since sine is an odd function, sin(- a) will be equal to - sin(a). Many students will mark "a" option as the correct answer in hurry. However, if we simplify the c option, we get:
$-\frac{\tan a}{\sec a} = -\frac{\sin a}{\cos a} \times \cos a = -\sin a$
Which is also the correct answer. So, when you face questions from trigonometry always try to simplify given options when the fourth option states "both answers are correct".

12) 6000
$Area\ of\ triangle = \frac{1}{2}ab\sin\gamma = \frac{1}{2} \times 200 \times 120 \times \sin 150 = 6000$

13) $2(\sin^2 x + 1)$
$(\sin x - 1)^2 + (\sin x + 1)^2 = (\sin^2 x + 1 - 2\sin x) + (\sin^2 x + 1 + 2\sin x)$
$= 2\sin^2 x + 2 = 2(\sin^2 x + 1)$

14) Both a and b
All the side lengths will be equal since it is an equilateral triangle. Height of the triangle will be equal to the altitude which can be found by Pythagorean theorem:
$Height = h = \sqrt{10^2 - 5^2} = \sqrt{75} = 5\sqrt{3}$

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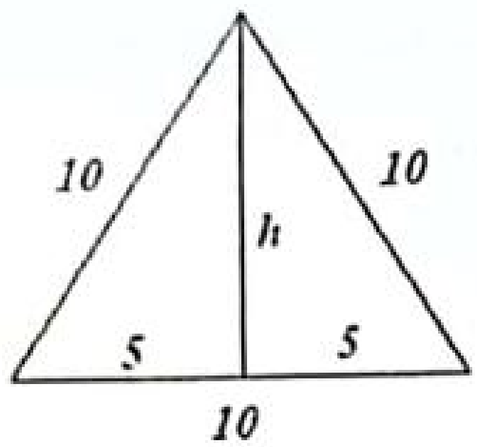
$So, Area = \frac{1}{2} \times Base \times Height = \frac{1}{2} \times 10 \times 5\sqrt{3} = 25\sqrt{3} \approx 43.30$

$\sqrt{3} \approx 1.732$



15) 0.866

16) All of these

17) Both A and B

In this question you would have to simplify option "a" to check if it gives cos(2θ)

$$\frac{1-\tan^2\theta}{1+\tan^2\theta} = \frac{1-\frac{\sin^2\theta}{\cos^2\theta}}{1+\frac{\sin^2\theta}{\cos^2\theta}} = \frac{\frac{\cos^2\theta-\sin^2\theta}{\cos^2\theta}}{\frac{\cos^2\theta+\sin^2\theta}{\cos^2\theta}} = \frac{\cos^2\theta-\sin^2\theta}{\cos^2\theta+\sin^2\theta} = \frac{\cos 2\theta}{1} = \cos 2\theta$$

18) $4\cos^3\alpha - 3\cos\alpha$

19) Tangent function and cotangent function

20) 1/2

Cos inverse and cos will cancel out each other, leaving behind 0.5.

21) 0.707

$\tan^{-1}(-1) = -45$

$\cos(-45) = 0.707$

22) All of these

All the given options are correct. Formula in option "a" is the half angle formula. Formula in option "b" is the reciprocal formula. $\pi + \theta/2$ will be in 3rd quadrant and value of tan of corresponding angles is the same in 1st and 3rd quadrants.

23) Both a and c

$\tan^{-1}\left(\frac{1}{\sqrt{3}}\right) = \frac{\pi}{6}$ radians

$\frac{13\pi}{6} = 2\pi + \frac{\pi}{6}$

So, Trigonometric ratios for both π/6 and 13 π/6 will be the same. Thus Both "a" and "c" are the correct options

24) R – (2n+1)(π /2) where 'n' can be zero

25) 0.07145

26) 30.76

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$$30\ degrees + 45\ minutes + 47\ seconds = 30 + \frac{45}{60} + \frac{47}{3600} = 30.76$$

27) 360

cos(360) = 1 cos(180) = - 1 cos(90) = 0 cos(270) = 0

28) π/4, 3π/4

$2\sin^2 x - 1 = 0$

$\sin^2 x = \frac{1}{2}$

$\sin x = \pm\frac{1}{\sqrt{2}}$

Since we are to find the solution in first two quadrants, we will only consider positive value of $\sin x$ as sine is positive in first two quadrants.

so, $\sin x = \frac{1}{\sqrt{2}} \rightarrow x = \frac{\pi}{4}$

The corresponding angle in the 2nd quadrant will be $= \pi - \frac{\pi}{4} = \frac{3\pi}{4}$

Hence, $x = \frac{\pi}{4}, \frac{3\pi}{4}$

29) 90°

$\sin^{-1} A + \sin^{-1} B = \sin^{-1}(A\sqrt{1-B^2} + B\sqrt{1-A^2})$

using the values of A and B in the above formula we get:

$$\sin^{-1}\left(\frac{3}{4}\right) + \sin^{-1}\left(\frac{\sqrt{7}}{4}\right) = \sin^{-1}\left(\frac{3}{4}\sqrt{1-\left(\frac{\sqrt{7}}{4}\right)^2} + \frac{\sqrt{7}}{4}\sqrt{1-\left(\frac{3}{4}\right)^2}\right)$$

$$= \sin^{-1}\left(\frac{3}{4}\sqrt{1-\frac{7}{16}} + \frac{\sqrt{7}}{4}\sqrt{1-\frac{9}{16}}\right) = \sin^{-1}\left(\frac{3}{4}\sqrt{\frac{9}{16}} + \frac{\sqrt{7}}{4}\sqrt{\frac{7}{16}}\right) = \sin^{-1}\left(\frac{3}{4}\times\frac{3}{4} + \frac{\sqrt{7}}{4}\times\frac{\sqrt{7}}{4}\right)$$

$$= \sin^{-1}\left(\frac{9}{16} + \frac{7}{16}\right) = \sin^{-1}\left(\frac{16}{16}\right) = \sin^{-1}(1) = 90°$$

30) All of these

This question is similar to the previous one, just with different options.

Since all the options result in the angle value equal to 90 degrees, all of them are correct.

31) 21600 minutes

1 degree = 60 minutes . So, 360 degrees = 360 x 60 minutes = 21600 minutes.

32) 4/5, -3/5

$1 + \tan^2 x = \sec^2 x$ $1 + \left(-\frac{3}{4}\right)^2 = \sec^2 x$

$\frac{25}{16} = \sec^2 x$

$\sec x = \pm\frac{5}{4}$

Since x is in 4th quadrant, and in 4th quadrant $\sec x$ is positive, So,

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$\sec x = \frac{5}{4}$

$\sin x = \cos x \times \tan x$

$Thus, \cos x = \frac{4}{5}$

$So, \sin x = \frac{4}{5} \times \left(-\frac{3}{4}\right) = -\frac{3}{5}$

33) π/2

$\tan^{-1} A + \tan^{-1} B = \tan^{-1}\left(\frac{A+B}{1-AB}\right)$

so,

$$\tan^{-1} x + \tan^{-1}\left(\frac{1}{x}\right) = \tan^{-1}\left(\frac{x+\frac{1}{x}}{1-x\left(\frac{1}{x}\right)}\right) = \tan^{-1}\left(\frac{x+\frac{1}{x}}{1-1}\right) = \tan^{-1}\left(\frac{1}{0}\right)$$

$\frac{1}{0}$ *is undefined, so we are to find the angle whose tangent is undefined.* $\tan\left(\frac{\pi}{2}\right)$ *is undefined, so* $\frac{\pi}{2}$ *is the asnwer.*

34) 0.5

35) – cos 2x

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

so, the given equation becomes equal to:

$1(\sin^2 x - \cos^2 x)$

$= -1(\cos^2 x - \sin^2 x)$

$= -\cos 2x$

36) 0.866

$\cos^{-1}(-1/2) = 120°$

$x/2 = 60$

so, x = 120

sin (60) = 0.866

37) tan(45+x)

$$\tan(45+x) = \frac{\tan 45 + \tan x}{1 - \tan 45 \tan x} = \frac{1+\tan x}{1-\tan x}$$

38) 120 degrees

39) π

40) – square root 3

Let the angle be x, $\rightarrow \tan x = \sqrt{3}$

$x = \tan^{-1}\sqrt{3} = 60°$

$2x = 120°$

$\tan 120 = -\sqrt{3}$

41) All of these

$Let, \sin^{-1}\left(\frac{3}{5}\right) = x,$

$so, \sin x = \frac{3}{5}$

$$\cos x = \sqrt{1-\sin^2 x} = \sqrt{1-\left(\frac{3}{5}\right)^2} = \sqrt{1-\frac{9}{25}} = \sqrt{\frac{16}{25}} = \frac{4}{5}$$

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$x = \cos^{-1}\left(\frac{4}{5}\right)$

$so, \sin^{-1}\left(\frac{3}{5}\right) = \cos^{-1}\left(\frac{4}{5}\right)$

$Also, \sin^{-1}\theta = \csc^{-1}\left(\frac{1}{\theta}\right)$

$so, \sin^{-1}\left(\frac{3}{5}\right) = \csc^{-1}\left(\frac{5}{3}\right)$

$Similarly, \cos^{-1}\theta = \sec^{-1}\left(\frac{1}{\theta}\right)$

$so, \cos^{-1}\left(\frac{4}{5}\right) = \sec^{-1}\left(\frac{5}{4}\right)$

$Thus\ all\ 3\ options\ are\ equivalent\ to\ \sin^{-1}\left(\frac{3}{5}\right)$

42) 2sin α cos α

43) 1

$1 + \tan^2 x = \sec^2 x \qquad 1 - \sin^2 x = \cos^2 x$

$so, (1 + \tan^2 x)(1 - \sin^2 x) = \sec^2 x\,(\cos^2 x) = 1$

44) π /4

sin t – cos t can be zero when:

1) either both sin(t) and cos(t) are zero

2) or both are equal

Sin(t) and cos(t) cannot both be zero for the same value of angle. However, they can be equal when t = π /4. $\sin(\pi/4) = \cos(\pi/4) = \frac{1}{\sqrt{2}}$

45) 60

Sum of angles of a triangle = 180 degrees.

so,

40 + 80 + 3rd angle = 180 $\qquad$ 3rd angle = 180 – 40 – 80 = 60 °

46) Odd

Replacing x with -x , we get:

f(-x) – f(-(-x)) = f(-x) – f(x) = – (f(x) – f(-x)) = Negative of original function.

So, f(x) – f(-x) is odd

47) $\text{cosec}^2 x$

48) -10

Cos(180) = -1 sin(270) = -1 cos(270) = 0 sec(180) = -1 cosec(270) = -1

Using these values in the given expression we get:

Cos(180) + 4sin(270) + 3cos(270) + sec(180) + 4cosec(270) = -1 + 4(-1) + 3(0) + (-1) + 4(-1) = - 10

49) 1 radian

50) 13.89

Since we are given two sides and an included angle we can use the law of cosines to solve this question.

$c^2 = a^2 + b^2 - 2ab\cos\gamma$

$Using\ the\ values, we\ get:$

$c^2 = 7^2 + 9^2 - 2(7)(9)\cos(120) = 193$

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$c = 13.89$

51) cos (2x)

$$\frac{1-\tan^2 x}{1+\tan^2 x} = \frac{1-\frac{\sin^2 x}{\cos^2 x}}{1+\frac{\sin^2 x}{\cos^2 x}} = \frac{\frac{\cos^2 x-\sin^2 x}{\cos^2 x}}{\frac{\cos^2 x+\sin^2 x}{\cos^2 x}} = \frac{\cos^2 x-\sin^2 x}{\cos^2 x+\sin^2 x} = \frac{\cos^2 x-\sin^2 x}{1} = \cos^2 x-\sin^2 x$$

$= \cos(2x)$

52) Circumcircle

53) 28

To answer this question, you must remember the values of basic trigonometric functions i.e., the values of 0, 30, 45, 60 and 90 of all 6 trigonometric functions.
For this question we need the values of cosine only.

$\cos 0 = 1$

$\cos 30 = \frac{\sqrt{3}}{2} = 0.866$

$\cos 45 = \frac{1}{\sqrt{2}} = 0.707$

$\cos 60 = \frac{1}{2} = 0.5$

$\cos 90 = 0$

Let the unknown angle be x. We are given that $\cos x = 0.88$
From the above values we can see that 0.88 is closest to 0.866. This means, the value of x must be somewhere near 30. The only option near 30 is 28, therefore, this is the correct answer.
Always use this same strategy when faced with such a similar question in the test.

54) π

The period of basic trigonometric functions are:
Period of Sine = Period of Cosine = Period of Cosec = Period of Secant = 2π
Period of Tan = Period of Cot = π

55) $\pi/4, 5\pi/4$

$\sin(x) = \cos(x)$

$\frac{\sin x}{\cos x} = 1$

$\tan x = 1$

$\tan x$ is equal to 1 in first quadrant for 45 degrees and in 3rd quadrant for 225(180+45) degrees. Measure of these angles in radians is $\pi/4$ and $5\pi/4$

56) $-\tan x$

cos and *sec* are even trigonometric functions while *sin, cosec, cot* and *tan* are odd trigonometric functions.
For an even function: $f(-x) = f(x)$
For an odd function: $f(-x) = -f(x)$
Since, *tan* is an odd function, $\tan(-x)$ will be equal to " $-\tan(x)$ "

57) $\pi/3, 5\pi/3$

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If $\sec^{-1}(2) = x$, this means: $\sec(x) = 2$

$\rightarrow \frac{1}{\cos(x)} = 2$

$\rightarrow \frac{1}{2} = \cos(x)$

Remember that cos is positive in 1st and 4th quadrant only. For 1st quadrant the value of x that satisfies $\cos(x) = 1/2$ is 60 degrees of $\pi/3$ radians.

The corresponding value in 4th quadrant will be calculated as:

360 – 60 = 300 degrees

Or

$$2\pi - \frac{\pi}{3} = \frac{5\pi}{3} radians$$

So, the set of correct answers will be:

60, 300 in degrees or $\pi/3, 5\pi/3$ in radians.

58) **– 0.5**

210 degrees lies in 3rd quadrant and value of sin is negative in 3rd quadrant. We can rewrite the equation as:

$\sin(210) = \sin(180 + 30)$

Using the rule:

$\sin(\pi + x) = -\sin(x)$

We can write:

$\sin(210) = -\sin(30) = -0.5$

59) $-2\cot(\theta)\csc(\theta)$

$$\frac{\sec(\theta)}{1+\sec(\theta)} + \frac{\sec(\theta)}{1-\sec(\theta)}$$

$$= \frac{\sec(\theta)(1-\sec(\theta)) + \sec(\theta)(1+\sec(\theta))}{1-\sec^2(\theta)}$$

$$= \frac{\sec(\theta) - \sec^2(\theta) + \sec(\theta) + \sec^2(\theta)}{1-\sec^2(\theta)}$$

$$= \frac{2\sec(\theta)}{1-\sec^2(\theta)}$$

Using the Pythagorean Identity:

$1 + \tan^2(\theta) = \sec^2(\theta)$

$\rightarrow 1 - \sec^2(\theta) = -\tan^2(\theta)$

The above equation becomes equal to:

$$\frac{2\sec(\theta)}{1-\sec^2(\theta)} = \frac{2\sec(\theta)}{-\tan^2(\theta)}$$

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$$= \frac{\frac{2}{\cos(\theta)}}{-\frac{\sin^2(\theta)}{\cos^2(\theta)}}$$

$$= \frac{2}{\cos(\theta)} \times \left(-\frac{\cos^2(\theta)}{\sin^2(\theta)}\right)$$

$$= \frac{-2\cos(\theta)}{\sin^2(\theta)}$$

$$= -2\frac{\cos(\theta)}{\sin(\theta)} \times \frac{1}{\sin(\theta)}$$

$$= -2\cot(\theta)\csc(\theta)$$

60) $\pi/2$

To find the period of any trigonometric function, set the argument of given function equal to period of same basic trigonometric function and find the corresponding value of θ. This value of θ will be the period of the given function.

The argument of given function $sin(4\theta)$ is 4θ and the period of sin function is 2π. So, we have:

$4\theta = 2\pi$

$\rightarrow \theta = \frac{\pi}{2}$

This is the period of the given function

61) $\pi/2$

Remember the following inverse trigonometric identities:

$\sin^{-1}(x) + \cos^{-1}(x) = \frac{\pi}{2}$

$\tan^{-1}(x) + \cot^{-1}(x) = \frac{\pi}{2}$

$\csc^{-1}(x) + \sec^{-1}(x) = \frac{\pi}{2}$

62) Parallel

The "Side Splitter" Theorem says that if a line intersects two sides of a triangle and is parallel to the third side of the triangle, it divides those two sides proportionally.

63) $4\sin(x)\cos^3(x) - 4\sin^3(x)\cos(x)$

Using the double angle identity: $\sin(2\theta) = 2\sin\theta\cos\theta$, we can write the given expression as:

$sin(4x) = \sin(2(2x)) = 2\sin(2x)\cos(2x)$

Again, using the same identity, we can write:

$2\sin(2x)\cos(2x) = 2[2\sin(x)\cos(x)]\cos(2x)$

$= 4\sin(x)\cos(x)\cos(2x)$

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Using the double angle identity of cosine: $\cos(2\theta) = \cos^2\theta - \sin^2\theta$, we can write the previous expression as:

$$4\sin(x)\cos(x)\cos(2x) = 4\sin(x)\cos(x)\,[\cos^2(x) - \sin^2(x)]$$

$$= 4\sin(x)\cos^3(x) - 4\sin^3(x)\cos(x)$$

64) $\dfrac{-\cos(8x)}{1+\sin(8x)}$

Multiplying and dividing by $\sin(4x) + \cos(4x)$, we get:

$$\frac{\sin(4x) - \cos(4x)}{\sin(4x) + \cos(4x)} = \frac{\sin(4x) - \cos(4x)}{\sin(4x) + \cos(4x)} \times \frac{\sin(4x) + \cos(4x)}{\sin(4x) + \cos(4x)}$$

$$= \frac{\sin^2(4x) - \cos^2(4x)}{(\sin(4x) + \cos(4x))^2} = \frac{-(\cos^2(4x) - \sin^2(4x))}{\sin^2(4x) + \cos^2(4x) + 2\sin(4x)\cos(4x)}$$

Using the identities:

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

We can write the previous expression as:

$$\frac{-(\cos^2(4x) - \sin^2(4x))}{\sin^2(4x) + \cos^2(4x) + 2\sin(4x)\cos(4x)} = \frac{-\cos(8x)}{1+\sin(8x)}$$

65) $2\sin\left(\frac{P+Q}{2}\right)\cos\left(\frac{P-Q}{2}\right)$

Remember these formulas for sum and difference of Sines and Cosines:

$Sin(P) + Sin(Q) =$

$$\sin P + \sin Q = 2\sin\left(\frac{P+Q}{2}\right)\cos\left(\frac{P-Q}{2}\right)$$

$$\sin P - \sin Q = 2\cos\left(\frac{P+Q}{2}\right)\sin\left(\frac{P-Q}{2}\right)$$

$$\cos P + \cos Q = 2\cos\left(\frac{P+Q}{2}\right)\cos\left(\frac{P-Q}{2}\right)$$

$$\cos P - \cos Q = -2\sin\left(\frac{P+Q}{2}\right)\sin\left(\frac{P-Q}{2}\right)$$

66) 4π

Period of $\tan(x)$ is π and the period of $\sin\left(\frac{x}{2}\right)$ is 4π. The period of $f(x)$ will be the LCM of these individual periods.

The LCM or The Lowest Common Multiple of π and 4π is "4π". This means, the period of $f(x) = \tan(x) + \sin\left(\frac{x}{2}\right)$ is 4π.

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67) **45, 135, 225, 315**
Tangent and Cotangent have the same value at 45 degrees in the first quadrant. This value is equal to 1. This pattern repeats in all the quadrants, the general solution for $tan(x) = cot(x)$ can be written as:
$x = \frac{\pi}{4} + \frac{k\pi}{2}$
Where, k is an integer. In degreed this solution can be written as:
$x = 45 + 90k$, Where k is an integer
For the given interval [0, 360], the values of x will be:
$x = 45 + 90(0) = 45$ $\quad$ $x = 45 + 90(1) = 135$
$x = 45 + 90(2) = 225$ $\quad$ $x = 45 + 90(3) = 315$

68) $\mathbf{1 - tan^2(x) = sec^2(x)}$
The 3 Pythagorean Identities are:
$\sin^2 x + \cos^2 x = 1$ $\quad$ $1 + \tan^2 x = \sec^2 x$ $\quad$ $1 + \cot^2 x = \csc^2 x$
Based on these, we can see that the equation in 2nd choice is a wrong one.

69) **17**
The hypotenuse of a Right-Angled Triangle forms the diameter of its circumcircle, and the circumcenter is the midpoint of hypotenuse. This means circumradius is always equal to half of the length hypotenuse for a Right-Angled Triangle.

70) **30**
We can express the area of a triangle in terms of measures of two sides and an included angle.
$Area = \frac{1}{2}bc\sin\alpha = \frac{1}{2}ca\sin\beta = \frac{1}{2}ab\sin\gamma$
We will be using: $\quad Area = \frac{1}{2}ab\sin\gamma$
Substituting the values, we get:
$400 = \frac{1}{2} \times 20 \times 80 \times \sin\gamma$
$\sin\gamma = \frac{2 \times 400}{20 \times 80} = \frac{1}{2}$
$\gamma = \sin^{-1}\left(\frac{1}{2}\right)$
$\gamma = 30$

71) **Parallelogram**
A circle can be inscribed in a square. When a circle is inscribed in a square, the length of each side of the square is equal to the diameter of the circle.
A circle can be inscribed in a Rectangle. A circle inscribed in a rectangle touches the larger side of the rectangle with its ends i.e., the larger sides of the rectangle are tangent to the circle.
A circle can be inscribed in a Triangle. In this case, all three sides of the triangle are tangents to the circle.
The only choice we are left with is Parallelogram. A circle cannot be inscribed in a parallelogram because of its geometry and angles being not equal to 90 degrees.

72) $[0,\ \pi],\ y \neq \pi/2$
Range of $y = \sec^{-1}(x)$ is : $[0,\ \pi],\ y \neq \pi/2$
Domain of $y = \sec^{-1}(x)$ is $x \geq -1, or\ x \leq 1$
Range of $y = \csc^{-1}(x)$ is : $[-\pi/2,\ \pi/2], y \neq 0$

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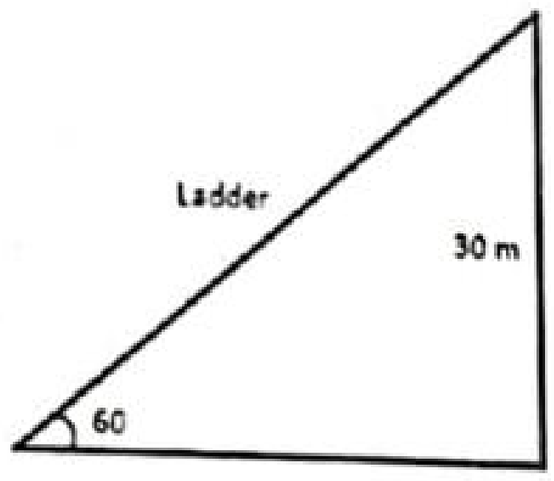
Domain of $y = \csc^{-1}(x)$ is $x \leq -1, or\ x \geq 1$

73) $20\sqrt{3}$

We can represent the given scenario in picture form as shown below:



We have a right-angled triangle. The ladder forms the hypotenuse of the right-angled triangle. We have a measure of an angle and the side opposite to the angle. Remember that "sin" relates the opposite side and hypotenuse as:

$$\sin\theta = \frac{Opposite}{Hypotenuse}$$

Let the length of ladder be "x". Using the values in the above equation, we get:

$$\sin 60 = \frac{30}{x}$$

$$x = \frac{30}{\sin 60}$$

$$x = \frac{30}{\frac{\sqrt{3}}{2}}$$

$$x = \frac{30 \times 2}{\sqrt{3}} = \frac{3 \times 10 \times 2}{\sqrt{3}} = \sqrt{3} \times 10 \times 2 = 20\sqrt{3}$$

74) $\cos(\sqrt{x})$

$$\sin^2(x) = \frac{1}{2}(1 - \cos(2x))$$

Since, $\cos(2x)$ is periodic with a period equal to π, $\sin^2(x)$ will also be a periodic function.

$\sin(x)$ is a periodic function with a period equal to 2π. Multiplying it with any constant number will have no effect on its periodicity. So, $4\sin(x)$ is a periodic function.

$\cos(x)$ is a periodic function, and all the variations of $\cos(x)$ of the form $\cos(kx)$ are also periodic with a period equal to $2\pi/k$. So, period of $\cos(2x)$ will be $2\pi/2 = \pi$.

This leaves us with only one choice $\cos(\sqrt{x})$. First thing to note is that square root is not defined for negative values. So, in $\cos(\sqrt{x})$ value of x must be equal to or greater than 0. There exists no such number T for which $\cos(\sqrt{x+T}) = \cos(\sqrt{x})$. This means, $\cos(\sqrt{x})$ is not a periodic function.

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Questions from 2nd Year Mathematics

Chapter 1 – Functions and Limits

1) If f(x) = g(x) and g(x) is inverse of f(x), what will be the value of g'(1)?
a) 0 b) e c) 1 d) ln 1

2) If $f(x) = \frac{1}{x^2}$, find the value of $f^{-1}(1)$
a) $\sqrt{2}$ b) $\frac{1}{\sqrt{2}}$ c) 1 d) 0

3) If $f(x) = (x + 1)^2$ and $g(x) = x - 1$, find f(g(4))
a) 4 b) 16 c) 25 d) 9

4) Evaluate: $\lim_{x \to 6} \left(\frac{\sqrt{x} - \sqrt{6}}{x - 6} \right)$
a) $\sqrt{6}$ b) $\frac{1}{2\sqrt{6}}$ c) 0 d) Limit does not exist

5) Evaluate: $\lim_{n \to \infty} \left(1 - \frac{1}{n}\right)^{2n}$
a) e b) e^{-1} c) e^2 d) e^{-2}

6) A function is said to be even when:
a) f(x) = f(x) b) f(-x) = f(x) c) f(-x) = - f(x) d) f(-x) f(-x)

7) Evaluate: $\lim_{x \to \infty} \left(\frac{\ln(x)}{x} \right)$
a) 0 b) 1 c) -1 d) None of these

8) If f(x) = 2x + 3, $g(x) = x^3$, find gof
a) $2x^3 + 3$ b) $(2x + 3)^3$ c) $2x^3$ d) None of these

9) Domain of the function: $\frac{1}{\sqrt{x^2 + 3x + 2}}$ *is:*
a) $(-\infty, -2) \cup (-1, \infty)$ b) $(-2, -1)$
c) $x \geq -1$ d) $(-\infty, \infty)$

10) Find $f^{-1}(x)$ of $f(x) = x^3$
a) $x^{\frac{1}{3}}$ b) 3^x c) $\left(x^{\frac{2}{3}}\right)^{0.5}$ d) Both a and c

11) If Domain of a function $f(x) = x^2$ is {1, -1, 0, 2, -2}, find its range
a) {1, 0, 4} b) {1, 0, -4} c) {1, 1, 0, 4 , 4} d) {1, 1, 0, -4, -4}

12) Determine if the following function is even or odd: $\frac{f(x) - f(-x)}{2}$
a) Even b) Odd c) Either even or odd d) All of these

13) If x is a real number, which of the following function is odd?
a) – sin(x) b) – cos(x) c) |x| d) $e^x - 1$

14) If f(x) = 2, find the value of f(x + 2)

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a) 4 b) 8 c) 2 d) 0

15) Vertical asymptotes of the graph $f(x) = \frac{x-2}{x^2-4}$ occur at:
a) x = -2 b) x = 2 c) y = 2 d) Both a and b

16) Evaluate: $\lim_{x\to 0} \frac{\sin(6x)}{x}$
a) 0 b) 6 c) 1/6 d) Does not exist

17) If $\lim_{x\to 3}\left(\frac{x^2+ax-33}{x-3}\right) = 14$, find the value of a.
a) – 8 b) 8 c) – 12 d) 12

18) $\lim_{x\to 0}\left(\frac{1-\cos x}{x}\right) =$
a) 0 b) 1 c) ∞ d) Does not exist

19) If f(x) is continuous , find the values of a and b.
$f(x) = ax^2 + 2x + 1, x \le 2$
$f(x) = 2x + b, x > 2$
a) a = 2, b = 4 b) a = 0, b = 1 c) a = 1, b = 3 d) a = -1, b = 5

20) If $f(x) = x^2 + 1,\ g(x) = 5x + 1$, find $f(g(x))$
a) $25x^2 + 10x + 2$ b) $5x^2 + 6$ c) $5x^3 + x^2 + 5x + 1$ d) $(x^2 + 1)^2(5x + 1)$

21) $\lim_{\theta\to 0}\left(\frac{\sin(6\theta)}{\theta}\right) =$
a) 0 b) 6 c) 1/6 d) Does not exist

Answers of Chapter 1 – Functions and Limits

1) 1

Since f(x) = g(x) and g(x) is the inverse of f(x), this means f(x) is the inverse of its own self. Such a self-inverse function is known as involution. Common examples are:

i) f(x) = x and ii) f(x) = 1/x

Inverse of these functions are equal to the original functions.

i) f'(x) = x and ii) f'(x) = 1/x

Since in the given question f(x) = g(x), we can write:

g(x) = f(x) = x Considering example i) only

g'(x) = f'(x) = x

g'(1) = f'(1) = 1

2) 1

$f(x) = \frac{1}{x^2}$

$y = \frac{1}{x^2}$

$x^2 = \frac{1}{y}$

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$\rightarrow x = \pm\sqrt{\frac{1}{y}}$

Replacing x with $f^{-1}(y)$, we get:

$f^{-1}(y) = \pm\sqrt{\frac{1}{y}}$

$f^{-1}(x) = \pm\sqrt{\frac{1}{x}}$

$f^{-1}(1) = \pm\sqrt{\frac{1}{1}} = \pm 1$

3) 16

$f(g(x)) = f(x-1) = ((x-1)+1)^2 = (x-1+1)^2 = x^2$
$f(g(4)) = (4)^2 = 16$

4) $\frac{1}{2\sqrt{6}}$

$$\lim_{x\to 6}\left(\frac{\sqrt{x}-\sqrt{6}}{x-6}\right) = \lim_{x\to 6}\left(\frac{\sqrt{x}-\sqrt{6}}{(\sqrt{x}-\sqrt{6})(\sqrt{x}+\sqrt{6})}\right) = \lim_{x\to 6}\left(\frac{1}{\sqrt{x}+\sqrt{6}}\right) = \frac{1}{\sqrt{6}+\sqrt{6}} = \frac{1}{2\sqrt{6}}$$

5) e^{-2}

$$\lim_{n\to\infty}\left(1-\frac{1}{n}\right)^{2n} = \lim_{n\to\infty}\left(1+\left(\frac{1}{-n}\right)\right)^{2n} = \lim_{n\to\infty}\left(1+\left(\frac{1}{-n}\right)\right)^{-n\times(-2)} = \lim_{n\to\infty}\left(\left(1+\left(\frac{1}{-n}\right)\right)^{-n}\right)^{-2} = e^{-2}$$

Rule used:

$$\lim_{n\to\infty}\left(1+\frac{1}{x}\right)^{x} = e$$

6) $f(-x) = f(x)$

7) 0

If we replace the value of x in the given expression it becomes $\frac{\infty}{\infty}$ which is an indeterminate form. To solve such type of expressions, we can take the derivative of numerator and denominator separately and then evaluate the limit as shown below:

$$\lim_{x\to\infty}\left(\frac{\ln(x)}{x}\right) = \lim_{x\to\infty}\left(\frac{\frac{d}{dx}(\ln(x))}{\frac{d}{dx}(x)}\right) = \lim_{x\to\infty}\left(\frac{\frac{1}{x}}{1}\right) = \lim_{x\to\infty}\left(\frac{1}{x}\right) = 0$$

8) $(2x+3)^3$

$g(x) = x^3, \quad f(x) = 2x+3$
$gof(x) = g(f(x)) = g(2x+3) = (2x+3)^3$

9) $(-\infty,-2) \cup (-1,\infty)$

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Domain is the set of all possible values for which the function is defined. The value ur cannot be negative neither the denominator of the fraction can be equal to zero.
So, to find the Domain we need to find out for which values of x the denominator of the will be greater than zero. i.e.

$\sqrt{x^2+3x+2} > 0$

$x^2+3x+2 > 0$ $\quad x^2+2x+x+2 > 0$ $\quad x(x+2)+1(x+2) > 0$

$(x+2)(x+1) > 0$

The checkpoints are $x = -2$ *and* $x = -1$. $(x+2)(x+1) = 0$ *at* $x = -2$ *and* $x = -1$

For any value of $x < -2, (x+2)(x+1) > 0$

For any value of x *between* -2 *and* $-1, (x+2)(x+1) < 0$

For any value of $x > -1, (x+2)(x+1) > 0$

So, for $x < -2$ *or* $x > -1$, *the denominator is greater than* 0

Therefore the Domain is: $(-\infty, -2) \cup (-1, \infty)$

10) Both a and c

Inverse of x^3 *is* $\sqrt[3]{x}$ *or* $x^{\frac{1}{3}}$, *which makes option a the correct one.*

If we simplify the c option: $\left(x^{\frac{2}{3}}\right)^{0.5} = \left(x^{\frac{2}{3}}\right)^{\frac{1}{2}} = x^{\frac{1}{3}}$, *so option c is also the correct answer.*

Therefore, both a and c are the correct answers.

11) {1, 0, 4}

We are given a set of values from the Domain, we can find the range by finding the value of the function at these values.

$f(x) = x^2$ $\quad f(1) = 1^2 = 1$ $\quad f(-1) = (-1)^2 = 1$ $\quad f(0) = 0^2 = 0$ $\quad f(2) = 2^2 = 4$ $\quad f(-2) = (-2)^2 = 4$

Therefore, the values in the range are: {1, 0, 4}

Note: You have to write each value in the range only once.

12) Odd

$$Let\ g(x) = \frac{f(x) - f(-x)}{2}$$

Replace each occurrence of x in the given function with –x to check if the function is even or odd or neither.

$$g(-x) = \frac{f(-x) - f(-(-x))}{2} = \frac{f(-x) - f(x)}{2} = -\frac{f(x) - f(-x)}{2} = -g(x)$$

Since $g(-x) = -g(x)$, the given function is odd.

13) – sin(x)

For an odd function: f(-x) = -f(x). We must check each of the options one by one to find which of them satisfy this condition

For f(x) = - sin(x)	f(-x) = - sin(-x) = -(- sin(x)) = - f(x)	Hence this function is Odd
For f(x) = - cos(x)	f(-x) = - cox(-x) = - cos(x) = f(x)	Hence this function is Even
For f(x) = |x|	f(-x) = |-x| = |x| = f(x)	Hence this function is Even
For f(x) = e^x - 1	f(-x) = e^{-x} – 1	This function is neither even nor odd

14) 2

The function is defined as f(x) = 2

This is a constant function, which means for all values of x the value of f(x) will always be 2.
i.e., even if the value of x is changed by adding 2, the value of f(x) will still be 2.

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The graph of f(x) will be a horizontal line passing through the point (0, 2)

15) $x = -2$

$$\frac{(x-2)}{(x^2-4)} = \frac{(x-2)}{(x+2)(x-2)}$$

Vertical asymptotes occur at the value where the denominator is zero. So, in the given case the vertical asymptotes can occur at x = 2 and x = -2. However, if both numerator and denominator are zero for the same value, we get a hole at that point instead of a vertical asymptote.

Therefore, the given rational expression will have a hole at x = 2 and vertical asymptote at x = -2

16) 6

$$\lim_{x\to 0}\frac{\sin(6x)}{x} = \lim_{x\to 0}\frac{6\ \sin(6x)}{6x} = 6\lim_{x\to 0}\frac{\sin(6x)}{6x} = 6(1) = 6$$

17) 8

$$\lim_{x\to 3}\left(\frac{x^2+ax-33}{x-3}\right)$$

Notice that we cannot substitute the value of x = 3 directly into the expression, else the denominator will be 0 and the result would be undefined. We can use the alternate method of taking derivative of numerator and denominator separately, and then using the value of x.

$$\lim_{x\to 3}\left(\frac{\frac{d}{dx}(x^2+ax-33)}{\frac{d}{dx}(x-3)}\right)$$

$$= \lim_{x\to 3}\left(\frac{2x+a}{1}\right)$$

$$= \lim_{x\to 3}(2x+a)$$

$$= 2(3)+a$$

$$= 6+a$$

We are given the value of this limit to be equal to 14. This gives us:

$6 + a = 14$

$14 - 6 = a$

$a = 8$

18) 0

$$\lim_{x\to 0}\left(\frac{1-\cos x}{x}\right)$$

Multiplying and dividing by $1+\cos x$, we get:

$$\lim_{x\to 0}\left(\frac{1-\cos x}{x}\times\frac{1+\cos x}{1+\cos x}\right)$$

$$= \lim_{x\to 0}\left(\frac{1-\cos^2 x}{x\,(1+\cos x)}\right)$$

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$$= \lim_{x \to 0} \left(\frac{\sin^2 x}{x\,(1 - \cos x)} \right)$$

$$= \lim_{x \to 0} \left(\frac{\sin x}{x} \right) \lim_{x \to 0} \left(\frac{\sin x}{1 - \cos x} \right)$$

$$= 1 \times \frac{\sin 0}{1 - \cos 0} = 0$$

19) a = 1, b = 3

If $f(x)$ is continuous then the value of $f(x) = ax^2 + 2x + 1$ and $f(x) = 2x + b$ must be the same at x = 2

Substituting the value of x = 2, we get:

$f(2) = 4a + 4 + 1 = 4a + 5$

And

$f(2) = 4 + b$

These two expressions must be equal. So,

$4a + 5 = 4 + b$

$4a - 1 = b$

Now, from the given choices we have to check which set of values satisfy this equation.

For a = 2, b = 4:

$4(2) - 1 = 4 \quad \rightarrow 7 = 4$ which is wrong.

For a = 0, b = 1

$4(0) - 1 = 1 \quad \rightarrow -1 = 1$ which is wrong.

For a = 1, b = 3

$4(1) - 1 = 3$

$3 = 3$ which is correct. So, this set of values is our correct answer.

20) $25x^2 + 10x + 2$

$f(g(x))$ denotes the composition of both functions. To find $f(g(x))$ we have to replace every occurrence of x in $f(x)$ with the value of $g(x)$. So,

$f(g(x)) = f(5x + 1)$

$= (5x + 1)^2 + 1 = 25x^2 + 10x + 1 + 1 = 25x^2 + 10x + 2$

21) 6

$$\lim_{\theta \to 0} \left(\frac{\sin(6\theta)}{\theta} \right)$$

Multiplying and dividing by 6, we get:

$$\lim_{\theta \to 0} \left(6 \times \frac{\sin(6\theta)}{6\theta} \right) = 6 \lim_{\theta \to 0} \left(\frac{\sin(6\theta)}{6\theta} \right)$$

Using the rule: $\lim_{x \to 0} \left(\frac{\sin x}{x} \right) = 1$

We get the answer: $6 \lim_{\theta \to 0} \left(\frac{\sin(6\theta)}{6\theta} \right) = 6(1) = 6$

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Answers of Chapter 2 – Differentiation

1) Derivative of $2x^5$ is
a) 10 b) 10x c) $10x^4$ d) $10x^5$

2) Which of the following Mathematician gave the notation dy/dx for the derivative?
a) Newton b) Cauchy c) Lagrange d) Leibniz

3) Ripples in shape of circles are produced when a stone is thrown in water. If the rate of change of circumference of these circles is 12π, what is the rate of change of Area of the circle when the radius is 3cm?
a) 28π b) 36π c) 54π d) 60π

4) What are the two numbers whose sum is 20 but their product is maximum?
a) 10, 10 b) 15, 5 c) 0, 20 d) 1, 19

5) What is the derivative of $2t^3$ with respect to $3t^2$?
a) $2t^3$ b) t c) t^2 d) 1/t

6) The function of the form f(x, y) = c, can be differentiated using which of the following methods?
a) Chain Rule b) Implicit differentiation
c) Product Rule d) Newton's method

7) Find the derivative of 3^{2x}
a) $2\ln(3) \times 3^{2x}$ b) $\ln(3) \times 3^{2x}$ c) $2x \times 3^{2x}$ d) $\ln(2) \times 3^{2x}$

8) The derivate of f(x) with respect to 'x' is defined as:
a) The rate of change of f(x) with respect to 'x'
b) The increase in the relevance rate of f(x) with respect to 'x'
c) The decrease in the relevance rate of f(x) with respect to 'x'
d) None of these

9) Derivative of $\text{cosec}^{-1}(x)$ is:
a) $-\frac{1}{|x|\sqrt{x^2-1}}$ b) $-\frac{1}{|x|\sqrt{x^2+1}}$ c) $\frac{1}{|x|\sqrt{x^2-1}}$ d) $-\frac{1}{\sqrt{x^2-1}}$

10) What is the derivative of $\tan(\sqrt{x})$
a) $\sec^2(\sqrt{x})$ b) $\frac{1}{\sqrt{2}}\sec^2(\sqrt{x})$ c) $\frac{\sec^2(\sqrt{x})}{2\sqrt{x}}$ d) $\sec^2(\sqrt{x})\tan\left(\frac{1}{2\sqrt{x}}\right)$

11) Differentiate ln(e) with respect to 'x'
a) 1/e b) 0 c) 1/x d) e

12) For which of the following intervals is the function $y = x^2 - 6x + 5$ increasing?
a) $1 < x < 5$ b) $x > 5$ c) $x > 3$ d) $x < 1$

13) Differentiate sin(2x) with respect to x.
a) 2cos(2x) b) 2sin(2x) c) $2(1 - \sin^2(x))$ d) Both a and c

14) Which of the following Mathematician gave the notation D f(x) for the derivative?
a) Newton b) Cauchy c) Lagrange d) Euler

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15) $\frac{d(0)}{dx} =$
a) Constant b) Zero c) Infinite d) None of these

16) Derivative of sin(x) is
a) – cos(x) b) cos(x) c) cosec(x) d) – cosec(x)

17) If $x = 3t$ and $y = at$, find $\frac{dy}{dx}$
a) 3a b) a/3 c) 3/a d) a + 3

18) Find the derivative of the following expression:
$e^{x^{-2}}$
a) $-2e^{x^{-2}}$ b) $-\frac{1}{2}e^{x^{-1}}$ c) $-\frac{2}{3}e^{x^{-2}}$ d) $e^{x^{-2}}$

19) Compute the following derivative:
$\frac{d}{dx}(e^e)$
a) e^e b) 1 c) e^x d) 0

20) Find derivative of $\left(\frac{1}{x}\right)^x$
a) $\left(\frac{1}{x}\right)^x(-\ln(x) - 1)$ b) $\frac{x}{-\ln(x)-1}$
c) $-\left(\frac{1}{x}\right)^x(\ln x)$ d) $-\ln(x) - 1$

21) Find the derivate of $\sqrt{\tan^{-1}(x)}$
a) $\frac{1}{2\sqrt{\tan^{-1}(x)}}$ b) $\frac{1}{2(1+x^2)\sqrt{\tan^{-1}(x)}}$ c) $\frac{1}{2(1+x^2)}$ d) $\frac{1+x^2}{2\sqrt{\tan^{-1}(x)}}$

22) Evaluate the following derivative:
$\frac{d^4}{dx^4}(e^{-5})$
a) e^{-5} b) e^{-1} c) 0 d) $-120e^{-5}$

23) If $y = \csc^{3/2} x$, find y'
a) $-\frac{3}{2}\csc^2(x)\sqrt{\csc(x)}$ b) $\csc^{3/2}(x)(\csc x - \cot x)$
c) $-\frac{1}{2}\sec^2(x)\sqrt{\cot(x)}$ d) $-\frac{3}{2}\csc(x)\cot(x)\sqrt{\csc(x)}$

24) Find $\frac{dy}{dx}$ if $y = \ln e^{3x}$
a) e^{3x} b) 3x c) 3 d) $\frac{3}{e^{3x}}$

25) Find derivative w.r.t to x of:
$$\frac{1+\frac{1}{x}}{1-\frac{1}{x}}$$
a) $-\frac{2}{(x-1)^2}$ b) $\frac{1-\frac{1}{x^2}}{\left(1-\frac{1}{x}\right)^2}$ c) $\frac{(1+x)^2}{(1-x)^2}$ d) None of these

26) Minimum value of $\sin x + \cos x$ over the interval $[0,2\pi]$ is:

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a) $\sqrt{2}$ b) $-\sqrt{2}$ c) 0 d) $-1/\sqrt{2}$

27) $\frac{d}{dx}(\log_3 x) =$

a) $\frac{1}{x}$ b) $\frac{1}{x\ln(3)}$ c) $\frac{1}{x\log 3}$ d) $\frac{1}{\log 3}$

28) What is the order of the differential equation:

$$\frac{d^3y}{dx^3}+\left(\frac{xd^2y}{dx^2}\right)^2+\frac{dy}{dx}-x=4$$

a) 5 b) 4 c) 3 d) 2

Answers of Chapter 2 - Differentiation

1) $10x^4$

Using the product rule of derivative, we can compute the derivative.

$$\frac{d}{dx}(2x^5) = 2\frac{d}{dx}(x^5)$$

$$= 2(5)(x)^{5-1} = 2(5)(x^4) = 10x^4$$

2) d) Leibniz

Name of Mathematician	Leibniz	Newton	Lagrange	Cauchy
Notation used for derivative	dy/dx or df/dx	f (x)	f'(x)	D f(x)

3) 36 π

$$Rate\ of\ change\ of\ Circumference\ of\ circles = \frac{dC}{dt} = 12\pi$$

$$Circumference = C = 2\pi r$$

Taking derivative of both sides with respect to "t".

$$\frac{dC}{dt} = 2\pi\frac{dr}{dt}$$

$$\rightarrow \frac{dr}{dt} = \frac{1}{2\pi}\left(\frac{dC}{dt}\right) = \frac{1}{2\pi}(12\pi) = 6$$

This means the rate of change of the radius is 6

$$Area\ of\ circle = A = \pi r^2$$

Taking derivative of both sides with respect to "t"

$$\frac{dA}{dt} = 2\pi r\frac{dr}{dt} = 2\pi(3)(6) = 36\pi$$

4) 10, 10

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An easy method to solve this question is to multiply the numbers in the given options and check which of them result in the maximum answer. It is obvious from the given options that 10, 10 will result in the maximum product.

Detailed Solution:
Let the two numbers be x and y. Their sum is 20, so we can write the equation as:

$$x + y = 20 \rightarrow y = 20 - x$$

Equation 1

The product of two numbers can be written as:

$$P = xy$$

Equation 2

Substituting the value of "y" from Equation 1 into Equation 2, we get:

$$P = x(20 - x) = 20x - x^2$$

Taking derivative of both sides with respect to "x".

$$\frac{dP}{dx} = 20 - 2x$$

Setting this equal to 0, and calculating the corresponding value of "x"

$$20 - 2x = 0$$
$$20 = 2x$$
$$x = 10$$

Finding the second derivative with respect to "x".

$$\frac{d^2P}{dx^2} = -2$$

For x = 10, the value of second derivate is negative. So, we get a maxima at x = 10.

Since x + y = 20, the value of y for x = 10 will be 10.
Therefore, the two numbers which will result in the maximum product are 10, 10

5) t
Let $y = 2t^3$ and $x = 3t^2$
Finding the derivative of y and x with respect to t:

$$\frac{dy}{dt} = 6t^2, \qquad \frac{dx}{dt} = 6t$$

We need to find the derivative of $y = 2t^3$ with respect to $x = 3t^2$ (dy/dx)

$$\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx} = 6t^2 \times \frac{1}{6t} = t$$

Therefore, the derivative of $2t^3$ with respect to $3t^2$ is t.

6) Implicit differentiation
The functions which are written in terms of both x and y where x and y cannot be easily separated are differentiated using implicit differentiation. Some examples of such functions are:

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$x^2 + y^2 = 12$, $x^2 + xy + 2y^2 = 15$

7) $2\ln(3) \times 3^{2x}$

$y = 3^{2x}$

$\ln(y) = \ln(3^{2x})$

$\ln(y) = 2x\ln(3)$

Taking derivative of both sides with respect to "x"

$$\frac{1}{y}\left(\frac{dy}{dx}\right) = 2\ln(3)$$

$$\frac{dy}{dx} = 2\ln(3)\,y = 2\ln(3) \times 3^{2x}$$

8) The rate of change of f(x) with respect to 'x'

9) $-\dfrac{1}{|x|\sqrt{x^2-1}}$

10) $\dfrac{\sec^2(\sqrt{x})}{2\sqrt{x}}$

$$\frac{d}{dx}(\tan(\sqrt{x})) = \sec^2(\sqrt{x}) \times \frac{d}{dx}(\sqrt{x})$$

$$= \sec^2(\sqrt{x}) \times \frac{1}{2\sqrt{x}} = \frac{\sec^2(\sqrt{x})}{2\sqrt{x}}$$

11) 0

We are to find: $\frac{d}{d}(\ln e)$

Note that, ln(e) is a constant quantity. The derivative of a constant is always equal to zero.

12) x > 3

A function is increasing when its first derivative is greater than 0.

$y = x^2 - 6x + 5$

Taking derivative of both sides with respect to "x".

$$\frac{dy}{dx} = 2x - 6$$

The function will be increasing if:

$2x - 6 > 0$ $\rightarrow 2x > 6$ $x \rightarrow > 3$

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13) 2cos(2x)

$$\frac{d}{dx}(\sin(2x) = \cos(2x) \times \frac{d}{dx}(2x) = 2\cos(2x)$$

14) Cauchy

Name of Mathematician	Leibniz	Newton	Lagrange	Cauchy
Notation used for derivative	dy/dx or df/dx	f (x)	f'(x)	D f(x)

15) Zero

Derivative of a constant number is always Zero. Since 0 is a constant, its derivative will be Zero.

16) cos(x)

17) a/3

$x = 3t$

Taking derivative of both sides with respect to "t":

$$\frac{dx}{dt} = 3$$

$y = at$

Taking derivative of both sides with respect to "t":

$$\frac{dy}{dt} = a$$

We need to find $\frac{dy}{dx}$. According to the chain rule:

$$\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx}$$

$$\frac{dy}{dx} = \frac{dy}{dx} \times \frac{1}{\frac{dx}{dt}}$$

$$\frac{dy}{dx} = a \times \frac{1}{3} = \frac{a}{3}$$

18) $-\frac{2}{3}e^{x^{-2}}$

$$\frac{d}{dx}(e^{x^{-2}}) = e^{x^{-2}} \times \frac{d}{dx}(x^{-2})$$

$$= e^{x^{-2}}(-2(x^{-2-1}))$$

$$= e^{x^{-2}}\left(-\frac{2}{x^3}\right) = \frac{-2e^{x^{-2}}}{3}$$

19) 0

e is a constant number, so e^e would also be a constant number. Derivative of a constant is always equ to 0. Do not confuse this with e^x.

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20) $\left(\frac{1}{x}\right)^x(-\ln(x)-1)$

$Let: y = \left(\frac{1}{x}\right)^x$

Taking natural log of both sides:

$\ln(y) = \ln\left(\frac{1}{x}\right)^x$

$\ln(y) = x\ln\left(\frac{1}{x}\right)$

$\ln(y) = x(\ln(1) - \ln(x))$

$\ln(y) = x(0 - \ln(x))$

$\ln(y) = x(-\ln(x))$

Taking derivative of both sides with respect to "x"

$\frac{1}{y} \times \frac{dy}{dx} = -\ln(x)\frac{d}{dx}(x) + x\frac{d}{dx}(-\ln(x))$

$\frac{1}{y} \times \frac{dy}{dx} = -\ln(x) + x\left(-\frac{1}{x}\right)$

$\frac{1}{y} \times \frac{dy}{dx} = -\ln(x) - 1$

$\frac{dy}{dx} = y(-\ln(x) - 1)$

$\frac{dy}{dx} = \left(\frac{1}{x}\right)^x(-\ln(x) - 1)$

21) $\frac{1}{2(1+x^2)\sqrt{\tan^{-1}(x)}}$

$\frac{d}{dx}\left(\sqrt{\tan^{-1}x}\right) = \frac{1}{2\sqrt{\tan^{-1}(x)}} \times \frac{d}{dx}(\tan^{-1}(x))$

$= \frac{1}{2\sqrt{\tan^{-1}(x)}} \times \frac{1}{1+x^2}$

$= \frac{1}{2(1+x^2)\sqrt{\tan^{-1}(x)}}$

22) 0

$\frac{d^4}{dx^4}$ means we have to find the 4th derivative of e^{-5}. Note that e^{-5} is a constant and derivative of a constant is always equal to 0. Taking further derivatives of 0 will again give 0 as the answer.

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$$\frac{d}{dx}(e^{-5}) = 0$$
$$\frac{d^2}{dx^2}(0) = 0$$
$$\frac{d^3}{dx^3}(0) = 0$$
$$\frac{d^4}{dx^4}(0) = 0$$

23) $-\frac{3}{2}\csc(x)\cot(x)\sqrt{\csc(x)}$

$$\frac{dy}{dx} = \frac{d}{dx}\left(\csc^{\frac{3}{2}}(x)\right)$$
$$= \frac{3}{2}\left(\csc^{\frac{3}{2}-1}(x)\right) \times \frac{d}{dx}(\csc x)$$
$$= \frac{3}{2}\left(\csc^{\frac{1}{2}} x\right)(-\csc(x)\cot(x))$$
$$= -\frac{3\csc(x)\cot(x)\sqrt{\csc(x)}}{2}$$

24) 3

$y = \ln e^{3x}$

Using the properties of log, we can write:

$y = 3x \ln(e)$

Remember that $\ln(e) = 1$. So, the equation becomes:

$y = 3x$

$$\frac{dy}{dx} = 3$$

25) $-\frac{2}{(x-1)^2}$

$$\frac{1+\frac{1}{x}}{1-\frac{1}{x}} = \frac{\frac{x+1}{x}}{\frac{x-1}{x}} = \frac{x+1}{x-1}$$

We can find the derivative of this expression using the quotient rule of derivatives:

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

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

26) $-\sqrt{2}$

$Let\ y = sinx + cosx$

Finding the first derivative:

$$\frac{dy}{dx} = cosx - sinx$$

Setting it equal to 0 and finding the critical points:

$cosx - sinx = 0$

$\cos x = \sin x$

$$1 = \frac{sinx}{cosx} = tanx$$

$x = \tan^{-1}(x)$

$$\rightarrow x = \frac{\pi}{4}, \frac{5\pi}{4}$$

Finding the 2nd derivative:

$$\frac{d^2y}{dx^2} = -\sin x - \cos x$$

Checking the points to find maxima and minima.

For $x = \pi/4$:

$$-\sin\left(\frac{\pi}{4}\right) - \cos\left(\frac{\pi}{4}\right) = -\frac{1}{\sqrt{2}} - \frac{1}{\sqrt{2}} = -\frac{2}{\sqrt{2}} = -\sqrt{2}$$

Since the value of 2nd derivative is negative at $x = \pi/4$, this means we have a maxima at $x = \pi/4$.

For $x = 5\pi/4$:

$$-\sin\left(\frac{5\pi}{4}\right) - \cos\left(\frac{5\pi}{4}\right) = -\left(\frac{-1}{\sqrt{2}}\right) - \left(\frac{-1}{\sqrt{2}}\right) = \frac{2}{\sqrt{2}} = \sqrt{2}$$

Since the value of 2nd derivative is positive at $x = 5\pi/4$, this means we have a minima at $x = 5\pi/4$.

Now we need to calculate the value of given function at this minima:

$$\sin\left(\frac{5\pi}{4}\right) + \cos\left(\frac{5\pi}{4}\right) = -\frac{1}{\sqrt{2}} - \frac{1}{\sqrt{2}} = -\frac{2}{\sqrt{2}} = -\sqrt{2}$$

27) $\frac{1}{x\ln(3)}$

The derivative of a general logarithmic function is given as:

$$\frac{d}{dx}(\log_a x) = \frac{1}{x} \cdot \frac{1}{\ln a}$$

Using the same formula, we can write the derivative of given expression as:

$$\frac{d}{dx}(\log_3 x) = \frac{1}{x} \cdot \frac{1}{\ln 3} = \frac{1}{x\ln(3)}$$

28) 3

The order of a differential equation is determined by the highest - order derivative, while the degree is determined by the highest power on a variable.

In the given equation, the highest order derivative is 3. This means the order of given differential equation is 3. The highest power on the variable is 2, therefore, the degree of the given equation is 2.

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Chapter 3 – Integration

1) $\int 0\, dx =$
a) $x + C$ b) C c) $1 + C$ d) None of these

2) $\int (x^2 + x - 2)\, dx =$
a) $3x^3 - x^2 + 3x - 1$ b) $\frac{x^3}{3} + \frac{x^2}{2} - 2x + C$
c) $3x + 1 + C$ d) None of these

3) Find the integral with respect to x of: $\frac{e^x}{e^x+1}$
a) $\ln|e^x + 1| + C$ b) $\ln|e^x| + C$ c) $e^x + C$ d) None of the

4) Opposite process of differentiation is known as:
a) Anti-Derivative b) Integration c) Optimizing d) Both a and b

5) Which of the following function has the same derivative and integral?
a) Linear Function b) Exponential Function
c) Radical Function d) Logarithmic Function

6) Compute the following integral:
$\int sin^{-1}x\, dx$
a) $x\cos^{-1}x - \sqrt{1-x^2} + C$ b) $x\sin^{-1}x + \sqrt{1-x^2} + C$
c) $x\cos^{-1}x + \sqrt{1-x^2} + C$ d) $x\sin^{-1}x - \sqrt{1-x^2} + C$

7) Compute the following integral
$\int x\, e^x\, dx$
a) $xe^x - x + C$ b) $e^x - xe^x + C$ c) $xe^x - x^2e^x + C$ d) $xe^x - e^x + C$

8) $\int_a^b f(x) =$
a) $\phi(a) - \phi(b)$ b) $\phi(a) + \phi(b)$ c) $\phi(b) - \phi(a)$ d) None of these

9) $\int f(x,y)$ is possible through:
a) Product Rule b) Chain Rule c) Double Integrals d) None of these

10) Find the area under the curve for $\int x^2 + 1\ dx$, between $x = 4$ and $x = 1$.
a) 24 b) 21 c) 17 d) 32

11) $\int \sqrt{\sin(x)}\cos(x)\ dx = ?$
a) $\ln|\sin x| + C$ b) $\frac{2}{3}\sin^{\frac{3}{2}}(x) + C$ c) $\sin^2(x) + C$ d) $-\cos(x) + C$

12) $\int_\infty^0 \left(\frac{1}{x^2+1}\right) dx =$
a) $\pi/2$ b) $-\pi/2$ c) 0 d) $\pi/3$

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13) If $\int f(x)\,dx = \ln|\csc x - \cot x|$, then $f(x)$ is:
a) $sec(x)$ b) $cosec(x)$ c) $\tan(x)$ d) None of these

14) Evaluate the following integral:
$$\int \frac{3x+1}{x^2-x-6}\,dx$$
a) $\ln|(x+2)(x-3)| + C$
b) $\ln|x+3| + 2\ln|x-2| + C$
c) $\ln|x-3| + \ln|x-2| + C$
d) $2\ln|x-3| + \ln|x+2| + C$

Answers of Chapter 3 - Integration

1) C

2) $\frac{x^3}{3} + \frac{x^2}{2} - 2x + C$

$$\int (x^2 + x - 2)\,dx = \int x^2\,dx + \int x\,dx - \int 2\,dx$$

$$= \frac{x^{2+1}}{2+1} + \frac{x^{1+1}}{1+1} - 2x + C$$

$$= \frac{x^3}{3} + \frac{x^2}{2} - 2x + C$$

3) $ln|e^x + 1| + C$

We have to evaluate: $\int \frac{e^x}{e^x+1}dx$

Let, $u = e^x + 1$

$\rightarrow du = e^x\,dx$

Substituting the values in the given expression, we get:

$$\int \frac{1}{u}du = \ln|u| + C$$

Substituting the value of u back into this equation gives us the final answer:

$$\int \frac{e^x}{e^x+1}dx = \ln|e^x + 1| + C$$

Note to remember: When the numerator in the fraction is the derivative of the denominator, the integral of the fraction will be equal to the Natural Log (ln) of the denominator. In given case, the derivative of denominator ($e^x + 1$) is e^x, which is in the numerator, so the integral would be the Natural Log of denominator ($e^x + 1$) i.e., $\ln|e^x + 1| + C$

4) Both a and b
The inverse process of differentiation i.e., process of finding such a function whose derivative is given is called anti-differentiation or integration.

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5) Exponential Function

Only the basic exponential function (e^x) is such a function whose derivative and integral both result in the same answer i.e., the same exponential function itself.

$$\frac{d}{dx}(e^x) = e^x$$

$$\int e^x \, dx = e^x + C$$

For other choices we get different answers when calculating the derivative and integral. For example, for the basic linear function (x):

$$\frac{d}{dx}(x) = 1$$

$$\int x \, dx = \frac{x^2}{2} + C$$

6) $x\sin^{-1}x + \sqrt{1-x^2} + C$

We can compute this integral using Integration by parts. The given expression can be rewritten as:

$$\int sin^{-1}x \cdot 1 \, dx$$

Remember "ILATE":

I = Inverse Function L = Logarithmic Function A = Algebraic Function

T = Trigonometric Function E = Exponential Function

The function appearing earlier in this order will be chosen as f(x) during the integration by parts process.

So,

$f(x) = \sin^{-1}x$ and $g'(x) = 1$

$\rightarrow f'(x) = \frac{1}{\sqrt{1-x^2}}$ and $\rightarrow g(x) = x$

The formula for integration by parts is:

$$\int f(x)\, g'(x)\, dx = f(x)g(x) - \int g(x)\, f'(x)\, dx$$

Using the values, we get:

$$\sin^{-1}x \cdot x - \int x \cdot \frac{1}{\sqrt{1-x^2}} dx$$

$$x\sin^{-1}x - \int \frac{x}{\sqrt{1-x^2}} \, dx$$

For:

$$\int \frac{x}{\sqrt{1-x^2}} \, dx$$

Let, $1 - x^2 = t$

$-2x \, dx = dt$

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$x\,dx = -\frac{1}{2}dt$

Replacing the values, we get:

$$\int \frac{x}{\sqrt{1-x^2}}\,dx = \int \frac{1}{\sqrt{t}} \times -\frac{1}{2}dt = -\frac{1}{2}\int (t)^{-\frac{1}{2}}\,dt$$

$$= -\frac{1}{2}\left(\frac{t^{-\frac{1}{2}+1}}{-\frac{1}{2}+1}\right) + C$$

$$= -\frac{1}{2}\left(\frac{t^{\frac{1}{2}}}{\frac{1}{2}}\right) + C = -\sqrt{t} + C$$

Replacing the values, we get:

$$\int \frac{x}{\sqrt{1-x^2}}\,dx = -\sqrt{1-x^2} + C$$

So, the value of our integral simplifies to:

$x\sin^{-1}x + \sqrt{1-x^2} + C$

7) $xe^x - e^x + C$

We can compute this integral using Integration by parts. The formula for integration by parts is:

$$\int f(x)\,g'(x)\,dx = f(x)g(x) - \int g(x)\,f'(x)\,dx$$

Remember "ILATE":

I = Inverse Function L = Logarithmic Function A = Algebraic Function

T = Trigonometric Function E = Exponential Function

The function appearing earlier in this order will be chosen as f(x) during the integration by parts process.

The given function is:

$$\int x\,e^x\,dx$$

Here, x is an Algebraic function and e^x is the Exponential function. So, x will be chosen as $f(x)$

$f(x) = x$ and $g'(x) = e^x$

$\rightarrow f'(x) = 1$ and $g(x) = e^x$

Using the values in the formula, we get:

$$\int x\,e^x\,dx = x(e^x) - \int e^x\,(1)dx$$

$$= xe^x - \int e^x\,dx = xe^x - e^x + C$$

8) $\phi(b) - \phi(a)$

$\int_a^b f(x)$ has a definite value $\phi(b) - \phi(a)$, so it is called the definite integral of f from a to b.

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9) Double Integrals
Given a two-variable function f(x, y), you can compute its integral by the taking an integral of an integral. This is called a double integral.

10) 24
Finding area under a curve is equivalent to finding the definite integral using the given values of x as upper and lower limits. This means, we have to calculate:

$$\int_1^4 x^2 + 1\ dx$$

Finding the integral and using the values, we get:

$$\left|\frac{x^3}{3} + x\right|_1^4 = \left(\frac{4^3}{3} + 4\right) - \left(\frac{1^3}{3} + 1\right) = \frac{64}{3} + 4 - \frac{1}{3} - 1 = \frac{63}{3} + 3 = 21 + 3 = 24$$

11) $\frac{2}{3}\sin^{\frac{3}{2}}(x) + C$
We can solve this problem by method of substitution.
Let $\sin(x) = u$
Take differential of both sides:
$\rightarrow du = \cos(x)\ du$
Substitute these values in given integral:

$$\int \sqrt{\sin(x)}\cos(x)\ dx = \int \sqrt{u}\ du = \int (u)^{\frac{1}{2}}\ du = \frac{u^{\frac{1}{2}+1}}{\frac{1}{2}+1} + C = \frac{u^{\frac{3}{2}}}{\frac{3}{2}} + C = \frac{2}{3}u^{\frac{3}{2}} + C$$

Now, replace back the value of u to get the final answer

$$\int \sqrt{\sin(x)}\cos(x)\ dx = \frac{2}{3}\sin^{\frac{3}{2}}(x) + C$$

12) $-\pi/2$

First, we need to find the value of given integral:

$$\int \frac{1}{x^2+1}\ dx$$

Remember that:

$$\frac{d}{dx}(\tan^{-1} x) = \frac{1}{x^2+1}$$

This means:

$$\int \frac{1}{x^2+1}\ dx = \tan^{-1} x$$

So, we can write the given integral as:

$$\int_{\infty}^{0} \left(\frac{1}{x^2+1}\right) dx = |\tan^{-1} x|_{\infty}^{0} = \tan^{-1}(0) - \tan^{-1}(\infty) = 0 - \frac{\pi}{2} = -\frac{\pi}{2}$$

13) $cosec(x)$
Remember these Integrals:

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$$\int \tan(x)\,dx = \ln|\sec(x)| + C = -\ln|\cos(x)| + C$$
$$\int \cot(x)\,dx = \ln|\sin(x)| + C$$
$$\int \sec(x)\,dx = \ln|\sec(x) + \tan(x)| + C$$
$$\int \csc(x)\,dx = \ln|\csc(x) - \cot(x)| + C$$

14) $2\ln|x-3| + \ln|x+2| + C$

Since the given expression is in form of a fraction, and the denominator can be reduced into fractions, this problem will be solved using the application of Partial Fractions.

Step 1: Factorize the denominator

$x^2 - x - 6 = x^2 - 3x + 2x - 6$
$= x(x-3) + 2(x-3)$
$= (x-3)(x+2)$

Step 2: Find the partial fractions of the given expression:

$$\frac{3x+1}{x^2-x-6} = \frac{3x+1}{(x-3)(x+2)}$$

$$\frac{3x+1}{(x-3)(x+2)} = \frac{A}{x-3} + \frac{B}{x+2}$$

Multiplying both sides by $(x-3)(x+2)$, we get:

$3x + 1 = A(x+2) + B(x-3)$ Equation 1

Substituting $x + 2 = 0 \rightarrow x = -2$, in Equation 1 we get:

$3(-2) + 1 = A(0) + B)(-2-3)$
$-5 = -5B \qquad \rightarrow B = 1$

Substituting $x - 3 = 0 \rightarrow x = -3$, in Equation 1 we get:

$3(3) + 1 = A(3+2) + B(0)$
$10 = 5A \qquad \rightarrow A = 2$

Using the values of A and B, we can write our original equation as:

$$\frac{3x+1}{x^2-x-6} = \frac{3x+1}{(x-3)(x+2)} = \frac{2}{x-3} + \frac{1}{x+2}$$

Step 3: Compute the Integral

$$\int \frac{3x+1}{x^2-x-6}\,dx = \int \frac{2}{x-3} + \frac{1}{x+2}\,dx = \int \frac{2}{x-3}dx + \int \frac{1}{x+2}dx$$

$$= 2\int \frac{1}{x-3}dx + \int \frac{1}{x+2}dx = 2\ln|x-3| + \ln|x+2| + C$$

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Chapter 4 – Analytic Geometry

1) The two lines: $7x + 2y + 3 = 0$ and $6y + 21x + 9 = 0$ are:
a) Intersecting b) Perpendicular c) Parallel d) Coinciding

2) Which of the following is the point slope form of the equation
a) $Ax + By = C$ b) $y - y_1 = m(x - x_1)$ c) $y = mx + b$ d) None of these

3) A line with point (1, 1) is perpendicular to a line having slope -3/4. What is the equation of the line?
a) $3x - 4y - 1 = 0$ b) $4x - 3y - 1 = 0$ c) $4y - 3x - 1 = 0$ d) $4y + 3x + 1 = 0$

4) Shortest distance of the point (1, 2) from the line $3x - 4y + 10 = 0$ is:
a) 5 b) 2 c) 1 d) 4

5) Which of the following is the correct formula for Rotation of axis?
a) $(x\sin\theta + y\cos\theta, -x\sin\theta + y\cos\theta)$ b) $(x\cos\theta + y\sin\theta, -x\sin\theta + y\cos\theta)$
c) $(x\sin\theta + y\sin\theta, -x\cos\theta + y\cos\theta)$ d) $(x\cos\theta + y\cos\theta, -x\sin\theta + y\sin\theta)$

6) Points P(2, 2), Q (-2, 2) and R(k, 4) represent the vertices of a Right-Angled Triangle with right angle at P. Find the value of k
a) 2 b) -2 c) 4 d) -4

7) Which of the following equations represent a horizontal line?
a) $x = c$ b) $y = c$ c) $x = -y$ d) $x = y$

8) $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ represents a pair of straight lines if:
a) $ab = 0$ b) $a + b = 0$ c) $h^2 - ab = 0$ d) All of these

9) If two lines are anti-parallel then,
a) Their slopes are equal b) Slopes are opposite
c) Product of slopes is -1 d) Both a and b

10) The slope of a line parallel to x-axis is
a) 1 b) -1 c) 0 d) Undefined

11) The points (4, -2), (-2, 4), (4, 4) are vertices of a triangle. Find the centroid of the triangle
a) (3, 3) b) (2, 2) c) (2, 3) d) (3, 2)

12) Find the distance AB between the two points: A (3, 1) and B (-2, -4).
a) $\sqrt{50}$ b) $\sqrt{26}$ c) $\sqrt{34}$ d) $\sqrt{10}$

13) If slope of two lines is equal, the lines would be:
a) Intersecting b) Perpendicular. c) Skewed d) Parallel

14) What is the slope of the line having an equation $y = 0$
a) 0 b) 1 c) Undefined d) -1

15) Product of slopes of 2 perpendicular lines is always:
a) 1 b) 0 c) -1 d) Undefined

16) If l_1 is $x - y + 3 = 0$ and l_2 is $x + y + 9 = 0$, find the angle between two lines.
a) 90 b) 0 c) 30 d) None of these

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17) Calculate the slope of line formed by joining the points (2, 5) and (6, 7)
a) 2 b) 1/2 c) – 2 d) – 1/2

18) The slope of line formed by (-1, 8) and (7, 9) is:
a) 8 b) 0.125 c) 4 d) 1/6

19) A line perpendicular to y – axis is drawn whose distance from y – axis is 4. Which of the following will represent the equation of the line?
a) x = 4 b) y = 4 c) x + y = 4 d) x – y = 4

20) Find the equation of the line parallel to line x = 6 and passing through the point (5, 7)
a) x = 7 b) x = 5 c) y = 5 d) y = 7

21) If α is the inclination of a line with positive x axis, what will be the slope of the line:
a) $\sin(\alpha)$ b) $\tan(\alpha)$ c) $\cos(\alpha)$ d) None of these

22) If the slope of line AB is m_1 and slope of line CD is m_2, they would be perpendicular if:
a) $1 - m_1 m_2 = 0$ b) $1 + m_1 m_2 = 0$ c) $m_1 m_2 = 1$ d) $1 + \frac{m_1}{m_2} = 0$

23) The points (1, 2) , (4, 6), (8, 5) and (a, b) represent the sides of a parallelogram. Find the value of a and b.
a) (2, 3) b) (3, 2) c) (5, 1) d) (1, 5)

24) Find the distance between the points (2, -2) and (2,3):
a) 1 b) 5 c) -1 d) 2

25) Which of the following point lies of the line 3x – 4y = 11
a) (2, -1) b) (3, 5) c) (5, 1) d) None of these

26) Every homogenous second-degree equation $ax^2 + 2hxy + by^2 = 0$ represents a distinct pair of lines through the origin if and only if:
a) $a + b = 0$ b) $h^2 < ab$ c) $h^2 > ab$ d) $h^2 = ab$

27) Which of the following can represent the slope of a line whose one point lies on negative x – axis and one point lies on negative y – axis?
a) y/x b) - y/x c) x/y d) -x/y

Answers of Chapter 4 – Analytic Geometry

1) Coinciding
Line 1: 7x + 2y + 3 = 0
Re-arranging the equation we get:

$$2y = -7x - 3$$

$$y = -\frac{7}{2}x - \frac{3}{2}$$

$$Slope\ of\ this\ line = -\frac{7}{2}$$

$$y - Intercept = -\frac{3}{2}$$

Line 2: 6y + 21x + 9 = 0

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Re-arranging the equation we get:

$6y = -21x - 9$

$y = -\frac{21}{6}x - \frac{9}{6}$

$y = -\frac{7}{3}x - \frac{3}{2}$

$Slope\ of\ this\ line = -\frac{7}{2}$

$y - intercept = -\frac{3}{2}$

Since the slope and y-intercept of both lines are the same, the lines are coinciding.
The answer would have been parallel in case only if the slopes would have been the same with different y-intercepts.

2) $y - y_1 = m(x - x_1)$

3) $4x - 3y - 1 = 0$

The required line is perpendicular to the line having a slope -3/4. So, the slope of the required line will be negative reciprocal of -3/4 which is equal to 4/3.
We have to find the equation of a line passing through the point (1, 1) and having a slope of 4/3. Using the point slope form of the equation:

$y - y_1 = m(x - x_1)$

$y - 1 = \frac{4}{3}(x - 1)$

$3(y - 1) = 4(x - 1)$

$3y - 3 = 4x - 4$

$0 = 4x - 3y - 4 + 3$

$4x - 3y - 1 = 0$

4) 1

The distance d from the point $P(x_1, y_1)$ to the line $ax + by + c = 0$ is given by:

$$d = \frac{|ax_1 + by_1 + c|}{\sqrt{a^2 + b^2}}$$

Using the given values, we get:

$$d = \frac{|3(1) + (-4)(2) + 10|}{\sqrt{(3)^2 + (-4)^2}} = \frac{5}{5} = 1$$

5) $(x\cos\theta + y\sin\theta, -x\sin\theta + y\cos\theta)$

6) 2

In a right-angled triangle, two sides are perpendicular. The product of slopes of two perpendicular lines must be -1. In the given triangle the right angle is formed at P, so the lines PQ and PR will be perpendicular to each other as shown below:

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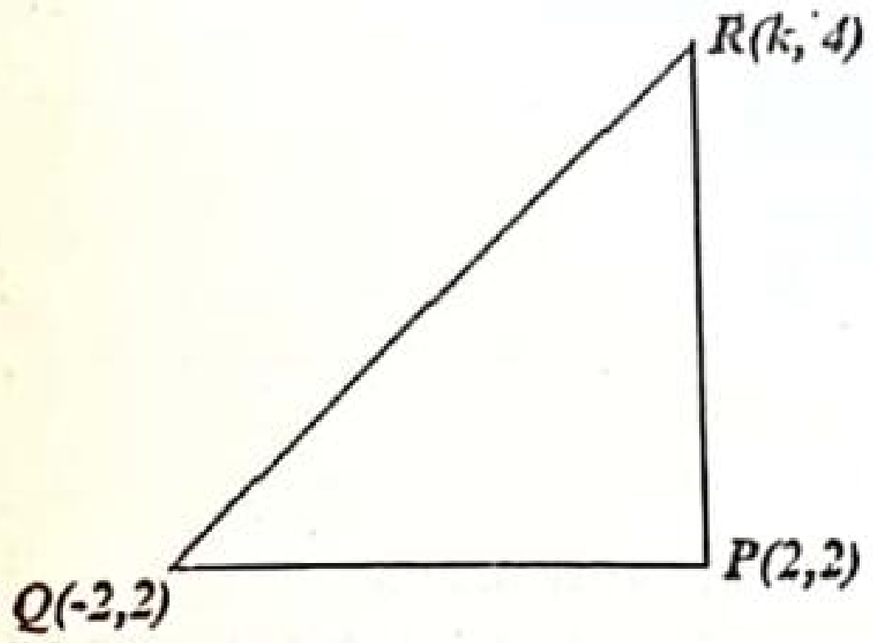

$$Slope\ of\ PQ = \frac{2-2}{2+(-2)} = 0$$

$$Slope\ of\ PR = \frac{4-2}{k-2} = \frac{2}{k-2}$$

Slope of PQ is zero, which means that PQ is a horizontal line. PR is perpendicular to PQ so PR must be a vertical line. Slope of a vertical line is undefined. So the expression in denominator of slope of PR must be zero.

i.e. $k-2=0$, so $k=2$

7) y = c

Any line parallel to x-axis will be a horizontal line. Equation of x-axis is y = 0.

So any equation of the form y = c, where c is a constant represents a horizontal line.

8) $h^2 - ab = 0$

The two lines represented by the homogenous $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$ are coincident if $h^2 - ab = 0$ and perpendicular if $a + b = 0$

9) Their slopes are equal

The slopes of two parallel or anti-parallel lines are always equal.

10) 0

Slope of x-axis and any line parallel to x-axis is 0.

Slope of y-axis and any line parallel to y-axis is Undefined.

11) (2, 2)

The coordinates of the centroid of a triangle can be calculated as:

$$\left(\frac{x_1+x_2+x_3}{3}, \frac{y_1+y_2+y_3}{3}\right)$$

Using the given points, we get:

$$\left(\frac{4+(-2)+4}{3}, \frac{-2+4+4}{3}\right) = \left(\frac{6}{3}, \frac{6}{3}\right) = (2,2)$$

12) $\sqrt{50}$

We can find the distance AB using the distance formula:

$$d = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$$

$$AB = \sqrt{(-2-3)^2 + (-4-1)^2} = \sqrt{25+25} = \sqrt{50}$$

13) d) Parallel

The slope of parallel lines is always equal.

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For perpendicular lines, the product of slopes is always -1.

14) 0
y = 0 defines x-axis as along entire x-axis the value of y is 0. The slope of x-axis and all the horizontal lines is always 0.

15) -1

16) 90
The angle θ from l_1 to l_2 is given by:
$$\tan\theta = \frac{m_2 - m_1}{1 + m_1 m_2}$$
Here, m_1 and m_2 represent the slopes of l_1 and l_2 respectively. So, first we need to find the slopes of the lines.
The general slope-intercept form of an equation is:
$$y = mx + c$$
Here m is the slope of the line. Rewriting the given equations:

l_1:	$y = x + 3$	This means,	$m_1 = 1$
l_2:	$y = -x - 9$	This means,	$m_2 = -1$

Substituting these values in the formula, we get:
$$\tan\theta = \frac{-1-1}{1+(1)(-1)} = -\frac{2}{0} = undefined$$
Remember than tan(90) is undefined. This means, the angle θ between the lines is 90 degrees, and the lines are perpendicular. The product of slopes of two perpendicular lines is always -1, which holds true for this case. This confirms that our answer is correct

17) 1/2
Slope of a line formed by two points is calculated as:
$$Slope = \frac{Rise}{Run} = \frac{Difference\ in\ y-coordinates}{Difference\ in\ x-coordinates} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{7-5}{6-2} = \frac{2}{4} = \frac{1}{2}$$

18) 0.125
Slope of a line formed by two points is calculated as:
$$Slope = \frac{Rise}{Run} = \frac{Difference\ in\ y-coordinates}{Difference\ in\ x-coordinates} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{9-8}{7-(-1)} = \frac{1}{8} = 0.125$$

19) y = 4
Remember that the equation of y – axis is x = 0. Any line perpendicular to y – axis will have equation of the form y = c, where c is the distance from the line to y – axis which is given to be 4. Therefore, the correct equation of the line will be y = 4.

20) x = 5
Since the required line is parallel to the line x = 6, the slopes of both lines would be same. x = 6 represent a vertical line, the slope of a vertical line is always undefined. So, the required line will also be a vertical line.
The equation of vertical lines is of the form x = c, where c is the x-coordinate of any point from which the line passes through, which in this case will be 5. Therefore, the equation of the required line is x = 5.
Note: Since this line is vertical, all the points from which the line will pass will have the x – coordinate equal to 5, for example, (5, 0) , (5,5), (5,50) ...

21) $\tan(\alpha)$

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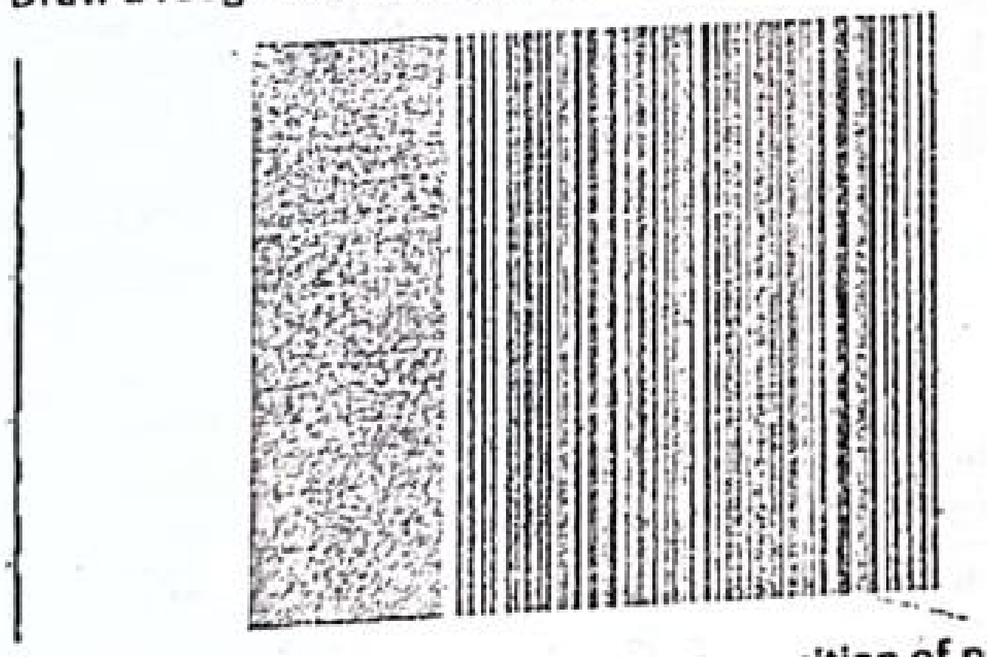
In analytical geometry, slope of gradient m of a non – vertical straight line with α as its inclination is defined as: $m = \tan(\alpha)$

22) $1 + m_1 m_2 = 0$
The product of slopes of two perpendicular lines is always equal to -1. This means, for given two lines:
Slope of AB × Slope of CD = -1
$m_1 \times m_2 = -1$
$m_1 m_2 = -1$
$1 + m_1 m_2 = 0$

23) (1, 5)
Pair of opposite sides in a parallelogram are always parallel and the product of slopes of two parallel lines is always equal to – 1. Using these facts, we can find the missing coordinates.
First, we need to find the slopes. Let the points be named as A(1, 2) , B(4, 6), C(8, 5) and D(a, b).

$$Slope\ of\ AB = \frac{6-2}{4-1} = \frac{4}{3}$$
$$Slope\ of\ BC = \frac{5-6}{8-4} = -\frac{1}{4}$$
$$Slope\ of\ CD = \frac{b-5}{a-8}$$
$$Slope\ of\ DA = \frac{2-b}{1-a}$$

Draw a rough sketch of the parallelogram. This will help you to observe which slopes are to be set equal.



The block dot shows the approximate position of point D. From the figure we can see that:
Slope of AB = Slope of CD
And
Slope of BC = Slope of AD
Setting these equal will gives us 2 equations in 2 variables, solving those equations simultaneously will give us the value of (a, b)

Equation 1:
Slope of AB = Slope of CD

$$\frac{4}{3} = \frac{b-5}{a-8}$$
$$4(a-8) = 3(b-5)$$
$$4a - 32 = 3b - 15$$
$$4a - 3b = 17$$

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Equation 2:
Slope of BC = Slope of AD

$$-\frac{1}{4} = \frac{2-b}{1-a}$$
$$-1(1-a) = 4(2-b)$$
$$-1 + a = 8 - 4b$$
$$a + 4b = 9$$

Multiplying Equation 2 by "4" and subtracting it from Equation 1:

$$4a - 3b - 4(a + 4b) = 17 - 4(9)$$
$$4a - 3b - 4a - 16b = -19$$
$$-19b = -19$$
$$b = 1$$

Using the value of b in Equation 2 gives us:
$a + 4(1) = 9 \qquad \rightarrow a = 5$
Thus, the coordinates of final point are (5, 1)

24) 5
Distance formula is used to find the distance between two given points. For two points (x_1, y_1) and (x_2, y_2) the distance between these points will be calculated as:
$$Distance = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Using this formula for the given points, we get:
$$Distance = \sqrt{(3-(-2))^2 + (2-2)^2}$$
$$Distance = \sqrt{25 + 0} \qquad \rightarrow Distance = 5$$

25) (5, 1)
To check which point lies on the given line, substitute the coordinates of given points one by one in place of x and y, and check which of the result in Right Hand Side being equal to Left Hand Side.
For (2, -1): $3(2) - 4(-1) = 6 + 4 = 10$ Does not lie on the line
For (3, 5): $3(3) - 4(5) = 9 - 20 = -11$ Does not lie on the line
For (5, 1): $3(5) - 4(1) = 15 - 4 = 11$ This point lies on the line.

26) $h^2 > ab$
Every homogenous second-degree equation $ax^2 + 2hxy + by^2 = 0$ represents a pair of straight lines through the origin. The lines are:
1) Real and distinct, if $h^2 > ab$
2) Real and coincident, if $h^2 = ab$
3) Imaginary, $h^2 < ab$

27) - y/x
Any point on x – axis will have its y – coordinate equal to zero. Similarly, any point on y – axis will have its x – coordinate equal to zero.
Let the point which lies on negative x – axis be (– x , 0) and the point which lies on negative y – axis be (0, – y). We need to find the slope of line formed by these two points.

$$Slope = \frac{Rise}{Run} = \frac{Difference\ in\ y - coordinates}{Difference\ in\ x - coordinates} = \frac{y_2 - y_1}{x_2 - x_1} = \frac{-y - 0}{0 - (-x)} = -\frac{y}{x}$$

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Chapter 5 – Linear Inequalities and Linear Programming

1) The feasible solution which maximizes or minimizes the objective function is called:
a) Optimal solution b) Feasible solution c) Linear solution d) Quintic solution

2) Feasible solution for a system of inequalities is restricted to 1st quadrant. Determine if this statement is True or False
a) True b) False
c) Depends on problem constraints d) None of these

3) Find the solution set of $|3 - 2x| \leq 5$
a) $x \leq 4$ b) $-4 \leq x \leq -1$ c) $1 \leq x \leq 4$ d) $x \geq 4$

Answers of Chapter 5 – Linear Inequalities and Linear Programming

1) Optimal solution
A function which is to be maximized or minimized is known as Objective Function. The feasible solution which maximizes or minimizes the Objective Function is known as Optimal Solution. The maximum and minimum values of the objective function occur at the corner points of the feasible region.

2) True
Feasible Region: The solution region of an inequality restricted to the first quadrant is called the feasible region. In this case both x and y are always non-negative, i.e., $x \geq 0, y \geq 0$.
Feasible Solution: Each point of the feasible region is called the feasible solution of the system of linear inequalities.
This shows the Feasible solution for a system of inequalities is always restricted to the 1st Quadrant.

3) $1 \leq x \leq 4$

$|3 - 2x| \leq 5$

Using the rule of Absolute Values:

If $|u| \leq a$, then $-a \leq u \leq a$. Using this rule for given inequality:

$-5 \leq 3 - 2x \leq 5$

$-5 - 3 \leq 3 - 2x - 3 \leq 5 - 3$

$-8 \leq -2x \leq 2$

$-\frac{8}{-2} \geq -\frac{2x}{-2} \geq \frac{2}{-2}$

Dividing or multiplying the Inequality by a negative number, changes the direction of inequality symbols.

$4 \geq x \geq 1$

$1 \leq x \leq 4$

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Chapter 6 – Conic Section

1) Equation of tangent to hyperbola $\frac{x^2}{2} - \frac{y^2}{2} = 1$ at point (2, 1) is:
a) $2y + x - 3 = 0$ b) $2y - x + 3 = 0$ c) $2x + y + 3 = 0$ d) $2x - y - 3 = 0$

2) Which of the following equation represents a hyperbola?
a) $x^2 + y^2 = 1$ b) $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ c) $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ d) $y^2 = 4ax$

3) A tangent is drawn at any point of hyperbola. What will be the product of distances of it from the foci?
a) a^2 b) b^2 c) c^2 d) m^2

4) Hyperbola is symmetric w.r.t
a) Transverse axis b) Conjugate axis c) Both a and b d) None of these

5) In an ellipse, the line through the focus and perpendicular to the major axis ending at the ellipse is called?
a) Latus rectum b) Focal cord c) Directrix d) Normal

6) A hyperbola has:
a) One focus, Two Directrices b) Two foci, Two Directrices
c) Two focus, One Directrix d) One focus, One Directrix

7) If a plane intersecting the cone is parallel to the base circles, the resulting conic is:
a) Circle b) Ellipse c) Parabola d) Hyperbola

8) Which of the following are the parametric equations of a hyperbola:
a) $x = a\tan\theta, y = b\cos\theta$ b) $x = a\,\mathrm{cosec}\,\theta, y = b\tan\theta$
c) $x = a\sin\theta, y = b\cos\theta$ d) $x = a\sec\theta, y = b\tan\theta$

9) The point (5, 5) lies _____ the circle $x^2 + y^2 = 25$
a) On the circle b) Inside c) Outside d) None of these

10) Which of the following is the equation of parabola which is symmetric about y-axis:
a) $x^2 = 4ay$ b) $y^2 = 4ax$ c) $(y-2)^2 = 4a(x+3)$ d) Both b and c

11) If the plane passes through the vertex of a cone, the intersection results in:
a) An ellipse b) A hyperbola c) A point circle d) A parabola

12) _____ is a special form of an ellipse when minor and major axes are equal.
a) Parabola b) Circle c) Hyperbola d) None of these

13) Find the vertex of the parabola $(x - 2)^2 = 4(y + 2)$
a) (2, 2) b) (-2, -2) c) (-2, 2) d) (2, -2)

14) Find the eccentricity of the hyperbola $\frac{x^2}{4} - \frac{y^2}{9} = 1$
a) $\frac{3}{2}$ b) $\sqrt{13}$ c) $\frac{\sqrt{13}}{2}$ d) $\frac{4}{9}$

15) Find the equation of asymptotes of the hyperbola: $\frac{(y+2)^2}{16} - \frac{(x-2)^2}{9} = 1$

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a) $y = \pm(x-2) - 2$
b) $y = \pm\frac{1}{2}(x-4) + 3$
c) $y = \pm\left(x - \frac{2}{3}\right)$
d) $y = \pm\frac{4}{3}(x-2) - 2$

16) When both nappes of a double-napped cone are intersected by a plane (not passing through the vertex), the cross section produces a/an:
a) Hyperbola b) Circle c) Ellipse d) Parabola

17) Find the focus of the parabola $y^2 = 4x$
a) (1, 0) b) (0, 1) c) (4, 0) d) (0, 4)

18) Two different conics can intersect at maximum _____ points:
a) 2 b) 3 c) 4 d) Infinite points

19) Which of the following conic has an eccentricity equal to 1:
a) Parabola b) Hyperbola c) Ellipse d) Circle

20) Eccentricity of earth is
a) Less than 1 b) Equal to 1 c) Greater than 1 d) Equal to 0

21) Which of the following conic has eccentricity $0 < e < 1$?
a) Parabola b) Hyperbola c) Ellipse d) Circle

22) Find the focus of conic: $x^2 = 4ay$
a) (0, – a) b) (a, 0) c) (0, a) d) (– a, 0)

23) Find the equation of tangent from (2, 3) to the circle $x^2 + y^2 = 4$
a) $5x - 12y = 26$ b) $5x - 12y = -26$ c) Both a and b d) None of these

24) Write equations of tangent to the circle $x^2 + y^2 - 4x + 6y + 9 = 0$, at the points on the circle whose ordinate is -2.
a) $3x + y - 1 = 0$ and $-3x + y - 1 = 0$
b) $4x + 7y = 0$ and $4x - 7y = 0$
c) $\sqrt{3}x + y - 1 - 2\sqrt{3} = 0$ and $-\sqrt{3}x + y - 1 + 2\sqrt{3} = 0$
d) $2x + \sqrt{3}y - 8 = 0$ and $2x - \sqrt{3}y - 8 = 0$

25) What are the vertices of the following conic?
$9x^2 + 16y^2 = 144$
a) $(0, \pm 4)$ b) $(\pm 4, 0)$ c) $(\pm 3, 0)$ d) $(0, \pm 3)$

26) If $h^2 = ab$, then the following equation represents:
$ax^2 + 2hxy + by^2$
a) Circle b) Parabola c) Ellipse d) Hyperbola

27) If $A \neq B$, and are of opposite signs, then the conic is:
a) Parabola b) Ellipse c) Hyperbola d) Circle

28) $2x^2 + 2y^2 + 4x - 6y - 15 = 0$, represents a:
a) Circle b) Parabola c) Ellipse d) Hyperbola

29) If a tangent is drawn on the circle, then the point where the circle touches the tangent is called?
a) Chord b) Secant c) Center d) Point of Contact

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30) Find the distance between the directrices of the following ellipse:
$4x^2 + 7y^2 = 28$
a) $14\sqrt{3}$ c) $\frac{14}{3}\sqrt{3}$ c) $14\sqrt{5}$ d) $\frac{14}{9}\sqrt{5}$

31) Find the eccentricity of the following conic:
$\frac{x^2}{4} - \frac{y^2}{9} = 1$
a) 9/4 b) $\sqrt{15}/4$ c) $\sqrt{13}/2$ d) $\sqrt{9/5}$

32) Which of the following elements belong to a Parabola?
a) 2 foci , 2 directrices b) 1 focus, 2 directrices c) 1 focus , 1 directrix d) 2 foci, 1 directrix

33) $e = \frac{\sqrt{3}}{2}$ defines which of the following conic:
a) Circle b) Ellipse c) Parabola d) Hyperbola

34) Find the center of the circle represented by following equation:
$3x^2 + 3y^2 + 6x - 3y - 2 = 0$
a) $(1, 1/2)$ b) $(1/2, 1)$ c) $(-1/2, -1)$ c) $(-1, 1/2)$

35) Which transformation would remove the terms of first degree from the equation:
$x^2 + 2y^2 + 2x - 4y = 0$
a) X + 1/2 , Y − 1 b) X − 1, Y + 1 c) X − 1/2, Y + 1 d) X + 1, Y − 1

Answers of Chapter 6 – Conic Section

1) $2x - y - 3 = 0$

$\frac{x^2}{2} - \frac{y^2}{2} = 1$

Taking derivative of both sides, we get:

$x - y\frac{dy}{dx} = 0$

$\frac{dy}{dx} = \frac{x}{y}$

Slope of tangent line at $(2, 1) = \frac{2}{1} = 2$

We have to find the equation of tangent with slope 1 and passing through the point (2,1).Using the point slope form we can write:

$y - 1 = 2(x - 2) \rightarrow y - 1 = 2x - 4 \rightarrow 2x - 4 - y + 1 = 0 \rightarrow 2x - y - 3 = 0$

2) $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

If the coefficients of x^2 and y^2 are not equal, but have the same signs, the equation represents an Ellipse.
If the coefficients of x^2 and y^2 are with opposite signs, the equation represents a Hyperbola.
If only one squared term is present in the equation i.e., either x^2 or y^2, the equation represents a Parabola.
If the coefficients of x^2 and y^2 are equal and with same signs, the equation represents a circle.

3) b^2

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Product of the distances from the foci to any tangent of the hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ is always b^2

4) Both a and b

Graph of a hyperbola is symmetric with respect to both axes: Transverse axis and Conjugate axis.

5) Latus rectum

In a conic, the focal chord is any line segment passing through the focus of the conic and having its endpoints on the conic. In an ellipse, each of focal chords perpendicular to the major axis is known as latus rectum of the ellipse.

6) Two foci, Two Directrices

A parabola has 1 focus, 1 directrix and 1 vertex with eccentricity equal to 1.
An ellipse has 2 foci, 2 directrices and 2 vertices with eccentricity between 0 and 1
A hyperbola has 2 foci, 2 directrices and 2 vertices with eccentricity greater than 1.

7) Circle

8) $x = a\sec\theta, y = b\tan\theta$

Re-arranging both equations.

$$\frac{x}{a} = \sec\theta \quad , \quad \frac{y}{b} = \tan\theta$$

Square both equations and subtract the second equation from the first one. This will result in:

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = \sec^2\theta - \tan^2\theta$$

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

Since, the coefficients of squared terms are with opposite signs, the equation represents a Hyperbola.

9) Outside

Substituting the given point (5, 5) in the given equation:

$x^2 + y^2 = (5)^2 + (5)^2 = 50$

Which is greater than 25. So, the point lies outside the circle.

10) $x^2 = 4ay$

The graph of the parabola $x^2 = 4ay$ opens vertically upward and is symmetric with respect to y – axis.

11) A point circle

If the intersecting plane passes through the vertex of the cone, the result is a single point or a point circle.

12) Circle

Circle is a special form of an ellipse with eccentricity equal to zero and having both axes(major and minor) equal in length.

13) (2, -2)

The vertex of the parabola of the form: $(x - h)^2 = 4a(y - k)$ lies at (h, k)
Comparing the given equation with the general equation of parabola, we get:
h = 2 and k = -2 So, the vertex of the given parabola will be at (2, -2)

14) $\frac{\sqrt{13}}{2}$

$$\frac{x^2}{4} - \frac{y^2}{9} = 1$$

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$\frac{x^2}{2^2} - \frac{y^2}{3^2} = 1$
$\rightarrow a = 2, \quad b = 3$
For hyperbola: $b^2 = c^2 - a^2$
So, $3^2 = c^2 - 2^2$
$c^2 = 9 + 4 = 13 \qquad \rightarrow c = \sqrt{13}$
$Eccentricity = e = \frac{c}{a} = \frac{\sqrt{13}}{2}$

15) $y = \pm\frac{4}{3}(x-2) - 2$
To find the asymptotes of the hyperbola, set it equal to zero (i.e., replace 1 by 0) and isolate y on one side of the equation. The resulting equation will represent the asymptotes of the hyperbola.
$\frac{(y+2)^2}{16} - \frac{(x-2)^2}{9} = 0$
$\frac{(y+2)^2}{16} = \frac{(x-2)^2}{9}$
$(y+2)^2 = \frac{16}{9}(x-2)^2$
$(y+2) = \pm\sqrt{\frac{16}{9}(x-2)^2}$
$y + 2 = \pm\frac{4}{3}(x-2)$
$y = \pm\frac{4}{3}(x-2) - 2$
The above equation represents the asymptotes of the hyperbola.

16) Hyperbola

17) (1, 0)
The focus of the parabola of the form $y^2 = 4ax$, lies at (a, 0)
Comparing the given equation with the general equation, we can write:
$y^2 = 4(1)(x)$
So, a = 1 Thus, the focus of the parabola will be at (1, 0)

18) 4
Two different conics can intersect each other at maximum 4 distinct points and minimum 0 point.

19) Parabola
A circle has eccentricity 0, an ellipse between 0 and 1, a parabola has eccentricity 1, and hyperbolae have eccentricity greater than 1.

20) Less than 1
The eccentricity of the Earth's orbit is currently about 0.0167; the Earth's orbit is nearly circular.

21) Ellipse
1) If $e = 0$, the conic is a circle
2) If $0 < e < 1$, the conic is an Ellipse
3) If $e = 1$, the conic is a Parabola
4) If $e > 1$, the conic is a Hyperbola

22) (0, a)

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$x^2 = 4ay$ is the general equation of a parabola which open upwards. The focus of this parabola lies on Y – axis with coordinates (0, a).
$x^2 = -4ay$ is the general equation of a parabola which open downwards. The focus of this parabola lies on y – axis with coordinates (0, – a).
$y^2 = 4ax$ is the general equation of a parabola which open towards right. The focus of this parabola lies on x – axis with coordinates (a, 0).
$y^2 = -4ax$ is the general equation of a parabola which open towards left. The focus of this parabola lies on x – axis with coordinates (– a, 0).

23) $5x - 12y = -26$
A circle can have 2 tangents drawn from a point outside the circle. For a circle:
$x^2 + y^2 = a^2$ Equation 1
The equation of tangents will be:
$y = mx \pm a\sqrt{1+m^2}$ Equation 2
Comparing the given equation ($x^2 + y^2 = 2^2$) with equation 1, we can write : a = 2 for the given equation.
Substituting this value of a in Equation 2, gives us:
$y = mx \pm 2\sqrt{1+m^2}$
Now we need the value of m to find the Equation of tangents. This tangent is passing through the point (2, 3). This means we can replace the values of (x, y) with the ordered pair (2, 3) and can find the value of m.

$3 = 2m \pm 2\sqrt{1+m^2}$
$(3 - 2m) = \pm 2\sqrt{1+m^2}$
Squaring both sides, we get:
$(3-2m)^2 = \left(\pm 2\sqrt{1+m^2}\right)^2$
$9 + 4m^2 - 12m = 4(1+m^2)$
$4m^2 + 9 - 12m = 4 + 4m^2$
$9 - 12m = 4$
$5 = 12m$
$m = \frac{5}{12}$
Using the value of m and a, in Equation 2 will give us the Equations of tangents to the circle $x^2 + y^2 = 4$ from point (2, 3). These equations will be:

$$y = \frac{5x}{12} \pm 2\sqrt{1+\left(\frac{5}{12}\right)^2}$$

$$y = \frac{5x}{12} \pm 2\sqrt{1+\frac{25}{144}}$$

$$y = \frac{5x}{12} \pm 2\sqrt{\frac{144+25}{144}}$$

$$y = \frac{5x}{12} \pm 2\sqrt{\frac{169}{144}}$$

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$$y = \frac{5x}{12} \pm 2\left(\frac{13}{12}\right)$$

$$y = \frac{5x \pm 26}{12}$$

$12y = 5x \pm 26$ $\rightarrow 5x - 12y = \pm 26$

Note: We took square of a radical. This can lead to an Extraneous root. So, we must check if the resulting answers are valid or not. To check we need to substitute the given point (2, 3) in the final equations:

$5x - 12y = 26$
$5(2) - 12(3) = 26$
$-26 = 26$ This is not true. Hence, $5x - 12y = 26$ is not the desired answer.

$5x - 12y = -26$
$5(2) - 12(3) = -26$
$-26 = -26$
This is true. Hence, $5x - 12y = -26$ is the desired equation of tangent to circle $x^2 + y^2 = 4$ from (2, 3)

Important Note: The given point is a point outside the circle. It is not the point of tangency that lies on the circle. The method used to find the tangent for point of tangency is different and is discussed in Question#24 of this chapter.

24) $\sqrt{3}x + y - 1 - 2\sqrt{3} = 0$ and $-\sqrt{3}x + y - 1 + 2\sqrt{3} = 0$
We are given the value of ordinate or the y – coordinate. To find the equation of tangents, we need to know the value of abscissa or the x – coordinate as well.
Since the point lies on the circle, we can substitute y = – 2 in the given equation and find the value of x.

$x^2 + (-2)^2 - 4x + 6(-2) + 9 = 0$
$x^2 - 4x + 4 - 12 + 9 = 0$
$x^2 - 4x + 1 = 0$

Using Quadratic Formula:

$$x = \frac{-(-4) \pm \sqrt{(4)^2 - 4(1)(1)}}{2(1)} = \frac{4 \pm \sqrt{16-4}}{2} = \frac{4 \pm \sqrt{12}}{2} = \frac{4 \pm \sqrt{4(3)}}{2} = \frac{4 \pm 2\sqrt{3}}{2} = 2 \pm \sqrt{3}$$

Thus, the two points on the circle with ordinate – 2 are:
$(2 + \sqrt{3}, -2)$ and $(2 - \sqrt{3}, -2)$
The general equation of the circle is: $x^2 + y^2 + 2gx + 2fy + c = 0$
Rewriting the given equation, we get: $x^2 + y^2 + 2(-2)x + 2(3)y + 9 = 0$
Comparing the 2 equations we can write: $g = -2$ $f = 3$ $c = 9$
The equation of tangent to the circle $x^2 + y^2 + 2gx + 2fy + c = 0$ at point (x_1, y_1) is given as:
$xx_1 + yy_1 + g(x + x_1) + f(y + y_1) + c = 0$

Using the given points, we can write the desired equations. For point $(2 + \sqrt{3}, -2)$, equation of tangent will be:

$x(2 + \sqrt{3}) + y(-2) + (-2)(x + 2 + \sqrt{3}) + 3(y - 2) + 9 = 0$
$2x + \sqrt{3}x - 2y - 2x - 4 - 2\sqrt{3} + 3y - 6 + 9 = 0$
$\sqrt{3}x + y - 1 - 2\sqrt{3} = 0$

Similarly, for point $(2 - \sqrt{3}, -2)$, equation of tangent will be:

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$x(2-\sqrt{3})+y(-2)+(-2)(x+2-\sqrt{3})+3(y-2)+9=0$
$2x-\sqrt{3}x-2y-2x-4+2\sqrt{3}+3y-6+9=0$
$-\sqrt{3}x+y-1+2\sqrt{3}=0$

25) $(\pm 4, 0)$
Step 1 is to identify the type of conic. Since, both the variables are squared, the given conic CANNOT be a parabola. The signs of coefficients of both squared terms are the same. So, given conic CANNOT be a hyperbola. The coefficients of both squared terms are different. Based on this information, we can conclude that the given equation represents an Ellipse.
We need to re-write the given equation to convert it into general form. Dividing both sides by 144 gives us:

$$\frac{9x^2}{144}+\frac{16y^2}{144}=1$$

$$\frac{x^2}{\frac{144}{9}}+\frac{y^2}{\frac{144}{16}}=1$$

$$\frac{x^2}{16}+\frac{y^2}{9}=1$$

$$\frac{x^2}{4^2}+\frac{y^2}{3^2}=1$$

The general equation of ellipse is:

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1, \qquad a>b$$

The vertices of this ellipse lie at $(\pm a, 0)$
Comparing the given equation with general equation, we can write : a = 4 and b = 3. So, the coordinates of vertices of given ellipse will be: $(\pm 4,0)$

26) Parabola
The most general equation of a conic is: $ax^2+2hxy+by^2+2gx+2fy+c=0$
If g = f = 0, the equation changes to: $ax^2+2hxy+by^2+c=0$
Which is the given equation. The quantity h^2-ab is called the discriminant of the equation and nature of a conic can be determined by the value of this discriminant.
i) If $h^2-ab<0$, the conic is either an ellipse or circle
ii) If $h^2-ab=0$, the conic is a parabola
iii) If $h^2-ab>0$, the conic is a hyperbola

27) Hyperbola
A general equation of second degree is: $Ax^2+By^2+Gx+Fy+C=0$
1) If $A=B\neq 0$, the equation represents a Circle
2) If $A\neq B$, and both are of the same signs, the equation represents an Ellipse
3) If $A\neq B$, and both have opposite signs, the equation represents a Hyperbola.
4) If $A=0$, or $B=0$, (both cannot be zero at the same time), the equation represents a Parabola.

28) Circle
Since, the coefficients of x^2 and y^2 are equal with the same signs, the given equation represents a Circle.

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If the coefficients of x^2 and y^2 are not equal, but have the same signs, the equation would represent an Ellipse.
If the coefficients of x^2 and y^2 are with opposite signs, the equation would represent a Hyperbola.
If only one squared term is present in the equation i.e., either x^2 or y^2, the equation would represent a Parabola.

29) **Point of Contact**
Point of contact is the point where two different lines, curves or angles meet. Tangent touches the circle at a point, so this point is the point of contact for circle and the tangent. A more specific name for this case is "Point of Tangency".

30) $\frac{14}{3}\sqrt{3}$
First, we need to convert the given equation to a general form. For this we need to divide both sides of the equation by 28. This gives us:

$$\frac{4x^2}{28}+\frac{7y^2}{28}=\frac{28}{28}$$

$$\frac{x^2}{7}+\frac{y^2}{4}=1$$

$$\frac{x^2}{(\sqrt{7})^2}+\frac{y^2}{(2)^2}=1$$

Since, the denominator under x^2 term is larger, the given equation is of the form:

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}=1, \qquad a>b$$

The equation of directrices of this general ellipse are:

$$x=\pm\frac{c}{e^2}$$

We need the values of c and e. For ellipse:
$c^2=a^2-b^2$
For given equation $a=\sqrt{7}$ and $b=2$. Using these values:
$c^2=7-4=3$
$c=\sqrt{3}$
e stands for eccentricity. Eccentricity of ellipse is calculated as:

$$e=\frac{c}{a}$$

Using the values:

$$e=\frac{\sqrt{3}}{\sqrt{7}}$$

Now we can find the equation of directrices. The equations are:

$$x=\pm\frac{c}{e^2}=\pm\frac{\sqrt{3}}{\left(\frac{\sqrt{3}}{\sqrt{7}}\right)^2}=\pm\frac{7}{\sqrt{3}}$$

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So, the two directrices are:

$$x = \frac{7}{\sqrt{3}} \qquad and \qquad x = -\frac{7}{\sqrt{3}}$$

The distance between two directrices will be:

$$Distance = \frac{7}{\sqrt{3}} - \left(-\frac{7}{\sqrt{3}}\right) = \frac{14}{\sqrt{3}}$$

We can rationalize this value as:

$$Distance = \frac{14}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = \frac{14\sqrt{3}}{3}$$

31) $\sqrt{13}/2$

Since the signs of coefficients of squared terms are opposite, the given equation represents a hyperbola.

$$\frac{x^2}{(2)^2} - \frac{y^2}{(3)^2} = 1$$

The given equation is of the form:

$$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$$

The formula to calculate the eccentricity of a conic is:

$$e = \frac{c}{a}$$

For hyperbola, $c^2 = a^2 + b^2$

Using the values, we get:

$$c^2 = 2^2 + 3^2 = 13 \qquad \rightarrow c = \sqrt{13}$$

So, the eccentricity will be:

$$e = \frac{\sqrt{13}}{2}$$

32) 1 focus , 1 directrix

A parabola has 1 focus, 1 directrix and 1 vertex with eccentricity equal to 1.
An ellipse has 2 foci, 2 directrices and 2 vertices with eccentricity between 0 and 1
A hyperbola has 2 foci, 2 directrices and 2 vertices with eccentricity greater than 1.

33) Ellipse

For a conic, e represents its eccentricity. The conics can be identified based on the following information.

1) If $e = 0$, the conic is a circle
2) If $0 < e < 1$, the conic is an Ellipse
3) If $e = 1$, the conic is a Parabola
4) If $e > 1$, the conic is a Hyperbola

The given value of eccentricity is: $e = \frac{\sqrt{3}}{2}$. The approximate value of $\sqrt{3}$ is 1.7

This means, we have a smaller value in numerator and a larger value in denominator. Whenever a smaller value is divided by a larger value, the result is a number between 0 and 1. Based on this, we can conclude that the value of eccentricity lies between 0 and 1, and therefore, the given eccentricity belongs to an ellipse.

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34) $(-1, 1/2)$

Dividing both sides of the given equation by 3 gives us: $x^2 + y^2 + 2x - y - \frac{2}{3} = 0$

The general equation of the circle is: $x^2 + y^2 + 2gx + 2fy + c = 0$

The center of the circle given by general equation lies at: $(-g, -f)$. Comparing the given equation with general equation, we can write:

$2g = 2 \quad \rightarrow g = 1$ $\qquad 2f = -1 \quad \rightarrow f = -\frac{1}{2}$

So, the coordinates of center of given circle will be: $(-1, 1/2)$

35) X – 1, Y + 1

For this question you need to check for all the given 4 choices, that which of them will eliminate the first-degree terms from the equation. By first degree terms we mean that the exponent of these variables must be 1. The first-degree terms in the given equation are "2x" and "4y"

Checking first option: X + 1/2 , Y – 1

Given equation is: $x^2 + 2y^2 + 2x - 4y = 0$

Equation of transformation will be:

x = X + 1/2 $\qquad$ y = Y – 1

Replace every occurrence of x and y by the values shown above. This will give us:

$$\left(X + \frac{1}{2}\right)^2 + 2(Y-1)^2 + 2(X + \frac{1}{2}) - 4(Y-1) = 0$$

$$X^2 + X + \frac{1}{4} + 2(Y^2 + 1 - 2Y) + 2X + 1 - 4Y + 4 = 0$$

$$X^2 + X + \frac{1}{4} + 2Y^2 + 2 - 4Y + 2X + 1 - 4Y + 4 = 0$$

$$X^2 + 2Y^2 + 3X - 8Y + \frac{29}{4} = 0$$

This transformation did not remove any first-degree terms. So, checking the next options.

Checking second option: X – 1, Y + 1

Given equation is: $x^2 + 2y^2 + 2x - 4y = 0$

Equation of transformation will be:

x = X – 1 $\qquad$ y = Y + 1

Replace every occurrence of x and y by the values shown above. This will give us:

$$(X-1)^2 + 2(Y+1)^2 + 2(X-1) - 4(Y+1) = 0$$

$$X^2 - 2X + 1 + 2(Y^2 + 2Y + 1) + 2X - 2 - 4Y - 4 = 0$$

$$X^2 - 2X + 1 + 2Y^2 + 4Y + 2 + 2X - 2 - 4Y - 4 = 0$$

$$X^2 + 2Y^2 - 3 = 0$$

This transformation has removed both the first-degree terms from the given equation, and so, this is the correct answer.

Keep checking the choices until you reach at the final answer, sometimes the answer is in option d, and for this you will have to check all the 4 options to get the answer.

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Chapter 7 – Vectors

1) Find a unit vector in direction of the vector $v = 3i - 4j$
a) $i - j$ b) $\frac{3}{5}i - \frac{4}{5}j$ c) $\frac{1}{3}i - \frac{1}{4}j$ d) $\frac{3}{12}i - \frac{4}{12}j$

2) If u, v and w are three vectors, then $(u \times v) \cdot w$ can represent the volume of:
a) Triangle b) Cube c) Cylinder d) Parallelepiped

3) If $a = 2i + 3j - 4k$ and $b = \alpha i + 9j + 5k$ are perpendicular vectors, find the value of α.
a) 7 b) -7/2 c) – 7 d) 7/2

4) Find the volume of parallelepiped formed by following 3 vectors:
$u = i + 2j - k$ $v = i - 2j + 3k$ $w = i - 7j - 4k$
a) 27 b) 32 c) 56 d) 48

5) Compute the value of: $(i \cdot j)(j \cdot j)(k \cdot k)$
a) 1 b) -1 c) 0 d) Undefined

6) If the volume of parallelepiped formed by vectors $u = 2i - \alpha j + 6k$, $v = i + 2j - k$ and $w = \alpha i + 3j + k$ is 4, which of the following can be a possible value of α?
a) 4 b) -7 c) 3 d) -8

7) Compute the value of: $i \times (j \times k) = ?$
a) 1 b) -1 c) 0 d) None of these

8) Compute the value of: $i \cdot (j \times k)$
a) 1 b) -1 c) 0 d) None of these

9) Compute the value of: $i \cdot (k \times j)$
a) 1 b) -1 c) 0 d) None of these

10) What will be the volume of parallelepiped represented by the vectors
$u = 9i - 5j,$ $v = 6i - 7j + k,$ $w = i - k$
a) 28 b) 33 c) 56 d) 38

11) Find a unit vector in the direction of vector $A = -i + 2j - 4k$
a) $-\frac{i}{\sqrt{7}} + \frac{2j}{\sqrt{7}} - \frac{4k}{\sqrt{7}}$ b) $-\frac{i}{\sqrt{21}} + \frac{2j}{\sqrt{21}} - \frac{4k}{\sqrt{21}}$
c) $-\frac{i}{3} + \frac{2j}{3} - \frac{4k}{3}$ d) $-\frac{i}{\sqrt{19}} + \frac{2j}{\sqrt{19}} - \frac{4k}{\sqrt{19}}$

12) Which of the following set can be the direction angles of a vector?
a) 60, 45, 90 b) 45, 45, 45 c) 60, 30, 30 d) 60, 60, 45

13) If $a = 2i - j + k$ and $b = -i + j$, find the angle between the vectors
a) $2\pi/3$ b) $3\pi/4$ c) $5\pi/6$ d) $\pi/2$

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Answers of Chapter 7 - Vectors

1) $\frac{3}{5}i - \frac{4}{5}j$

The unit vector in the direction of vector v will be: $\frac{v}{|v|}$

$|v| = \sqrt{(3)^2 + (-4)^2} = \sqrt{9+16} = \sqrt{25} = 5$

So, the unit vector in direction of given vector will be:

$\underline{v} = \frac{3i - 4j}{5} = \frac{3}{5}i - \frac{4}{5}j$

2) Parallelepiped

The triple scalar product $(u \times v) \cdot w$ represents the volume of a parallelepiped with u, v *and* w being its conterminous edges.

3) -7/2

Dot product of two perpendicular vectors is always equal to 0. If we calculate the dot product of given vectors and set it equal to 0, we can find the value of α.

$a.b = (2i + 3j - 4k) \cdot (\alpha i + 9j + 5k)$

$a.b = 2\alpha + 27 - 20$

$a.b = 2\alpha + 7$

We have obtained the value of dot product. Now we can set it equal to 0 and find the value of α.

$0 = 2\alpha + 7$

$\alpha = -\frac{7}{2}$

4) 48

Formula to calculate the volume of a parallelepiped is:

Volume of Parallelepiped = $(u \times v) \cdot w$

We can use the determinant formula to calculate the value of this Triple Scalar Product. According to the formula for any 3 vectors:

$u = a_1 i + b_1 j + c_1 k$ $\quad v = a_2 i + b_2 j + c_2 k$ $\quad w = a_3 i + b_3 j + c_3 k$

$$(u \times v) \cdot w = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

Using this formula for the given 3 vectors, we get:

$$(u \times v) \cdot w = \begin{vmatrix} 1 & 2 & -1 \\ 1 & -2 & 3 \\ 1 & -7 & -4 \end{vmatrix}$$

Expanding the determinant by 1st column:

$(u \times v) \cdot w = 1(8 + 21) - 2(-4 - 3) - 1(-7 + 2)$

$(u \times v) \cdot w = 29 + 14 + 5$

$(u \times v) \cdot w = 48$

Thus, the volume of parallelepiped formed by given 3 vectors is 48.

5) 0

Remember that:

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1) Dot product of 2 parallel unit vectors is always equal to 1.
2) Dot product of 2 perpendicular unit vectors is always equal to 0.
So, $i \cdot j = 0$ $j \cdot j = 1$ $k \cdot k = 1$
So, the value of given expression becomes:
$(i \cdot j)(j \cdot j)(k \cdot k) = 0 \times 1 \times 1 = 0$

6) 3
Formula to calculate the volume of a parallelepiped is:
Volume of Parallelepiped = $(u \times v) \cdot w$
We can use the determinant formula to calculate the value of this Triple Scalar Product. According to the formula for any 3 vectors:
$u = a_1 i + b_1 j + c_1 k$ $v = a_2 i + b_2 j + c_2 k$ $w = a_3 i + b_3 j + c_3 k$

$$(u \times v) \cdot w = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

Using this formula for the given 3 vectors, we get:

$$(u \times v) \cdot w = \begin{vmatrix} 2 & -\alpha & 6 \\ 1 & 2 & -1 \\ \alpha & 3 & 1 \end{vmatrix}$$

Expanding the determinant by first row, we get:

$(u \times v) \cdot w = 2(2+3) + \alpha(1+\alpha) + 6(3-2\alpha)$
$(u \times v) \cdot w = 10 + \alpha + \alpha^2 + 18 - 12\alpha$
$(u \times v) \cdot w = \alpha^2 - 11\alpha + 28$

This equation represents the volume of parallelepiped. Since, the above equation can be factorized easily, many students in hurry set this equal to 0, and find the resulting value of α, which leads to a wrong answer. The volume of parallelepiped is given to be 4, so we set the above equation equal to 4 and find the resulting value of α.

$\alpha^2 - 11\alpha + 28 = 4$
$\alpha^2 - 11\alpha + 24 = 0$
$\alpha^2 - 3\alpha - 8\alpha + 24 = 0$
$\alpha(\alpha - 3) - 8(\alpha - 3) = 0$
$(\alpha - 8)(\alpha - 3) = 0$
$\alpha = 3, \alpha = 8$

Thus, the possible values of α are 3 and 8, and from these only 3 is available in the given choices.

7) 0
Remember that:
1) Cross product of 2 parallel unit vectors is always equal to 0.
2) Cross product of 2 perpendicular unit vectors is always a unit vector perpendicular to both given vectors. $i \times j = k$ $j \times k = i$ $k \times i = j$
So, $i \times (j \times k) = i \times i = 0$

8) 1
Remember that:

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1) Cross product of 2 parallel unit vectors is always equal to 0.
2) Cross product of 2 perpendicular unit vectors is always a unit vector perpendicular to both given vectors. $i \times j = k$ $j \times k = i$ $k \times i = j$
3) Dot product of 2 parallel unit vectors is always equal to 1.
4) Dot product of 2 perpendicular unit vectors is always equal to 0.
So, $i \cdot (j \times k) = i \cdot i = 1$

9) -1
Remember that:
1) Cross product of 2 parallel unit vectors is always equal to 0.
2) Cross product of 2 perpendicular unit vectors is always a unit vector perpendicular to both given vectors. $i \times j = k$ $j \times k = i$ $k \times i = j$
Note: Changing the position of vectors in cross product will result in a negative answer.
(For example, $j \times i = -k$)
3) Dot product of 2 parallel unit vectors is always equal to 1.
4) Dot product of 2 perpendicular unit vectors is always equal to 0.
So, $i \cdot (k \times j) = i \cdot (-i) = -(i \cdot i) = -1$

10) 28
Formula to calculate the volume of a parallelepiped is:
Volume of Parallelepiped = $(u \times v) \cdot w$
We can use the determinant formula to calculate the value of this Triple Scalar Product. According to the formula for any 3 vectors:
$u = a_1 i + b_1 j + c_1 k$ $v = a_2 i + b_2 j + c_2 k$ $w = a_3 i + b_3 j + c_3 k$

$$(u \times v) \cdot w = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

Using this formula for the given 3 vectors, we get:

$$(u \times v) \cdot w = \begin{vmatrix} 9 & -5 & 0 \\ 6 & -7 & 1 \\ 1 & 0 & -1 \end{vmatrix}$$

Expanding the determinant by 3rd column, we get:
$(u \times v) \cdot w = 0(0+7) - 1(0+5) - 1(-63+30)$
$(u \times v) \cdot w = 0 - 5 + 33$
$(u \times v) \cdot w = 28$

11) $-\frac{i}{\sqrt{21}} + \frac{2j}{\sqrt{21}} - \frac{4k}{\sqrt{21}}$
A unit vector in the direction of a vector is calculated by dividing the vector with its magnitude. So, unit vector in direction of given vector will be:

$$\underline{A} = \frac{A}{|A|}$$

$$|A| = |-i + 2j - 4k| = \sqrt{(-1)^2 + (2)^2 + (-4)^2} = \sqrt{1+4+16} = \sqrt{21}$$

So, the required unit vector will be:

$$\underline{A} = \frac{-i + 2j - 4k}{\sqrt{21}} = -\frac{i}{\sqrt{21}} + \frac{2j}{\sqrt{21}} - \frac{4k}{\sqrt{21}}$$

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12) 60, 60, 45

The angles α, β *and* γ are direction angles of a single vector if:

$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$

So, we need to evaluate this expression for all given choices to find out which of them can be the set of direction angles of a vector.

For option a) 60, 45, 90

$$\cos^2 60 + \cos^2 45 + \cos^2 90 = \left(\frac{1}{2}\right)^2 + \left(\frac{1}{\sqrt{2}}\right)^2 + 0 = \frac{1}{4} + \frac{1}{2} = \frac{3}{4}$$

For option b) 45, 45, 45

$$\cos^2 45 + \cos^2 45 + \cos^2 45 = \left(\frac{1}{\sqrt{2}}\right)^2 + \left(\frac{1}{\sqrt{2}}\right)^2 + \left(\frac{1}{\sqrt{2}}\right)^2 = \frac{1}{2} + \frac{1}{2} + \frac{1}{2} = \frac{3}{2}$$

For option c) 60, 30, 30

$$\cos^2 60 + \cos^2 90 + \cos^2 30 = \left(\frac{1}{2}\right)^2 + \left(\frac{\sqrt{3}}{2}\right)^2 + \left(\frac{\sqrt{3}}{2}\right)^2 = \frac{1}{4} + \frac{3}{4} + \frac{3}{4} = \frac{7}{4}$$

For option d) 60, 60, 45

$$\cos^2 60 + \cos^2 60 + \cos^2 45 = \left(\frac{1}{2}\right)^2 + \left(\frac{1}{2}\right)^2 + \left(\frac{1}{\sqrt{2}}\right)^2 = \frac{1}{4} + \frac{1}{4} + \frac{1}{2} = 1$$

Thus, from the given choices 60, 60, 45 can be the direction angles of a vector.

13) $5\pi/6$

We can use the definition of dot product to find the angle between the two vectors.

For any two vectors a and b:

$$a \cdot b = |a||b| \cos\theta$$

$$\cos\theta = \frac{a \cdot b}{|a||b|}$$

Here, $a \cdot b$ is the dot product of two vectors.

$|a|$ *and* $|b|$ represent the magnitude of each vector and θ Is the angle between two vectors.

$$a \cdot b = (2i - j + k) \cdot (-i + j) = -2 - 1 = -3$$

$$|a| = |2i - j + k| = \sqrt{2^2 + (-1)^2 + 1^2} = \sqrt{6}$$

$$|b| = |-i + j| = \sqrt{(-1)^2 + 1^2} = \sqrt{2}$$

Using these values In the formula, we get:

$$\cos\theta = \frac{-3}{\sqrt{6}\sqrt{2}} = -\frac{3}{\sqrt{12}} = -\frac{3}{2\sqrt{3}} = -\frac{\sqrt{3}}{2}$$

$$\theta = \cos^{-1}\left(-\frac{\sqrt{3}}{2}\right) = 150° = \frac{5\pi}{6}$$

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Past Paper Questions from Physics Portion of NETs

The number of Physics questions in NETs out of 200 are:

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- NET Biotechnology : 30 MCQs
- NET BS Physics : 170 MCQs

The key to performing better in this section is reading and practice. Each and every formula in the textbook must be learned. The tables of measurements given in the textbooks are also important and must be learned. Most of the questions in Physics portion are numerical or formula based but a few questions will be based on theory. So, you must read and learn the theory to maximize your chances of scoring more.

The Questions in the Physics portion are from both FSc 1st year and FSc 2nd year. So. every chapter must be prepared. However, some chapters are more important than the rest and you will find more questions from these chapters in your NET. List of important chapters for Physics are:

FSc First Year:

- **Chapter 1 – Measurements**
- **Chapter 3 – Motion and Force**
- **Chapter 4 – Work and Energy**
- **Chapter 5 – Circular Motion**
- **Chapter 7 – Oscillations**

FSc Second Year:

- **Chapter 12 – Electrostatics,**
- **Chapter 13 –Current Electricity**
- **Chapter 14 –Electromagnetism**
- **Chapter 15 –Electromagnetic Induction**
- **Chapter 19 – Dawn of Modern Physics**
- **Chapter 21 – Nuclear Physics**

The following pages contain the Physics Questions from **Past Papers of NUST** (2013 Onwards) along with their answers and solutions.

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Questions from 1st Year Physics

Chapter 1 – Measurements

1) Volume of sphere having radius 17 cm is:
a) 20579.53 cm^3 b) 0. 03 cm^3 c) 0. 08 cm^3 d) 0. 01 cm^3

2) Ratio of Nano to Atto is:
a) 10^9 b) 10^8 c) 10^{12} d) 10^{-9}

3) Zeros are always considered significant when they are
a) In between non-zero digits b) On left of non-zero digits
c) On right of non-zero digits d) All of the above

4) Weight is equivalent to which of the following
a) Momentum b) Energy c) Acceleration d) Force

5) 1 femto is equal to
a) 10 atto b) 100 atto c) 1000 atto d) 10000 atto

6) Dimension of power?
a) $M^1L^2T^{-2}$ b) $M^1L^2T^{-3}$ c) $M^0L^{-1}T^0$ d) $M^{-1}L^2T^3$

7) Which one of the following is correct
a) 1GeV=10^9 eV b) 1Mev=10^6 eV c) 1eV =1.6 x 10^{-19} J d) All of the above

8) Dimensions of torsional couple is similar to the dimension of
a) Power b) Current
c) Work d) Galvanometer constant

9) Branch of physics which deals with sub atomic particles.
a) Atomic physics b) Particle physics c) Molecular physics d) Nuclear physics

10) Dimensions of work?
a) $M L T^{-2}$ b) $M L^{-1}T^{-2}$ c) ML^2T^2 d) ML^2T^{-2}

11) The SI unit of mass is?
a) Miligram b) Gram c) Kilogram d) Ton

12) SI unit of velocity is:
a) ms b) s/m c) m/s d) s/m^2

13) SI unit of acceleration is:
a) ms^{-1} b) ms^{-2} c) ms^2 d) ms

14) What are the units of a and b in v = a + bt, where unit of v=ms^{-1} and t=s
a) ms^{-1} and ms^{-2} b) ms^{-1} and ms^{-1} c) ms^{-2} and ms^{-2} d) ms^{-2} and ms^{-1}

15) What is absolute uncertainty in length of 10m measured by scale of precision of 0.1m?
a) 0.1 b) 10 c) 0.01 d) 1.5

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16) Unit of light year is:
a) Seconds b) Meter c) Meter/Second d) Volts

17) Parsec is the unit of?
a) Frequency b) Mass c) Distance d) Time

18) Which one has least value?
a) Femto b) Pico c) Atto d) Milli

19) If v = a + bt, the dimensions of a and b are:
a) LT^{-1} and LT^{-2} b) LT^{-1} and T c) $L^{-2}T$ and T d) None of these

20) Radian is a:
a) Base unit b) Derived unit c) Supplementary unit d) None of these

21) Least count of micrometer screw gauge is?
a) 0.02 cm b) 0.01 cm c) 0.01 mm d) 0.02 mm

22) What are the Dimensions of P^2/m, where P is the momentum and m is the mass?
a) $M^2L^2T^2$ b) $M^2L^2T^{-2}$ c) ML^2T^{-2} d) MLT^{-2}

23) If A = 2.79 and B = 8.1, then A+B =
a) 10.89 b) 10.9 c) 11 d) None of these

24) Number of Significant figures in 0.000634 is:
a) 7 b) 6 c) 3 d) None of these

25) 1 inch = _____ cm
a) 2.50 b) 2.52 c) 2.54 d) 2.56

26) Unit of pressure?
a) Kelvin b) Candela c) Pascal d) Joule

27) Pa m^2 is the unit of
a) Work b) Pressure c) Force d) Power

28) Which of the following quantity has the dimension $[MLT^{-1}]$
a) Force b) Work c) Momentum d) Pressure

29) If v is the velocity of an object, then the following equation is always:
$$\left[1-\frac{v^2}{c^2}\right]^{-0.25}$$
a) Greater than 1 b) Less than 1 c) Equal to 1 d) None of these

30) Suppose A = 4.1, and B = 3.26 and the result from calculator comes to be 1.00876543. What shou be the correct number of significant figures in final answer if the calculation involv multiplication and division only?
a) 2 b) 3 c) 4 d) 9

31) Which measure is nearest to your height?
a) 0.01 cm b) 2 cm c) 40 cm d) 160 cm

32) 1 femto =
a) 10^{-15} b) 10^{-9} c) 10^{-6} d) None of these

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33) 1 rad is equal to how many degrees?
a) 57.196 b) 57.296 c) 58.196 d) 58.296

34) If 5.1 is added to 3.014, the number of significant figures in final answer would be?
a) 1 b) 2 c) 3 d) 4

Answers of Chapter 1 – Measurements

1) 20579.53 cm^3

$$Volume\ of\ sphere = \frac{4}{3}\pi r^3$$

$$r = 17\ cm$$

$$So, Volume = \frac{4}{3}\pi\,(17)^3 = 20579.53\ cm^3$$

The above calculation involves the use of calculator to get the exact answer. However, you can choose the correct answer from the options by just observing the options. Calculation involves multiplication of 4/3, pie and cube of 17. Multiplying these 3 will never result in a number less than 1. Infact cube of 17 will be a huge number so the result will also be a big number. And only one such number is given in the options.

This question is added in almost all NETs, but students get confused and mark the wrong option as they think they need a calculator to solve it. In questions of this type, you always have to reach at the correct answer by observation.

2) 10^9

Nano = 10^{-9} Atto = 10^{-18} Nano : Atto = Nano / Atto = $10^{-9}/10^{-18} = 10^{-9+18} = 10^9$

3) In between non-zero digits

The digits 1 to 9 are always significant. When zero is in between the two significant digits (non-zero digits) It is always considered significant. For example, in 2.509, zero is significant. When zero is on left of significant figures it is not considered significant. For example, in 0.00678 there are only 3 significant figures. Zeros on right side may or may not be significant. Since we are to tell the location at which zeros are always significant, so this position is only in between the two significant digits.

4) Force

Weight is the force that acts on a body and is directed towards the center of the earth. So, force is the correct answer.

5) 1000 atto

1 atto = 10^{-18} 1 femto = 10^{-15}

$10^{-15} = 10^{-18} \times 10^3$

1 femto = 1atto x 1000

6) $M^1L^2T^{-3}$

Power= Work Done /Time

Dimensional Formula of Work= $M^1L^2T^{-2}$ Divide it by Time T^1

So Dimensional Formula of Power = $M^1L^2T^{-3}$.

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You don't need to learn the Dimensions of work, you can always find it by breaking it in simpler formula in terms of mass, time and distance.
Work = Force x Distance& Force = Mass x acceleration,
So, Work = Mass x Distance x Acceleration
Work = Mass x Distance x Distance/Time^2
Work = Mass x Distance^2 / Time^2
From here you can directly write the Dimensional formula of Work. Use this technique for all the quantities.

7) All of the above

8) Work
Unit of torsional couple = Nm
The only quantity in the options with the unit Nm is the work. Since the units of two are same, the Dimensions will also be the same.

9) Particle physics

10) ML^2T^{-2}
Work = Force x Distance& Force = Mass x acceleration,
So, Work = Mass x Distance x Acceleration
Work = Mass x Distance x Distance/Time^2
Work = Mass x Distance^2 / Time^2
So Dimensions of work = $M L^2 T^{-2}$

11) Kilogram

12) m/s

13) ms^{-2}

14) ms^{-1} and ms^{-2}
The dimensions on both sides of the equation must be the same. And two quantities can only be added if they have the same units.
So units of a + bt = unit of v = m/s
Unit of a = m/s Unit of bt = m/s
So, unit of b = m/s^2

15) 0.1
Absolute uncertainty = Precision = Least Count = 0.1m

16) Meter

17) Distance
A parsec (symbol: pc) is a unit of length used to measure large distances to objects outside the Solar System. A parsec is equal to about 3.26 light-years (31 trillion kilometres or 19 trillion miles) in length.

18) Atto
Atto = 10^{-18} Femto=10^{-15} Pico=10^{-12} Milli=10^{-3}

19) LT^{-1} and LT^{-2}
We are given that v = a + bt

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Here v represents the velocity. The units and dimensions of both sides of the equation must be the same.
Unit of velocity is ms^{-1}.
This means, the unit of a and the unit bt must also be ms^{-1}.
So, unit of a = ms^{-1} Dimensions of a = LT^{-1}
Unit of bt = ms^{-1} → Unit of b = ms^{-2} Dimensions of b = LT^{-2}

20) Supplementary unit
There are only two supplementary units: Radian and Steradian

21) 0.01 mm
The smallest reading up to which a screw gauge can be measured is called least count of screw gauge. It can be find out by following method.
Least Count = Pitch of screw gauge / Number of divisions on circular scale
Least Count = 1 mm/100 = 0.01 mm

22) ML^2T^{-2}

$$\frac{p^2}{m} = \frac{(mv)^2}{m} = mv^2$$

Therefore, the Dimensions will be $M[LT^{-1}]^2 = ML^2T^{-2}$

23) 10.9
In adding or subtracting, the number of decimal places retained in the answer should equal the smallest number of decimal places in any of the quantities being added or subtracted.
Number of decimal places in A is 2, number of decimal places in B is 1. So the number of decimal places in A + B must be 1.
A + B = 2.79 + 8.1 = 10.89
Rounding of to 1 decimal place we get the answer:
A + B = 10.9

24) 3
Zeros to the left of significant figures are not considered significant. So in this problem, the digits 634 are the only significant figures.

25) 2.54

26) Pascal

27) Force
Pa stands for Pascal. Pascal is equivalent to Newton per meter square.
So, Pa = Nm^{-2} → Pa m^2 = $Nm^{-2}m^2$ = N
Pa m^2 simplifies to newton(N) which is the unit of Force.

28) Momentum
We can convert the given dimension to units to find out to which quantity do they belong.
Dimension of kg (mass) = M Dimension of m (length) = L Dimension of s (time) = T
So, the units equivalent to the given dimension are: $kgms^{-1}$
kg is the unit of Mass and ms^{-1} is the unit of velocity.
So the given dimensions are of Mass x Velocity which is Equal to Momentum.

29) Greater than 1
v is the velocity of an object, and c is the speed of light. The magnitude of velocity (or speed) of the object will always be less than the speed of light. This means, the value in numerator of the given fraction is

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smaller than the value given in denominator. When a smaller number is divided by a larger number, the result is a number between 0 and 1. For example: $\frac{3}{4} = 0.75$
When this result will be subtracted from 1, the answer again will be any number between 0 and 1. For example, $1 - 0.75 = 0.25$
Notice that the exponent is negative. So, we can take the reciprocal of the equation to make the exponent positive. This gives us:

$$\frac{1}{\left[1-\frac{v^2}{c^2}\right]^{0.25}}$$

The value inside the brackets is between 0 and 1, as discussed above. A value between 0 and 1 when raised to any positive exponent will always be between 0 and 1. For example, $0.25^{0.25} = 0.707$.
Now we have 1 in numerator and a number smaller than 1 in denominator. When a larger number is divided by a smaller number, the result is always greater than 1. Therefore, we can conclude that the given expression will always give a value greater than 1.

30) 2
For multiplication or division, the rule is to count the number of significant figures in each number being multiplied or divided and then limit the significant figures in the answer to the lowest count. The number of significant figures in A is 2 and in B is 3. So, the final answer must have 2 significant figures.

31) 160 cm
This is a unit conversion question. Remember that 1 feet = 30.48 cm
In general, the average height of an adult varies from 5 feet to 6 feet. Converting these into centimeters, we get:
5 feet = 152.4 cm
6 feet = 182.88 cm
The only option that is in this range is 160cm. So, this would be the correct answer

32) 10^{-15}
Femto is the one of the prefixes of SI system. In metric system, 1 femto meter = 10^{-15} meter.

33) 57.296
One radian is equal to 180/π degrees, which is approximately 57.3°.

34) 2
For addition and subtraction, look at the decimal portion (i.e., to the right of the decimal point) of the numbers ONLY. Here is what to do:
a) Count the number of significant figures in the decimal portion of each given number. (The digits to the left of the decimal place are not used to determine the number of decimal places in the final answer.)
b) Add or subtract in the normal fashion.
c) Round the answer to the LEAST number of places in the decimal portion of the given numbers
$5.1 + 3.014 = 8.114$
But the final answer must only contain 1 decimal position, as per the rules of Significant figures. So, the final answer will be 8.1 and it contains 2 significant digits.

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Chapter 2 – Vectors and Equilibrium

1) Two vectors are of magnitude 50 and 31, the resultant might be?
a) 82 b) 15 c) 78 d) 91

2) If a force of 2N acting through a moment arm of √2 m produces a torque of √6 Nm, what is the angle between F and r.
a) 0 degrees b) 30 degrees c) 45 degrees d) 60 degrees

3) The cross product of three unit vectors (i, j, k) equals:
a) 1 b) -1 c) 0 d) Infinite

4) (j x j).i =
a) 1 b) -1 c) 0 d) 2

5) Dimension of Torque is?
a) $M L T^{-2}$ b) $M L^{2} T^{-2}$ c) $M L^{-2} T^{2}$ d) $M L^{-2} T^{-2}$

6) Rain is vertically downwards with the velocity of 30m/s , a wind blows from north to south direction with 10m/s then at what angle should the umbrella of the person be held and in which direction.
a) Tan^{-1} (1/3) vertical towards north b) Tan^{-1} (1/3) vertical towards south
c) Cos^{-1} (1/3) vertical towards north d) Cos^{-1} (1/3) vertical towards south

7) Three books A, B, C are place on each other with A on top, B in mid and C at bottom. If weight of A is 2N, B is 5N and that of C is 4N, what is the total force being exerted on book B?
a) 11 N b) 5 N c) 7 N d) 6 N

8) How much angle does the vector 2i+3j makes with y axis.
a) 50 b) 34 c) 60 d) 75

9) A vector having magnitude equal to one is called
a) Position vector b) Unit vector c) Null vector d) None of these

10) If the velocity v being a vector quantity is multiplied to scaler quantity mass, the result will be:
a) Vector b) Scaler
c) These two cannot be multiplied d) None of these

11) If y-component of a force acting In y direction is 6N the x-component will be
a) 6N b) 12N c) Zero d) None of these

12) i . (j × k)
a) 0 b) 2 c) -1 d) 1

13) If the dot product of vectors is equal to product of their magnitudes, the angle between them is?
a) 90 b) 180 c) 0 d) 270

14) Vector components in space are:
a) 1 b) 2 c) 3 d) Infinite

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15) Two vectors of magnitude 10m and 20m have an angle 30° between them. The component of shorter vector parallel to the longer vector will be:
a) 5 m b) 8.66 m c) 10 m d) 17.32 m

16) Two vectors A and B both have magnitude of 5N and the angle between them is 135, then magnitude of A x B will be:
a) 25 b) 17.678 c) – 17.678 d) – 25

17) If the magnitude of vectors A, B and C is 12, 5 and 13 units respectively and A + B = C. What will be the angle between vectors A and B?
a) 90 b) 0 c) 60 d) 15

18) Which of the following option(s) represent a vector quantity?
a) $kgms^{-1}$ b) $kgms^{-2}$ c) kg d) Both a and b

19) What is the angle made by the vector – i – 5j with x-axis?
a) $\tan^{-1}\left(\frac{1}{5}\right)$ b) $90 + \tan^{-1}\left(\frac{1}{5}\right)$ c) $180 + \tan^{-1}\left(\frac{1}{5}\right)$ d) $270 - \tan^{-1}\left(\frac{1}{5}\right)$

20) If A and B are two vectors, area of parallelogram formed by these vectors will be?
a) AB b) A . B c) AB cos θ d) |A x B|

21) (1, 1, 1) · (2, 2, 2) =
a) 2 b) 4 c) 6 d) 8

22) If a Force F of magnitude 5N makes an angle of 60 with x-axis, the x-component of the vector will be:
a) $F/2$ b) $\sqrt{3}F/2$ c) $F/\sqrt{2}$ d) F

Answers of Chapter 2 – Vectors and Equilibrium

1) 78

For two vectors A and B, their resultant will always be in the range:

$|A - B| \leq Resultant \leq |A + B|$

So, in this case resultant will be in range of:

$19 \leq Resultant \leq 81$

From the given options, only 78 lies within this range so 78 is the correct answer.

2) 60 degrees

$Torque = rF \sin\theta$

$\sqrt{6} = \sqrt{2} \times 2 \times \sin\theta$

$\sin\theta = \frac{\sqrt{6}}{2\sqrt{2}} = \frac{\sqrt{3}}{2}$

So, $\theta = 60\ degrees$

3) 0 $i \times j \times k = k \times k = 0$

4) 0 $(j \times j) \cdot i = 0 \cdot i = 0$

5) $M L^2 T^{-2}$

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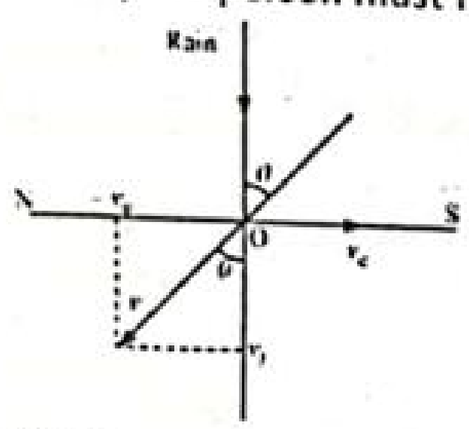
Torque = Moment Arm x Force
Torque = Moment Arm x Mass x Acceleration
Torque = Moment Arm x Mass x Distance/Time^2
Torque = Mass x Distance^2 x Time^{-2}
So Dimensions of Torque = $M L^2 T^{-2}$

6) Tan(inverse)1/3 vertical towards south
vc = Velocity of the wind
vr = Velocity of falling rain
In order to protect from the rain, the person must hold the umbrella in the direction of the relative velocity (v) of the rain with respect to the person.
v = vr + (-vc) = 30 + (-10) = 20 m/s
tan θ = vc / vr = 10 / 30
θ = tan-1 (1 / 3) = tan-1 (0.333) ≈ 18
Hence, the person must hold the umbrella toward the south, at an angle of nearly 18° with the vertical.



7) 7 N
Book B will experience a force due to weight of book A which is 2N. Also, weight of B is an action on book C, so C will react back with an equal force in upward direction so total force on B will be 2 + 5 = 7N.

8) 34
$\tan\theta = \frac{3}{2} = 1.5 \qquad \rightarrow \theta = \tan^{-1}(1.5) = 56$
This is the angle made by vector with x-axis. So, angle made with y-axis will be 90-56 = 34 degrees.
Now the exact answer of the above expression [$\tan^{-1}(1.5)$] cannot be found without using calculator. So here you have to observe the options and see which one could be the possible answer.
Value of tan(45) is 1 and value of tan(60) is 1.732. This means answer of $\tan^{-1}(1.5)$ Lies within 45 and 60 and is near to 60 degrees as 1.5 is nearer to 1.732. Now you can consider any value between 45 and 60 degrees that is near to 60 degrees. Let it be 55 degrees. Now 55 will be the angle made by vector with x-axis. So, the angle made by vector with y-axis will be 90-55= 35 degrees. Now check the options and see if there is any answer close to this value. Only one such option exists, and it is 34 degrees.

9) Unit vector **10) Vector**
11) Zero
The statement mentions that the force is acting along y axis, so its x-component will be zero.

12) 1 $i \cdot (j \times k) = i \cdot i = 1$

13) 0
If two vectors are parallel (i.e. angle between is 0), the dot product will be the product of the magnitudes of two vectors. For two parallel vectors A and B: A.B = AB cos(0) = AB

14) Infinite
There can be infinite components of a vector in the space. However, the rectangular components will be only 3.

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15) 8.66 m
In this problem we have to find the projection of smaller vector along the longer vector.
Let vector A = 10m and vector B = 20m
The projection of A along B will be: A cos (θ) = 10 cos(30) = 8.66 m

16) 17.678 $$A \times B = ABsin(\theta) = 5(5)\sin(135) = 17.678$$

17) 90
The magnitude of vectors A,B and C is 12, 5 and 13, respectively. Where, A + B = C
Magnitudes of these vectors will be related as:
$|A|^2 + |B|^2 + 2\,|A||B|cos\,(\theta) = |C|^2$
Where " θ " is the angle between vector A and B.
Therefore, $12^2 + 5^2 + 12(5)\cos(\theta) = 13^2$
$144 + 25 + 60\cos(\theta) = 169$ $\rightarrow 169 + 60\cos(\theta) = 169$
$60\cos(\theta) = 0$ $\rightarrow \cos(\theta) = 0$ $\rightarrow \theta = 90°$

18) Both a and b
Kilogram meter per second is the standard unit of momentum (Momentum = Mass x Velocity) and kilogram meter per second squared is the unit of force (Force = Mass x Acceleration). Both are vector quantities.

19) $180 + \tan^{-1}\left(\frac{1}{5}\right)$
Since both the components of given vector are negative, this indicates that the vector lies in 3rd quadrant and the angle made by a vector in 3rd quadrant is calculated as:
$$\theta = 180 + \tan^{-1}\left(\frac{|V_x|}{|V_y|}\right)$$
Here, $|V_x|$ = Magnitude of x – component of the vector. $|V_y|$ = Magnitude of y – component of the vector
Using the values, we get:
$$\theta = 180 + \tan^{-1}\left(\frac{|-1|}{|-5|}\right) = 180 + \tan^{-1}\left(\frac{1}{5}\right)$$

20) |A x B|
The magnitude of cross product of 2 vectors, which form the sides of a parallelogram, represent the Area of the parallelogram.

21) 6
Using the component formula for the dot product of three-dimensional vectors,
$a \cdot b = a_1b_1 + a_2b_2 + a_3b_3$
The dot product of given vectors come out to be: $a \cdot b = 1(2) + 1(2) + 1(2) = 2 + 2 + 2 = 6$

22) $F/2$
The x – component of a vector is calculated as:
$F_x = F\cos\theta$
Since the given choices are in terms of F, we will not substitute the value of F. Using the value of θ:
$$F(x) = F\cos(60) = F\left(\frac{1}{2}\right) = \frac{F}{2}$$

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Chapter 3 – Motion and Force

1) A balloon is going upwards with a velocity 12 m/s. It releases a packet when it is at a height of 65 from ground. How much time the packet will take to reach the ground if $g=10\ m/s^2$?
a) 5 b) 6 c) 7 d) 8

2) Newton's 3rd law of motion is for bodies that are
a) In motion b) At rest c) Both a and b d) None of these

3) A person has to cover a distance of 6 km in 45 minutes. If he covers one-half of the distance in two-thirds of the total time; to cover the remaining distance in the remaining time, his speed (in km/hr) must be:
a) 6 b) 8 c) 12 d) 15

4) Which of the following has no acceleration:
a) Man driving a car on busy road
b) Rock rolling down a mountain
c) A luggage in flying airplane
d) A car on a rough road

5) In elastic collision
a) KE is conserved
b) Momentum is conserved
c) Both a and b
d) None of these

6) The laws of motion show the relation between
a) Mass and acceleration
b) Mass and velocity
c) Mass and weight
d) Force and acceleration

7) When the speed of body is doubled is momentum becomes
a) Halved b) Doubled c) Tripled d) Remains same

8) Laws of motion describes?
a) Relationship of body, force and motion in response
b) Relationship of body and force
c) Relationship of force and motion
d) Relationship of body and motion in response

9) When a car moves with constant velocity force on it is
a) Up b) Down c) Left d) Zero

10) A body of mass 0.5 kg starts from rest (t=0) & experiences a force F= 8i + 6j. What will be its velocity at t=1 if it covers a distance of 4m?
a) 13 ms^{-1} b) 20 ms^{-1} c) 17 ms^{-1} d) 25 ms^{-1}

11) Ball thrown freely from a tower reaches ground in 4s. The height of tower is about
a) 20m b) 40m c) 80m d) 160m

12) A body of mass m = 3.513 kg is moving along the x axis with a speed of 5.00 ms^{-1}. The magnitude of its momentum is recorded as
a) 14.57 kg m/s b) 17.6 kg m/s c) 18.565 kg m/s d) 13.56 kg m/s

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13) A body is dropped from a height 175m, how much time will it take to reach the ground?
a) 3.5 sec b) 5.97 sec c) 4.68 sec d) 2 sec

14) A car travels a distance of 350 miles in 5.0 hours. Find its average speed.
a) 10 miles/hr b) 70 miles/hr c) 50 miles/hr d) 60 miles/hr

15) Unit of Momentum is?
a) kg/s b) kgms c) kgm/s d) None of these

16) When a body is falling under the action of gravity the direction of acceleration is:
a) Upwards b) Downwards c) Towards Right d) Towards Left

17) If force of 2.5N changes the velocity from 50m/s to 100m/s in time 50s, the mass of the body?
a) 5 kg b) 2.5 kg c) 1kg d) 10kg

18) Formula of maximum range of projectile is?
a) $2v_i/g$ b) v_i^2/g c) $v_i g$ d) None of these

19) A Lead Ball and a Feather are dropped in vacuum both at the same time. Which of the following will be true:
a) The feather will move at fast rate than the ball
b) The feather will move with slow rate than the ball
c) Both will move with the same rate
d) None of these

20) If a force acts on a body for 2 sec and its rate of change of momentum is 50, the force acting on the body is:
a) 100 b) 50 c) 25 d) None of these

21) Dimensions of Linear Momentum are:
a) $M L T^{-1}$ b) $M L^2 T^{-2}$ c) $M^2 L T^1$ d) $M L T^{-2}$

22) The unit of impulse is same as of
a) Force b) Momentum c) Acceleration d) Work

23) A ballistic missile is
a) Unpowered b) Unguided c) Both a and b d) None of these

24) Newton's first law is applicable on:
i) Body in motion ii) Body in rest
a) i only b) ii only c) Neither a nor b d) Both a and b

25) The relation of time of flight with initial velocity is?
a) $2u/g$ b) $u^2/2g$ c) u/g d) $2g/u$

26) A body with constant speed can still be accelerating. This statement is:
a) True b) False
c) Depends on the frame of reference d) None of these

27) Formula for Horizontal Range of a projectile is:
a) $\frac{v^2 \sin 2\theta}{g}$

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b) $\frac{v \sin \theta}{g}$

c) $\frac{2v \sin \theta}{g}$

d) None of these

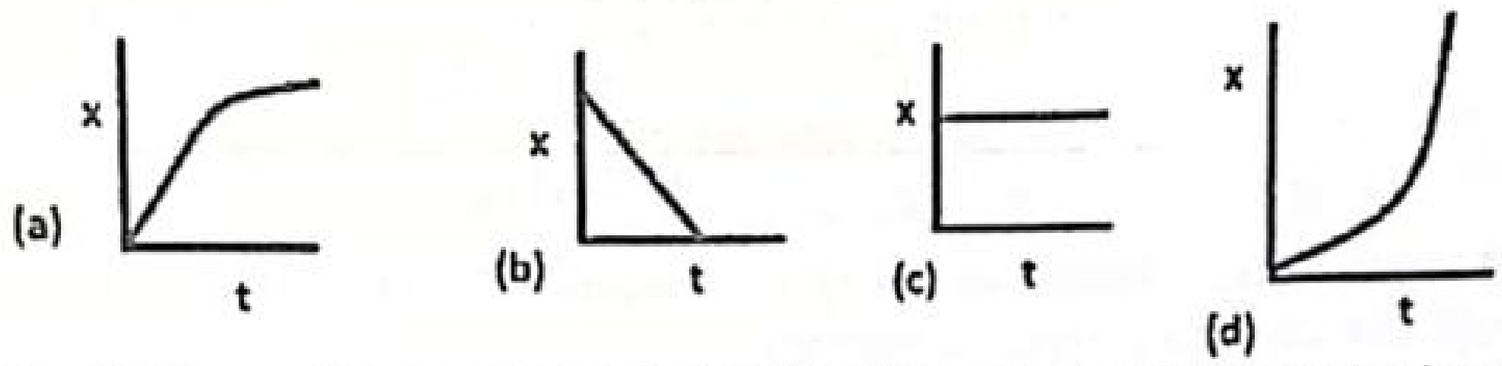
28) Product of Force and Time is

a) Impulse d) Momentum c) Force d) Inertia

29) The expression dp/dt represents

a) Impulse b) Time c) Angular momentum d) Force

30) If a car is moving with constant non-zero velocity, then its displacement time graph will be:



31) A ball is thrown from some height; it strikes the ground and bounces back to the same height. This scenario represents which situation:

a) Perfectly elastic b) Elastic c) Perfectly inelastic d) Inelastic

32) Path followed by a projectile is known as?

a) Trajectory b) Ellipse c) Distance d) None of these

33) A neutron collides with a stationary proton at rest. After collision

a) Proton moves with velocity double to that of neutron

b) Neutron comes to rest and proton moves with same velocity as that of neutron

c) Proton moves with double velocity in opposite direction

d) None of these

34) In projectile motion, which velocity component remains same throughout the flight?

a) Horizontal component b) Vertical component

c) Both a and b d) None of these

35) If the velocity of a body is reducing, the negative acceleration is called:

a) Deceleration b) Retardation c) Both a and b d) None of these

36) Which of the following changes, when particle is moving with uniform velocity?

a) Speed b) Velocity c) Acceleration d) Position Vector

37) A body has mass 1 kg on earth. Its mass on moon will be

a) 0.6 kg b) 0.4 kg c) 0.8 kg d) 1 kg

38) If a body is placed from poles to equator, the weight of the body will

a) Increase b) Decrease c) Stay constant d) None of these

39) At what angle is the range of projectile the maximum?

a) 90 b) 0 c) 45 d) None of these

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40) A particle with initial velocity 40 m/s is moving with a constant acceleration of $10 m/s^2$. The distance covered in 5th second will be:

a) 325 m b) 240 m c) 85 m d) 125 m

Answers of Chapter 3 – Motion and Force

1) 5

According to 2nd Equation of Motion:

$$S = v_i t + \frac{1}{2} g t^2$$

$$65 = -12t + \frac{1}{2}(10)t^2$$

Here Initial velocity is taken as negative because direction of movement of balloon and the packet are opposite.

$$65 = -12t + 5t^2$$

$$5t^2 - 12t - 65 = 0$$

Now from the given options check which one of them satisfies the above equation. The one which will satisfy the equation will be the desired value of time.

Putting t = 5 we get:

$$5(5)^2 - 12(5) - 65 = 0$$

$$125 - 60 - 65 = 0$$

$$0 = 0$$

Thus in t=5 sec the packet will reach the ground) The above equation could also have been solved using the methods to solve the quadratic equations.

2) Both a and b

3) 12

$$3\ km\ is\ covered\ in\ time\ = \frac{2}{3} \times 45\ =\ 30\ mins$$

$$Remaining\ distance\ =\ 3\ km$$

$$Remaining\ time\ =\ 15\ min\ =\ \frac{15}{60}\ hour\ = \frac{1}{4}\ hour$$

$$Required\ speed\ = \frac{Distance}{Time} = \frac{3}{\frac{1}{4}}\ km/h\ =\ 12\ km/h$$

4) A luggage in flying airplane

Luggage in flying plane is at rest with respect to the plane so it has no acceleration of its own. In other 3 options there is movement of the body involved, so they will have an acceleration as well.

5) Both

Elastic collisions are those in which both momentum and K.E are conserved) While in inelastic collision only momentum is conserved not the K.E .

6) Force and acceleration

7) Doubled

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$P = mv$
The new speed is double than the previous one, so we can write:
$v' = 2v$
So, new momentum will be:
$P' = mv' = m(2v) = 2(mv) = 2P$
So on doubling the velocity, momentum also doubles.

8) Relationship of body, force and motion in response

9) Zero
As a result of constant velocity, acceleration of the car will be zero resulting in zero force.

10) 13 ms^{-1}
$v_i = 0$
$a = \frac{F}{m} = 16i + 12j$
$|a| = 20\frac{m}{s^2}$
$S = According\ to\ 3rd\ equation\ of\ motion$
$(V_f)^2 = (V_i)^2 + 2aS = 0 + 2(20)(4) = 160$
$V_f = \sqrt{160} \approx 13$

11) 80m

$S = V_i t + \frac{1}{2}gt^2$
$S = \frac{1}{2}gt^2 = \frac{1}{2}(10)(16) = 80m$

12) 17.6 kg m/s
Momentum P = mv = (3.513) (5) = 17.565 kg m/s

13) 5.97 sec
$S = v_i t + 1/2\ gt^2$
$175 = 0 + 1/2\ (9.8)\ (t)^2$
$175 \times 2/9.8 = t^2$
square root (35.7) = 5.97 seconds

14) 70 miles/hr
V = Distance Covered/Time Taken = 350 miles/5 hours = 70 miles/hour

15) kgm/s
Momentum = mv
So, unit = kg m/s

16) Downwards
The only force acting will be the force of gravity towards the center of the earth so the direction of acceleration will also be the same i.e., downwards.

17) 2.5 kg
$F = m\frac{v_f - v_i}{t}$

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$$m = \frac{Ft}{v_f - v_i} = \frac{2.5 \times 50}{50} = 2.5\ kg$$

18) v_i^2/g

19) Both will move with the same rate
No external force acts on either of them so the rate of falling of them will be exactly the same. At every point, the two will be moving side by side.

20) 50
Force = Change in Momentum / Time = Rate of change of momentum = 50N

21) $M\ L\ T^{-1}$
P = mv
Unit = kg m/s
Dimension = $M\ L\ T^{-1}$

22) Momentum
Impulse = F x t = Change in Momentum
Unit of impulse = Ns or kg m/s
Unit of Momentum = kg m/s

23) Both a and b

24) Both a and b

25) 2u/g
Formula of time of flight of projectile motion is:
$t = \frac{(2\ u\ \sin\theta)}{g}$, where u is the initial velocity.

26) True
Acceleration is a vector quantity. So, change in speed or direction both can result in acceleration. If speed is constant but the direction is changing the body will be accelerating.

27) $\frac{v^2 \sin 2\theta}{g}$

28) Impulse
The product of the net force and the time interval over which the force is applied is called impulse. An impulse produces a change in momentum. Impulse is a vector quantity.

29) Force
dp/dt represents the time rate of change of momentum which is equal to the applied Force.

30) Graph b
The graph b is the correct answer. The slope of the displacement time graph is equal to the velocity. A constant velocity graph will be rising or falling at same slope, for non-zero velocity. Option c is incorrect, as the velocity represented by graph c is 0.

31) Perfectly elastic
Since the ball moves back to its original position this means no K.E is lost in the process, therefore the given scenario is perfectly elastic.

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32) Trajectory

33) Neutron comes to rest and proton moves with same velocity as that of neutron
Proton and neutron are almost equal in mass. Considering the negligible difference between both the particles, according to the laws of momentum, neutron will come to rest and proton will start moving with the same velocity as that of neutron.

34) Horizontal component
Horizontal component of a projectile is the same throughout the motion, vertical component keeps on changing.

35) Both a and b

36) Position Vector
Only the position vector can change when a particle is moving with uniform velocity. Position vector represents the position with respect to the origin which will be different at ever point during the motion. Since velocity is uniform, the acceleration will stay zero.

37) 1 kg
Mass is a constant quantity. It stays the same irrespective of the position and location. Weight however changes as it depends on the value of g. Value of g is different on moon, so weight of the body would be different on the moon while mass will be the same.

38) Decrease
The value of g is more at the poles than the equator. While moving from poles to equator, the value of g decreases. Therefore, the weight of the body will also be decreased.

39) 45
Range of a Projectile can be calculated as:

$$R = \frac{v^2 \sin(2\theta)}{g}$$

We can see that the range will be maximum when the value of $\sin(2\theta)$ is maximum (i.e., when it is equal to 1). $\sin(2\theta)$ will be equal to 1, when the value of 2θ is 90. This means, θ must be 45 degrees to get maximum range for Projectile Motion.

40) 85 m
Distance covered in the 5th second = Distance covered in 5 seconds – Distance covered in 4 seconds
We have the value of acceleration, initial velocity, and time, so we can use the 2nd equation of motion
Using the 2nd equation of motion:
$s = ut + 0.5at^2$
Distance covered in 5 seconds = $40(5) + 0.5(10)(5^2) = 325m$
Distance covered in 4 seconds = $40(4) + 0.5(10)(4^2) = 240m$
Therefore, the Distance covered in the 5th second = 325 – 240 = 85m.

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Chapter 4 – Work and Energy

1) What will be the speed of electron having an energy of 18.2×10^{-17} Joule?
a) 1.9×10^{18} b) 2.197×10^{-25} c) 2×10^{7} d) None

2) What is the unit of Power?
a) Watt b) Ampere c) Newton d) Joules

3) A body of mass m moving with velocity v has a kinetic energy K. If its velocity is increased by 25%, what will be the new K.E?
a) 25/16 K b) 23/34 K c) 12/45 K d) 34/58 K

4) Work will be maximum when the angle between force and displacement is:
a) 0 b) 90 c) 180 d) 4

5) Dimensions of U are:
a) $[M L^{2} T^{-2}]$ b) $[M L^{3} T^{-1}]$ c) $[M^{2} L^{2} T]$ d) $[M L^{-1} T^{-2}]$

6) A body of mass m moving with velocity v has a kinetic energy K. If its velocity is increased by 25%, what will be the work done in terms of K.E?
a) Zero b) 2.5 K c) 0.56 K d) 0.25 K

7) Which one of them is not conservative force?
a) Electric force b) Gravitational force c) Tension in string d) Elastic spring force

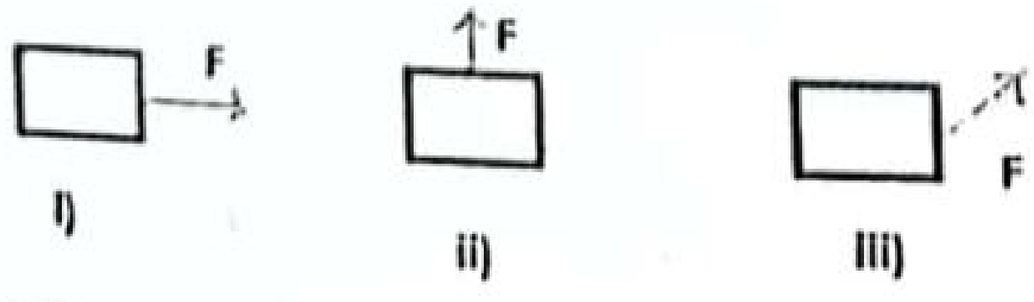
8) What is the power of a body if 1N force is acted upon a body have a constant velocity of $10ms^{-1}$?
a) 0 b) 30 c) 0.5 d) 10

9) The escape velocity of a body from the earth is V_e. If the radius of the earth contracts to $1/4^{th}$ of its value, keeping the mass of the earth constant, the escape velocity will be:
a) Doubled b) Halved c) Remain same d) Tripled

10) A ball is released from a height h, above a table. Given that air resistance is negligible and 50% of its kinetic energy is converted to other forms of energy at each bounce, what will be the height reached after the second bounce?
a) h/4 b) h/2 c) h/8 d) h/3

11) All the food that you eat in one day has about the same energy as _____liter of petrol
a) 3 b) 1/3 c) 9 d) 1/9

12) From the given options, which one lists the amount of work done from smallest to largest if the displacement is in forward direction?



a) ii), iii), i) b) i), ii), iii) c) iii), ii), i) d) i), iii), ii)

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13) Two bodies X of mass 4 kg and Y of mass 6 kg have same linear momentum. If the kinetic energy of Y is 48 J then kinetic energy of body X is:
a) 48 J b) 64 J c) 72 J d) 96 J

14) Mechanical energy of an object is the sum of its Potential Energy and _____?
a) Electrical Energy b) Thermal Energy c) Kinetic Energy d) All of these

15) If the speed of an object is doubled, its Kinetic Energy will
a) Increase by 4 times b) Decrease by 4 times
c) First increase then decrease d) Remain the same

16) If a force of 1N acts on a body through a distance of 1m in the direction of force, how much work is done?
a) +1 J b) – 1 J c) 0 J d) Either a or b

17) If the mass and radius of Earth are reduced to one fourth, the escape velocity will:
a) Reduce to one fourth b) Reduce to one half
c) Remain the same d) Increase to two times

18) Minimum velocity needed to put the satellite into orbit is
a) 5.6 b) 6.2 c) 7.9 d) None of these

19) Which of the following is a conservative field?
a) Electrical b) Resistance c) Friction d) Magnetic

20) Which of the following is a unit of Work?
a) Meter b) Newton c) Joule d) Joule/second

21) Escape velocity of moon is
a) 2.38 km/s b) 3.38 km/s c) 4.38 km/s d) 5.38 km/s

22) Value of solar constant on the surface of Earth is:
a) 1 kWm^2 b) 1.4 kWm^{-2} c) 1 kWm^{-2} d) 1.4 kWm^2

24) Work done by retarding force is:
a) Positive b) Negative c) Zero d) None of these

25) Joule =
a) Watt/second b) Newton Meter c) Newton/meter d) Watt second

26) When we lift an object, we do work against which of the following:
1) Friction 2) Gravity
a) 1 only b) 2 only c) Both 1 & 2 d) Either 1 or 2

27) An object of mass 2kg has a velocity of 6m/s. After 8 seconds, its velocity increases to 10m/s. Calculate the power of the object.
a) 10 watts b) 5 watts c) 8 watts d) 9 watts

28) A force of 10 N is acting on an object at angle of 120 degrees through a distance of 4m. Calculate the work done.
a) – 20 J b) 20 J c) 40 J d) – 40 J

29) Which of the following fields is dependent on the path?
a) Gravitational field b) Conservative field

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c) Non-conservative field d) None of these

30) Escape velocity of Jupiter is:
a) 37 b) 61 c) 25.4 d) 22.4

31) $[ML^2T^{-3}]$ is the dimension of:
a) Power b) Work c) Momentum d) Force

32) The basic source of geothermal energy is
a) Sun b) Earth c) Moon d) Water

33) In which of the following case(s) the work done be positive?
a) Object moves in the direction of Force b) Object moves in opposite direction of Force
c) Object moves at Right Angle to the Force d) Both a and c

34) Escape velocity of Neptune is:
a) 2.4 b) 10.4 c) 25.4 d) 37.0

Answers of Chapter 4 – Work and Energy

1) 2×10^7

$$E = \frac{1}{2}mv^2 = \frac{1}{2} \times 9.1 \times 10^{-31} \times v^2$$

$$\frac{18.2 \times 10^{-17} \times 2}{9.1 \times 10^{-31}} = v^2$$

$$\frac{18.2 \times 2 \times 10^{14}}{9.1} = v^2$$

$$4 \times 10^{14} = v^2$$

$$v = \sqrt{4 \times 10^{14}} = 2 \times 10^7$$

2) Watt

3) 25/16 K
Original K.E = K = 0.5 mv^2
New velocity = v + 25%(v) = 1.25v
New K.E = 0.5 m $(1.25v)^2$ = 1.5625 (0.5 mv^2) = 1.5625K
Now from the given options check which of the fraction gives a result equal to 1.5625. The answer of 25/16 is 1.5625 so the answer is 25/16 K .

4) 0
Work is equal to the dot product of Force and Displacement and dot product is maximum when both vectors are in the same direction i.e. angle between them is zero.

5) [M L^2 T^ -2]
U stands for absolute potential energy. The units of energy are Joule.
Joule = N m = Kg m s-2 m = kg m^2 s^{-2}
So Dimensions = M L^2 T^{-2}

6) 0.56 K
$Work\ done\ =\ Change\ in\ K.E$

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$Original\ K.E = K = 0.5\,mv^2$
$New\ velocity = 1.25v$
$So\ new\ K.E = 0.5\,m\,(1.25v)^2 = 1.5625\,(0.5mv^2) = 1.5625\,K$
$Change\ in\ K.E = 0.5625K$

7) Tension in string
If the work done by a force depends only on the initial and final states of a system and not on the path taken by the force, then it is a conservative force. Otherwise, it is non-conservative.

8) 10 Power = force x velocity = 1 x10 = 10

9) Doubled

$$v_e = \sqrt{\frac{2GM}{R}}$$

$$New\ R = R' = \frac{R}{4}$$

$$So, \quad New\ v_e = v_e' = \sqrt{\frac{2GM}{R'}} = \sqrt{\frac{2GM}{R/4}} = \sqrt{\frac{2GM}{R} \times 4} = 2\sqrt{\frac{GM}{R}} = 2v_e$$

10) h/4
Energy at beginning = 100 % K.E
Energy after 1st bounce = 50% (Half of original)
Energy after 2nd bounce = 25% (One Fourth of original)
The height reached will be in proportion to the energy possessed by the ball.
So, height at beginning = h
Height after 1st bounce = h/2
Height after 2nd bounce = h/4

11) 1/3

12) ii), iii), i)
For figure ii, the work done is zero as angle between Force & Displacement is 90. Work will be maximum for figure i. So, from smallest to largest the order of work done will be: ii < iii < i

13) 72 J
$P_x = P_Y$
$4v_x = 6v_Y$
$v_x = 6/4\ v_Y$
$K.E_Y = 48 = 0.5\ (6)\ (v_Y)^2$
$v_Y = 4$
So, $v_x = 6$
$K.E_x = 0.5\ (4)\ (6)^2 = 72J$

14) Kinetic Energy
The mechanical energy of an object can be the result of its motion (i.e., kinetic energy) and/or the result of its stored energy or position (i.e., potential energy). The total amount of mechanical energy is, therefore, the sum of the potential energy and the kinetic energy.

15) Increase by 4 times

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The change in the kinetic energy of the object as the speed changes is proportional to the square of the factor by which the speed changes. For example if the speed of the object becomes double, its kinetic energy becomes 4 times the initial kinetic energy.
Kinetic energy at velocity v = 0.5 mv^2
Kinetic energy at double velocity (2v) = 0.5 $m(2v)^2$ = 0.5$m(4v^2)$ = 4 (0.5 mv^2)
Thus when the velocity is doubled, the kinetic energy is increased by 4 times.

16) +1 J

17) Remain the same
Escape Velocity can be given as:

$$V_{esc} = \sqrt{\frac{2GM}{R}}$$

$If\ the\ mass\ is\ reduced\ to \frac{1}{4} th, the\ new\ mass\ will\ be = \frac{M}{4}$

$If\ the\ radius\ is\ reduced\ to \frac{1}{4} th, the\ new\ radius\ will\ be = \frac{R}{4}$

$The\ new\ escape\ velocity\ will\ be:$

$$New\ V_{esc} = \sqrt{\frac{2G\left(\frac{M}{4}\right)}{\frac{R}{4}}} = \sqrt{\frac{2GM}{R}}$$

From here we can conclude that if the Mass and Radius of the Earth are changed by the same factor, the escape velocity will stay the same.

18) None of these
$v_{esc} = \sqrt{2gR}$
$g = 9.8\ ms^{-2}$
$R = 6.4\ \times 10^6 m$
Using the values, we get:
$v_{esc} = \sqrt{2 \times 9.8 \times 6.4 \times 10^6} = 11200 ms^{-1} = 11.2\ kms^{-1}$

19) Electrical 20) Joule 21) 2.38 km/s 22) 1 kWm^{-2}

24) Negative
Retarding force always acts at an angle greater than 90 degrees with respect to the direction of motion of the object. Work done will always be negative when the angle between the force and direction of motion is greater than 90 degrees.

25) Newton Meter

26) 2 only
While lifting the object the work is done against gravity, no friction is involved in this. However, when we push an object on the ground, in this case we do work against the friction.

27) 8 watts
Mass of the body = m = 2 kg
Initial velocity of the body = v_i = 6 m /sec.
Final velocity of the body = v_f = 10 m / sec.
Time required for this change in velocity = t = 10 sec.

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Power developed during this process = P = ?
P = Work done / time
First, we need to find the work done,
From Work – Energy theorem we know that:

Work done = Change in kinetic energy

$$Work\ done = Final\ K.E - Initial\ K.E = \frac{1}{2}m\,(v_f)^2 - \frac{1}{2}\,m\,(v_i)^2$$

$$= \frac{1}{2}(2)(10)^2 - \frac{1}{2}(2)(6)^2 = 100 - 36 = 64\,J$$

Substitute this value of work in formula of power:

$$P = \frac{64\,J}{8\,s} = 8\ watts$$

28) – 20 J

The work W that a force F does on an object is the product of "magnitude F of the force, magnitude d of the displacement and cosine of the angle θ between them".
W = Fd cos θ.
W = 10 x 4 x cos 120
W = 40 x -0.5 = -20 J

29) Non-conservative field

A conservative force is one for which the work done is independent of path. A non-conservative field is one for which the work done depends on the path. Gravitation field is an example of conservative field.

30) 61

31) Power

The easy approach will be to convert dimensions into units:
ML^2T^{-3} in unit form will be " $kg\ m^2\ s^{-3}$ "
$kg\ m^2\ s^{-3} = kg\ ms^{-2}\ ms^{-1}$
$= Nms^{-1} = Js^{-1}$ = Watt

32) Earth

Geothermal energy is the heat energy extracted from inside the Earth in the form of hot water or steam.

33) Object moves in the direction of Force

Work is defined as the dot product of Force and Displacement.

$$W = F \cdot d = Fd\cos\theta$$

Value of cosine is positive for $(0 \leq \theta < 90)$, 0 for an angle of 90 degrees, and negative for $(90 < \theta \leq 180)$.
When object moves in the same direction of the applied force, the angle between Force and Displacement will be 0, and value of work will be positive. For option b, work will be negative and for option c, work done will be 0.

34) 25.4

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Chapter 5 – Circular Motion

1) The number of revolutions in 3pi radians
a) 2 b) 3 c) 3/2 d) 1/2
e) 1/60

2) The velocity of a disc at the bottom of an inclined plane is?
a) $\sqrt{gh}$ b) $\sqrt{\frac{4gh}{3}}$ c) $\sqrt{\frac{3gh}{4}}$ d) $\sqrt{\frac{5gh}{6}}$

3) Moment of inertia in angular motion plays the same role as
a) Mass in linear motion b) Acceleration in linear motion
c) Rest mass d) None of these

4) A particle moving along a circular path of radius 5m and with uniform speed 5 m/s. What will be the average acceleration when the particle completes half revolution?
a) 10 pi b) 5/pi c) 10/pi d) Zero

5) What is the unit of angular momentum
a) J b) Js c) Js^{-1} d) Js^{-2}

6) When speed is doubled the centripetal force will be?
a) Same b) Doubled c) Tripled d) Quadrupled

7) On doubling the mass, the linear momentum and angular momentum of the body will be:
a) Remain same b) Increased c) Decreased d) Doubled

8) Unit of Angular Momentum?
a) $Kg\ m^2 s^{-1}$ b) Js c) Js^{-1} d) Both a and b

9) A bicycle wheel of radius 0.70 m is turning at an angular speed of 6.3 rad/s as it rolls on a horizontal surface without slipping. What is the linear speed of the wheel?
a) 1.4 m/s b) 0.11 m/s c) 28 m/s d) 4.4 m/s
e) 9.1 m/s

10) Angular velocity is measured in
a) rad/min b) m/s c) angle/s d) None of the above

11) Apparent weight of a body in an elevator accelerating downwards is given by:
a) m (g + a) b) ma c) m (g – a) d) Zero

12) What will be the velocity of a body revolving in a circle of radius 2m with an angular velocity of 1 rev/sec?
a) 1/2 m/s b) 1 m/s c) 2 m/s d) None of these

13) 1 degree is equal to _____ radians
a) 180 b) 3.14 c) 0.01745 d) 45

14) Centrifugal force is:
a) Pseudo force b) Action force c) Both a and b d) None of these

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15) Centrifugal force of a body depends upon?
a) Weight b) Mass c) Volume d) None of these

16) What is the work done by a body moving with 1 m/s velocity in circular orbit of radius 10m?
a) 10 b) 100 c) 5 d) Zero

17) The period of rotation of geosynchronous satellite is
a) 1 day b) 1 month c) 1 year d) 1 year

18) A body moving with an angular velocity of 1 rev/sec has a frequency of:
a) 0.5 Hz b) 2 Hz c) 1 Hz d) None of these

19) Js is the unit of:
a) Linear momentum b) Angular momentum c) Energy d) Mass

20) A stone attached to a rope which is whirled in a circle. If the rope breaks during the motion, the stone will move:
a) Radially inwards b) Radially outwards c) Along tangent d) Along circle

21) Moment of inertia of a sphere is:
a) $\frac{1}{12}mL^2$ b) mr^2 c) $\frac{1}{2}mr^2$ d) $\frac{2}{5}mr^2$

22) A particle is moving in a circle with radius r and velocity v if radius is doubled keeping the velocity constant, the value of tangential acceleration will be:
a) Doubled b) Quadrupled c) Halved d) Same

23) Mass of a person is 50 kg. The apparent weight of the person in elevator is double of his real weight. Find the acceleration of the elevator. Consider g = 10 m/s^2
a) 15 m/s^2 upward b) 15 m/s^2 downward c) 10 m/s^2 upward d) 10 m/s^2 downward

24) In rotation motion the torque is:
a) Rate of change of angular momentum b) Rate of change of linear momentum
c) Rate of change of inertia d) Rate of change of centripetal force

25) A particle is moving in a uniform circular path. If its mass is reduced to half of its original mass, the force acting upon it will be?
a) Half b) Doubled c) Remain Same d) None of these

26) If the actual weight of a person standing in an elevator is 75N, and the apparent weight in the accelerated elevator is 105N, find the acceleration and direction of elevator motion. (Use g = 10m/s^2)
a) 4 m/s^2 downwards b) 4 m/s^2 upwards c) 6 m/s^2 downwards d) 6 m/s^2 upwards

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Answers of Chapter 5 – Circular Motion

1) 3/2
2pi radian= 360 degrees = 1 revolution
1 pi radian = 1/2 revolution
So,
3pi radian =3/2 revolution

2) $\sqrt{\frac{4gh}{3}}$

$P.E = K.E_{tran} + K.E_{rot}$
$mgh = 0.5mv^2 + 0.5I\omega^2$
$mgh = 0.5mv^2 + 0.5(0.5mr^2)\left(\frac{v}{r}\right)^2$ (Cancelling out "m" from both sides and simplifying)
$gh = 0.5v^2 + 0.25v^2$
$gh = 0.75v^2$
$gh = \frac{3}{4}v^2$
$\frac{4}{3}gh = v^2$
$v = \sqrt{\frac{4gh}{3}}$

3) Mass in linear motion

4) 10/pI
r = 5m
Displacement = Diameter = 2r = 10
v = 5m/s
v = r w
w = 2 π f = 2π / t = v/r
t = 2πr/v = 2π
Acceleration = v / t = 5 / 2π

5) Js^{-1}

6) Quadrupled

$F = \frac{mv^2}{r}$
$New\ speed = v' = 2v$
$So, New\ force = F' = \frac{m(2v)^2}{r} = 4\left(\frac{mv^2}{r}\right) = 4F$

7) Doubled
Both Linear and Angular momentum are proportional to the mass of the body, so on doubling the both the quantities will be doubled.

8) Both a and b

9) 4.4 m/s

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v = r w
v = 6.3 rad/s x 0.7 m = 4.41 m/s

10) rad/min

11) m (g – a) In case of an elevator accelerating downwards, the apparent weight equals: T = mg - ma

12) 2 m/s Formula: v = rw

13) 0.01745

14) Pseudo force
Pseudo Force: The forces which arise without any physical contact .
Centrifugal force is a reactional force of centripetal force and does not involve any physical contact.

15) Mass
Since it is a reactional force of centripetal force, so its magnitude will depend on the magnitude of centripetal force and thus on the mass, velocity, and the radius.

16) Zero Work done in a circular path is zero.

17) 1 day

18) 1 Hz
Angular velocity = 1 rev/sec
From here we can find angular frequency, by changing the units to radians/sec
1 revolution = 2π radians.
So, Angular frequency = $\omega = 2\pi$ rad/sec
Also,
$\omega = 2\pi f$
$\rightarrow 2\pi = 2\pi f$
$\rightarrow f = 1\ Hz$
Frequency gives us the number of cycles completed per second. The angular velocity shows us that 1 revolution is completed in 1 second, so we can see directly from here that the frequency is 1 Hz.

19) Angular momentum

20) Along tangent
When the string breaks, the centripetal force stops to act. However, due to inertia the stone continues to move along the tangent to circular path.

21) $\frac{2}{5}mr^2$

22) Halved
Tangential acceleration is given by:
$$a = \frac{v^2}{r}$$
If the radius is doubled, the new radius will be 2r. So the acceleration will be:
$$a' = \frac{v^2}{2r} = \frac{1}{2}\left(\frac{v^2}{r}\right) = \frac{1}{2}(a) = \text{Half of initial acceleration}$$

23) 10 m/s² upward

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There can be two cases of apparent weight in an elevator:

- Elevator moves upward: The apparent weight is more than real weight. T = w + ma
- Elevator moves downward: The apparent weight is less than real weight. T = w – ma

In this case the apparent weight is more, so the elevator is moving upwards. The formula of apparent weight in this case is given as:

T = w + ma

Apparent weight is double, so we can write:

2w = w + ma

→ w = ma

Using the values in above equation, we get:

50(10) = 50a

This means a = 10

With this we can say that elevator is moving upwards with an acceleration of $10 m/s^2$

24) Rate of change of angular momentum

Applied Force = Rate of Change of Linear Momentum.

Applied Torque = Rate of Change of Angular Momentum.

25) Half

The Centripetal Force acting on an object moving in a circular path is given as:

$$F = \frac{mv^2}{r}$$

If the mass is reduced to half of its original value, the new mass will be = m/2

Using this value, the Centripetal Force becomes:

$$F' = \frac{\left(\frac{m}{2}\right)v^2}{r} = \frac{mv^2}{2r} = \frac{1}{2}\left(\frac{mv^2}{r}\right) = \frac{1}{2}F$$

When the mass of the body is reduced to half, the centripetal force acting on it will also be reduced to half as both these quantities are directly proportional.

26) 4 m/s^2 upwards

Since the apparent weight of the person is more than his actual weight, this means the elevator is moving upwards. In this case, the equation is:

$T = w + ma$

Here, T = Apparent Weight

w = mg = Actual weight

m = mass of the person

Using the actual weight, we can find the mass of the person.

$75 = m(10)$

$m = 7.5\ kg$

Using the values in the first equation:

$105 = 75 + 7.5(a)$

$30 = 7.5a$

$a = 4\ ms^{-2}$

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Chapter 6 – Fluid Dynamics

1) What is dimension of coefficient of viscosity?
a) MLT b) $ML^{-1}T$ c) $ML^{-1}T^{-1}$ d) MLT^{-1}

2) Terminal velocity of a water droplet is dependent on:
a) Mass b) Radius c) Both a and b d) None of these

3) Speed and Pressure relation of a fluid is given by:
a) Venturi relation b) Stoke's Law
c) Equation of Continuity d) Bernoulli's Equation

4) Blood pressure of a healthy person is_____mm Hg.
a) 140 / 60 b) 120 / 80 c) 80 / 120 d) 90 / 60

5) In a river flow of water is maximum at
a) Middle b) Top right corner
c) Top left corner d) Same flow throughout

6) If an object sinks in the water, then
a) Object is denser than water b) Water is denser than object
c) Either a or b d) None of these

7) If the radii of two droplets are in the ratio 2:3, what will be the ratio of their Terminal velocities?
a) 2 : 3 b) 4 : 6 c) 4 : 9 d) 2 : 6

Answers of Chapter 6 – Fluid Dynamics

1) $ML^{-1}T^{-1}$

$F = 6\pi\eta r v$

$\eta = \frac{F}{6\pi r v}$

$Unit\ of\ \eta = \frac{N}{m.ms^{-1}} = Nm^{-2}s = (kgms^{-2})m^{-2}s = kg\ m^{-1}s^{-1}$

$Dimension\ of\ \eta = M\ L^{-1}\ T^{-1}$

2) Radius

$v_t = \frac{2gr^2\rho}{9\eta}$

From the above equation it is obvious that terminal velocity is dependent on the radius.

3) Venturi relation

Bernoulli's Equation is a general equation which relates other factors in addition to Speed and Pressure. While the Venturi Relation directly relates speed and pressure of a fluid. Hence Venturi relation is the correct answer here.

4) 80 / 120

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5) Middle
Towards the middle of a river, water tends to flow fastest; towards the margins of a river water tends to flow slowest.

6) Object is denser than water
An object sinks in the water when it is denser than water. This means, density of object is more than the water.
Density is defined as :

$$Density = \frac{Mass}{Volume}$$

For the same amount of volume, if the mass of object is more than the mass of water, the object will be denser(will have more density) and will sink in water.

7) 4 : 9
The formula to calculate the Terminal velocity of a droplet with radius "r" is:

$$v_t = \frac{2gr^2\rho}{9\eta}$$

Let the radius of first droplet be 2r. The radius of second droplet must be 3r, to maintain the given ratio.
Ratio of the terminal velocities of both droplets will be:

$$\frac{v_1}{v_2} = \frac{\frac{2g(2r)^2\rho}{9\eta}}{\frac{2g(3r)^2\rho}{9\eta}} = \frac{(2r)^2}{(3r)^2} = \frac{4r^2}{9r^2} = \frac{4}{9} = 4:9$$

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Chapter 7 – Oscillations

1) If length of simple pendulum is increased four times what will be effect on its frequency?
a) Half b) Double c) No effect d) None of these

2) Acceleration of a body executing SHM is directed towards:
a) Extreme position b) Peak point
c) Mean position d) Point of maximum energy

3) A block of mass m = 2 kg is attached to an ideal spring of spring constant k = 200 N/m. The block is at rest at its equilibrium position. An impulsive force acts on the block, giving it an initial speed of 2 m/s. Find the amplitude of the resulting oscillations.
a) 2 b) 3 c) 0.2 d) 0.02

4) According to hooke's law:
a) F=-kx b) F=kx c) F=k/x d) F=-k/x

5) If T is to be increased to 3T then length of pendulum should be increased by:
a) 9 times b) 8 times c) 10 times d) 20 times

6) If T is to be reduced to T/3 then length of pendulum should be:
a) L/9 b) L/2 c) L/3 d) L/4

7) Second's pendulum has frequency equal to?
a) 0.5 Hz b) 1 Hz c) 2 Hz d) 4 Hz

8) If length of the pendulum is halved time period will be?
a) T/sq root 2 b) T/2 c) T/3 d) T/4

9) If the length of pendulum is increased 4 times, the new time period will be?
a) 2T b) 3T c) 4T d) 5T

10) If a hole is dug to the center of earth and a ball is dropped in it, the ball will:
a) Be static b) Attain max acceleration
c) Oscill>te d) Continue its motion till the other end and stop

11) Time period of simple pendulum depends on
a) Mass b) Length of the pendulum
c) Acceleration due to gravity g d) Both b and c

12) If the value of g is made g/16, what will be the effect on time period of pendulum?
a) Doubled b) Four times c) Halved d) One fourth

13) A vibrator produces 25 waves in 5 seconds. What is its time period?
a) 2 b) 1/2 c) 1/5 d) None of the above

14) A spring in SHM oscillates between -A and A with time period T. If the spring starts from mean position and moves towards A, at what time will it be at a distance of A/2 from the mean position?
a) Pi/2 b) Pi c) 3 pi/2 d) 2pi

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15) A spring is moving with SHM from X=10 cm to X=40 cm then it has maximum velocity at?
a) 10cm b) 25cm c) 30cm d) 40cm

16) Seconds pendulum has time period
a) 1 sec b) 2 sec c) 4 sec d) 0.5 sec

17) A simple pendulum with spring constant 500n/m oscillates between two points x1 = 10cm and x2 = 15 cm. What is total mechanical energy at 10cm?
a) 10000J b) 6250J c) 1562.5J d) None of these

18) The motion of particle executing SHM is given by x = 0.01 sin 100 π t, where x is in meter and time is in second. The time period is
a) 0.2 b) 0.1 c) 0.02 d) 0.01

19) If the length of simple pendulum is increased to 6 times and g reduces to 3 times, then time period will be?
a) Increased by √18 times b) Increased by √16 times
c) Decreased by √18 times d) Decreased by √16 times

20) The total energy of pendulum is 50J what, will be its kinetic energy at mean position?
a) 50J b) 25J c) 0J d) None of these

21) If length of a pendulum is 4 times g, its time period will be:
a) 4π b) 2π c) π d) π/2

22) If spring constant is 2 and displacement is also 2 then sum of KE and PE?
a) 8 J b) 16 J c) 4 J d) None of these

23) General Equation of SHM is given as:
x(t) = A sin(wt)
Find approximate value of wt, if x(t) = 71cm and A=100cm.
a) 30 degrees b) 45 degrees c) 60 degrees d) 90 degrees

24) On increasing the spring constant to 4 times its value:
a) Frequency of mass spring system doubles b) Time period of mass spring system doubles
c) Both time period & frequency gets double d) None of these

25) What will be the time period of pendulum if length becomes 5 times and g becomes 1/5 times at some height from the earth?
a) 5t b) t/5 c) 15t d) 25t

26) What is the kinetic energy at the extreme position during SHM?
a) Zero b) Maximum c) Minimum d) Constant

27) According to the hook's law, strain is directly proportional to stress
a) True b) False c) None of these d) May or may not

28) In Damping
a) Energy is constant b) Energy remains in the system
c) Dissipated from the System d) None of these

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29) A simple pendulum suspended from the ceiling of a lift has time period T when the lift is at rest. When the lift falls freely
a) Time period becomes zero
b) Acceleration becomes zero
c) Vibration is stopped
d) None of these

30) If the spring is halved, the new spring constant of each part will be:
a) 3k
b) 2k
c) 4k
d) k/2

31) Which of the following changes must when a wave changes its medium?
a) Frequency
b) Amplitude
c) Speed
d) None of these

32) Which of the following is true for a wave entering a denser medium?
a) Reflected away from normal
b) Refracted towards normal
c) Reflected towards normal
d) Refracted away from normal

33) In SHM _____ is conserved
a) K.E
b) P.E
c) Total Energy
d) All of these

34) What will be impact on the frequency of a simple pendulum if the length of pendulum is halved and value of gravity is doubled?
a) Halved
b) Doubled
c) Quadrupled
d) None of these

35) Transvers waves can transfer their energy on, in
a) Solids
b) Liquids
c) Gases
d) All of these

36) What is the time period of $\sin(\omega t)$?
a) $2\pi f$
b) $2\pi t$
c) Both a and b
d) None of these

37) In S.H.M which of the following remains constant?
a) Total energy
b) P.F at extreme
c) K.E at mean
d) All of these

38) If mass attached to a spring and the spring constant of a spring are doubled, the resulting Time period will:
a) Remain Same
b) Be Doubled
c) Be Halved
d) Be Quartered

39) A pendulum oscillates on x-axis between 10 cm and 50 cm. Calculate its amplitude
a) 60 cm
b) 40 cm
c) 30 cm
d) 20cm

40) In which of the following scenarios will the K.E be zero?
a) At maximum height when a ball is thrown upwards
b) At extreme position of a Simple Pendulum
c) At the amplitude of the Mass Spring System
d) All of these

41) A pendulum is placed at Lahore, Murree, and K2. At which location will the frequency of Pendulum be maximum?
a) Lahore
b) Murree
c) K2
d) Same frequency at all locations

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Answers of Chapter 7 – Oscillations

1) Half

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$f = \frac{1}{T} = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$$

$$New\ frequency = f' = \frac{1}{2\pi}\sqrt{\frac{g}{4l}} = \frac{1}{2\pi}\cdot\frac{1}{2}\sqrt{\frac{g}{l}} = \frac{1}{2}\left(\frac{1}{2\pi}\sqrt{\frac{g}{l}}\right) = \frac{1}{2}f$$

2) Mean position

3) 0.2

At extreme position, the K.E is zero while P.E is maximum and at mean position P.E is zero and K.E is maximum.

According to law of conservation of energy:

Total energy at mean position = Total energy at extreme position

K.E + P.E (at mean position) = K.E + P.E (at extreme position)

K.E + 0 = 0 + P.E

$$\frac{1}{2}mv^2 = \frac{1}{2}kA^2$$

$$mv^2 = kA^2$$

$$A^2 = \frac{mv^2}{k} = \frac{8}{200} = \frac{4}{100}$$

$$A = \sqrt{\frac{4}{100}} = \frac{2}{10} = 0.2\ m$$

4) F = - kx

5) 9 times

$$T = 2\pi\sqrt{\frac{l}{g}}$$

T is proportional to square root of length, so the change in T will be equal to the square root of the change in l. So if length is increased to 9 times (9l), T will increase to 3 times (3T).

6) 1/9l

$$T = 2\pi\sqrt{\frac{l}{g}}$$

T is proportional to square root of length,so the change in T will be equal to the square root of the change in l. So if length is decreased to 9 times (l/9), T will decrease to 3 times (T/3).

7) 0.5 Hz

8) T/sq root 2

$$T = 2\pi\sqrt{\frac{l}{g}}$$

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T is proportional to square root of length, so the change in T will be equal to the square root of the change in l. So if length is decreased to 2 times (l/2), T will decrease to square root 2 times (T/square root of 2).

9) 2T

$$T = 2\pi\sqrt{\frac{l}{g}}$$

T is proportional to square root of length, so the change in T will be equal to the square root of the change in l. So, if length is increased to 4 times (4l), T will increase to 2 times (2T).

10) Oscillate

When ball is dropped it will continue its journey downwards due to gravity. Due to inertia it will cross the central point of earth and then its velocity will start decreasing till it becomes zero and it will start moving towards center of the earth again due to gravity showing an oscillatory movement.

11) Both b and c

$$T = 2\pi\sqrt{\frac{l}{g}}$$

12) Four times

$$T = 2\pi\sqrt{\frac{l}{g}}$$

Since T is inversely proportional to square root of g, so change in T will be equal to the square root of reciprocal of change in g.

Since g is reduced to 16 times, so resultantly T will increase by 4 times.

13) 1/5

Time period = Time taken to produce 1 wave = 5/25 = 1/5 sec

14) 3 pi/2

The general equation of SHM is: $x = x' \sin wt$

Using values for given case we get:

$$\frac{A}{2} = A \sin wt \qquad \frac{1}{2} = \sin wt$$

$$\rightarrow \sin^{-1}\left(\frac{1}{2}\right) = wt$$

$$\frac{\pi}{6} = wt \qquad \frac{\pi}{6} = 2\pi f.t$$

$$\frac{1}{6} = \frac{2}{T}.t \qquad t = \frac{T}{12}$$

Thus, at a time equal to T/12 the spring will be at a distance of A/2 from mean position.

15) 25cm

Velocity is maximum at the mean position. Mean position is at the middle of two extreme positions. So, find the mid distance of two given extreme, it will be the point where velocity is maximum. Mid position = (10 + 40)/2 = 25 cm

16) 2 sec

A second's pendulum is a pendulum whose period is precisely two seconds; one second for a swing in one direction and one second for the return swing, a frequency of 1/2 Hz

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17) 1562.5J

The two extremes are 10cm and 15cm and at extreme position the entire energy is the potential energy.
So, $E = 0.5\ kA^2$
Here A is the amplitude. The distance between two extremes is 5cm and the mean position is in between the two extreme points. So, distance from mean to the extreme position will be 5/2 = 2.5cm.
$E = 0.5\ (500)(2.5)^2 = 1562.5\ J$

18) 0.02

Comparing the given equation with general equation of SHM x = a sin(wt), we get
$w = 100\pi$ $\quad 2\pi f = 100\pi \quad 2f = 100 \quad f = 50$
$T = 1/f = 1/50 = 0.02$

19) Increased by √18 times

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$T' = 2\pi\sqrt{\frac{6l}{\frac{g}{3}}} = 2\pi\sqrt{\frac{l}{g}\times 18} = \sqrt{18}\times T$$

20) 50J

At mean position, P.E is zero and all of the energy is Kinetic energy.

21) 4π

$$T = 2\pi\sqrt{\frac{l}{g}} = 2\pi\sqrt{\frac{4g}{g}} = 4\pi$$

22) 4 J

K.E + P.E = Total Energy.
Total Energy = $0.5\ kA^2$, where A is the amplitude.
So, Total energy = 4J

23) 45 degrees

71 = 100 sin(wt)
sin (wt) = 0.71
wt = $\sin^{-1}(0.71)$ = 45 degrees

24) Time period of mass spring system doubles

$$T = 2\pi\sqrt{\frac{m}{k}}$$
$$m' = 4m$$
$$T' = 2\pi\sqrt{\frac{4m}{k}} = 2\left(2\pi\sqrt{\frac{m}{k}}\right) = 2T$$

Since the Time period is doubled, the frequency will be half.

25) Becomes 5 times

$$T = 2\pi\sqrt{\frac{l}{g}}$$

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$$T'' = 2\pi\sqrt{\frac{5l}{g/5}} = 2\pi\sqrt{\frac{25\,l}{g}} = 5\left(2\pi\sqrt{\frac{l}{g}}\right) = 5T$$

26) Zero

At extreme position during SHM, the body is at rest and hence its velocity and kinetic energy at that point would be zero and its entire energy will be the potential energy.

27) True

Hooke's law: The strain (deformation) of an elastic object or material is proportional to the stress applied to it.

28) Dissipated from the System

Damping is the process in which energy is dissipated from the oscillating system.

29) Acceleration becomes zero

When the lift is falling freely the apparent weight of the pendulum will be zero, as a result the apparent/effective acceleration will be zero. Since the effective acceleration is zero, the time period of the pendulum will be infinite. Hence the possible answer to this question is Acceleration becomes zero.

30) 2k

For a spring

F = kx k = F/x

For a constant F, k ∝ 1/x k is inversely proportion to x

∴ If Length(x) is halved, spring constant(k) will be doubled. i.e., new spring constant = 2k

31) Speed

When a wave moves from one medium to another medium its speed and wavelength changes, while the frequency stays the same. The amplitude may change if there is any absorption by the medium. So, from the given options, the property of a wave which would definitely change, is the speed of the wave.

32) Refracted towards normal

When a wave passes from less dense into a denser medium, it is refracted toward the normal. When a wave passes from a denser into a less dense medium, it is refracted away from the normal.

33) Total Energy

In S.H.M total energy which is the sum of Kinetic Energy and Potential Energy is always conserved while K.E and P.E keep on changing in magnitude from 0 to a maximum value.

34) Doubled

The formula for frequency of a simple pendulum is:

$$f = \frac{1}{2\pi}\sqrt{\frac{g}{L}}$$

Since the length is halved, the new length will be $L/2$

Value of g is doubled, so new value will be 2g. Using these values in the above formula, we get:

$$f' = \frac{1}{2\pi}\sqrt{\frac{2g}{L/2}} = \frac{1}{2\pi}\sqrt{\frac{4g}{L}} = \frac{1}{2\pi}\times 2\sqrt{\frac{g}{L}} = 2\left(\frac{1}{2\pi}\sqrt{\frac{g}{L}}\right) = 2f = 2\ Times\ of\ Initial\ Frequency$$

35) Solids

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Transverse waves need a rigid medium to transfer their energy due to vibration of the particles. Since solids have enough shear strength, transverse waves can transfer their energy in solids. Liquids and Gases do not have enough shear strength i.e. they are not rigid enough.

36) None of these
The time period of the sine wave can be given as:

$$T = \frac{2\pi}{\omega}$$

Where ω is the angular velocity, $\omega = 2\pi f$

37) All of these
The Total energy remains constant throughout the Simple Harmonic Motion. Both K.E and P.E keep on changing but at extreme position the value of P.E is always the same i.e., maximum and the value of K.E at mean position is always the same i.e., maximum.
If we were given the following options:
b) P.E c) K.E
the correct answer would have been Total energy. But the positions are specified in the options, and at given positions, the P.E and K.E are always constant. So, All of these would be the correct answer for this case.

38) Remain Same
Time period of a spring in SHM can be calculated by:

$$T = 2\pi\sqrt{\frac{m}{k}}$$

Here m is the mass, and k is the spring constant. If both these quantities are doubled, the formula will be changed to:

$$Time\ Period = 2\pi\sqrt{\frac{2m}{2k}} = 2\pi\sqrt{\frac{m}{k}} = T$$

This means if both mass and spring constant are doubled, the Time Period will remain the same.

39) 20cm
Amplitude is the maximum displacement of the object from its Mean Position. In other words, amplitude is the distance from mean position to the extreme position. Moreover, the mean position is in between the two extreme positions.
One extreme is at 10cm and the other extreme is at 50cm. The distance between two extreme positions = 50 – 10 = 40 cm
Since, the mean position is exactly in the middle of two extreme positions, the distance between mean position and extreme position will be = 40/2 = 20 cm, which is the amplitude of the SHM.

40) All of these
When a ball is thrown upwards, at maximum height the Potential Energy is maximum while Kinetic energy is zero as the ball makes a shift in its motion(from going up to going down) and stops momentarily.
For any object under SHM, Kinetic energy is zero at extreme position. So, for pendulum at extreme position, the K.E will be 0.
Amplitude means the maximum distance from mean position, so in other words, amplitude represents Extreme Position of SHM and K.E is 0 at extreme position.

41) Lahore
Time period of a simple pendulum is given by:

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$$T = 2\pi\sqrt{\frac{l}{g}}$$

Frequency is the reciprocal of Time Period. So, frequency would be:

$$F = \frac{1}{T} = \frac{1}{2\pi}\sqrt{\frac{g}{l}}$$

This equation shows that Frequency is directly proportional to the square root of "g". Higher the value of g. higher will be the frequency.

As we move away from the surface of the earth, the value of g starts decreasing. Based on this, the value of g will be in order:

Lahore > Murree > K2

Since, Frequency is directly proportional to the square root of "g", the order of Frequency will also be the same:

Lahore > Murree > K2

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Chapter 8 – Waves

1) The frequency of a wave as the source approaches the observer with speed v
a) Increases b) Decreases
c) First increases then decreases d) Remains same

2) In an organ pipe if one side is closed, then it is proved that harmonics released will be
a) Even numbers b) Odd numbers c) Odd and even both d) Fractional numbers

3) If particles are displaced in direction perpendicular to waves then waves are?
a) Longitudinal waves b) Transverse Waves c) Stationary Waves d) All of these

4) Blue colored source is seen Red if
a) Source is moving away from observer b) Observer is moving away from source
c) Gamma rays' effect is observed d) None of these

5) When the source moves towards an observer the frequency of waves as perceived by observer:
a) Increases b) Decreases c) Remains constant d) None of these

6) Speed of sound is greatest in
a) Glass b) Water c) Methanol d) Helium

7) Speed of sound in vacuum is:
a) 340 m/s b) 3×10^8 m/s c) 4000 ft/s d) None of these

8) Ratio of velocity of sound in oxygen as compared to hydrogen is
a) 4 : 1 b) 16 : 1 c) 1 : 4 d) 1 : 16

9) In which of the following medium will the speed of sound be maximum?
a) Glass b) Water c) Copper d) Wood

10) Energy of sound waves is proportional to:
a) Frequency b) Wavelength c) Velocity d) Phase Angle

11) When out of phase waves meet at a point _____ occurs:
a) Full constructive interference b) No effect
c) Full destructive interference d) Same phase

12) A wave of light having the wave equation $r = r_o \sin(\omega t)$ reflects from the water surface. After reflection, the equation of the wave will be:
a) $r = r_o \cos(\omega t)$ b) $r = -r_o \cos(\omega t)$ c) $r = -r_o \sin(\omega t)$ d) $r = r_o \sin(\omega t)$

13) Standing pattern of Nodes and Antinodes form:
a) Stationary Waves b) Progressive Waves c) Travelling Waves d) All of these

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Answers of Chapter 8 - Waves

1) Increases
This is an application of Doppler's Effect. When a source moves towards the observer, the wavelength of the waves decreases resulting in increased frequency.

2) Odd numbers
In an organ pipe closed at one end, only odd harmonics are generated, which are given by the equation:
$f_n = \frac{nv}{4l}$, where $n = 1, 3, 5, \ldots$

3) Transverse Waves

4) Source is moving away from observer
The wavelength of red color is more than that of blue. According to Doppler's effect when source is moving away from observer the wavelength increases. So, in this case blue colored source will be seen red.

5) Increases

6) Glass
The speed of sound is greater in solids as compared to liquids and gases because the molecules of solids are closely packed and respond more quickly to the disturbance.

7) None of these
Speed of sound in vacuum is zero as sound waves need a medium to travel through.

8) 1 : 4
At same temperature, the speed of sound in gases is inversely proportional to the square root of their densities. i.e.

$$v = \sqrt{\frac{\gamma P}{\rho}}$$

Density of oxygen is 16 times as compared to that of hydrogen. So, the speed of sound in hydrogen will be 4 times its speed in oxygen. So, the ratio of speed of sound in oxygen as compared to hydrogen will be 1:4

9) Glass
Sound travels fastest in solids and slowest in air. This is because the particles in solids are closer together than the particles in liquids or gases, and the particles in liquids are closer together than the particles in gases. The tighter the particles are packed in a space, the more frequently they collide. This allows sound, which is simply the combined collisions of particles, to travel fastest in solids. So, to reiterate, sound travels fastest in solids, then water, and slowest in air.
Among solids, when medium is glass, speed of sound is 5500 m/s, for copper 3600 m/s and for wood 4000 m/s.

10) Frequency
Energy and power of a wave are proportional to the square of amplitude of the wave and the square of the angular frequency of the wave.

11) Full destructive Interference

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Destructive interference occurs when the maxima of two waves are 180 degrees out of phase: a positive displacement of one wave is cancelled exactly by a negative displacement of the other wave. The amplitude of the resulting wave is zero.

12) $r = -r_o \sin(\omega t)$

As a result of reflection, the wave travels in the opposite direction of its original motion. Opposite direction of wave is denoted by adding a "negative sign" to the argument of the function. So, the equation of reflected wave will be:

$r = r_o \sin(-\omega t)$

Remember that:

$\sin(-\theta) = -\sin\theta$

So, the above equation will be converted into:

$r = -r_o \sin(\omega t)$

13) Stationary Waves

There are 2 main type of waves:

1) Stationary or Standing waves
2) Progressive or Travelling waves

A stationary wave is confined to a place, but progressive waves keep travelling. Nodes and Antinodes are the characteristics of Stationary/Standing waves.

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Chapter 9 – Physical Optics

1) A mixture of electric fields and magnetic fields is?
a) Plane polarized light
b) Circular polarized light
c) Unpolarized light
d) Constant

2) The central fringe in a diffraction pattern obtained by using a single slit is?
a) Bright
b) Dark
c) No fringes will be formed
d) None of the above

3) Which of the following can be the objective of Polarization:
a) Decrease in E
b) Decrease in capacitance
c) Decrease in current
d) None of these

4) When light enters from air to glass _____ remains constant?
a) Frequency b) Wavelength c) Velocity d) All of these

5) The distance between two fringes in double slit experiment is directly proportional to
a) Wavelength of light
b) Distance between the slits
c) Both a and b
d) None of these

6) Confining of wave into one plane is called
a) Polarization b) Depolarization c) Transformation d) None of these

7) Light rays coming from the tube light are
a) Plane b) Spherical c) Cylindrical d) None of these

8) Wave fronts coming from small light bulb
a) Spherical b) Cylindrical c) Plane d) None of these

9) If the grating element is made 1/10th the resolving power will become
a) 1/100 times b) 1/10 times c) 100 times d) 10 times

10) In interference energy _____ destroyed
a) May be b) Will be c) Can be d) Cannot be

11) Sky appears blue due to?
a) Light Interference b) Light diffraction c) Light scattering d) Light polarization

12) Interference is shown by ____ Light
a) Monochromatic b) Polychromatic c) Both a and b d) None of these

13) If an Electromagnetic wave is plane polarized, then the direction of electric field and magnetic field will be
a) Perpendicular
b) Parallel
c) Along direction of propagation of wave
d) None of these

14) In Young's Experiment, central spot in Interference pattern is
a) Always bright
b) Always dark
c) Depends on size of slit
d) Depends on distance from screen

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15) The branch of Physics in which we study the properties of light and its applications on optical instruments is called?
a) Physical Optics b) Quantum optics c) Light optics d) None of these

Answers of Chapter 9 – Physical Optics

1) Unpolarized light
The rays of light which reach directly from sun (or any other source) are unpolarized and contain both electric and magnetic fields propagating at right angles to each other.

2) Bright
A narrow slit produces a series of bright and dark regions with the first bright region at the center of the pattern.

3) Decrease in E
Through Polarization, the plane in which the Electric Field is propagating can be blocked allowing only magnetic field to flow forward)

4) Frequency
When a wave enter from one medium to another, its velocity and wavelength are changed due to the change in medium but frequency remains same as it depends on the source of waves not the medium of propagation.

5) Wavelength of light
$Formula\ of\ fringe\ spacing\ is\ y = \frac{\lambda L}{d}$

6) Polarization **7) Spherical** **8) Spherical**

9) 10 times
R = N x m
Grating element = d = L/N So, N = L/d Thus, R = L/d x m
Grating element is inversely proportional to the resolving power. So in the given case R will become 10 times.

10) Cannot be. Energy cannot be created nor destroyed, it only changes from one form to another.

11) Light scattering
During daylight, the sky appears to be blue because air scatters blue sunlight more than it scatters red

12) Monochromatic
The following conditions must be met to observe interference:
i) The interfering beams must be monochromatic i.e., of a single wavelength
ii) The interfering beams of light must be coherent

13) Perpendicular
The direction of Electric field and Magnetic field in Electromagnetic field is always perpendicular to each other whether the EM wave is plane polarized or unpolarized. However, when the EM wave is plane polarized, the direction of Electric and Magnetic fields is fixed along an axis while in case of unpolarized the direction keeps on changing but both the fields remain perpendicular to each other.

14) Always bright **15) Physical Optics**

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Answers of Chapter 10 – Optical Instruments

1) q/p Magnification = Size of Image/Size of Object = q/p

2) f_o/f_e
Magnification = Focal Length of Objective/Focal Length of Eye Piece = f_o/f_e

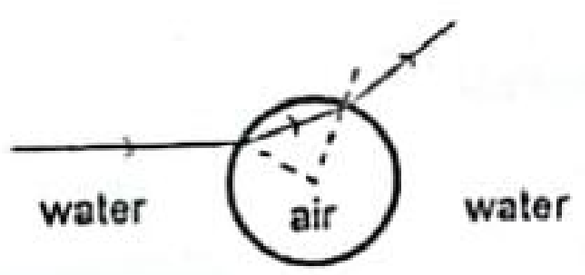
3) 5 $M = f_o/f_e$ $M = 25/5 = 5$

4) Both b and c

5) 18cm, 2cm
Magnifying power m = fo/fe = 9 (i)
fo + fe = 20 cm (ii)
on solving (i) and (ii) we get,
fo = 18 cm, fe = 2 cm

6) 2F
When the convex lens is cut into two identical halves, the focal length of each half will be double than the original focal length of the complete lens.

7) Concave lens
Since air is optically rarer than water, the ray of light bends away from the normal at the point of incidence when moving from water to air while it bends towards the normal while moving from air to water. The normal at any point of a spherical bubble will pass through the center of the bubble. It is clearly visible that the air bubble acts as a DIVERGING LENS (concave lens) in water.



8) Objective lens

9) 14000 It can carry more than 14 TV channels or 14000 phone calls.

10) 10cm
Power of a lens = 1/focal length, where focal length is in meter and power is in diopters.
So, focal length = 1/10 = 0.1 m = 10cm

11) Linear Magnification

12) Both b and c
According to the Raleigh formula, resolving power is given as:

$$R = \frac{D}{1.22\lambda}$$

Here D is the diameter of the lens i.e., aperture.
λ is the wavelength of light. We know that:

$$c = f\lambda \quad \rightarrow \quad \lambda = \frac{c}{f}$$

Here c is the speed of light and f is the frequency. Using the value of λ in above equation, we get:

$$R = \frac{D}{1.22\left(\frac{c}{f}\right)} = \frac{D \times f}{1.22c}$$

This relation shows that Resolution is directly proportional to D and f. So, increasing the size of aperture and increasing the frequency, we can increase the resolution.

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Chapter 11 – Heat and Thermodynamics

1) Which of the following act as a heat pump?
a) Refrigerator b) Air conditioner c) Deep Freezers d) All of the above

2) Compression of gas under constant temperature is process:
a) Adiabatic b) Isothermal c) Isochoric d) Isobaric

3) Entropy _____ on melting of ice
a) Remains same b) Increases c) Decreases d) Decreases slightly

4) As a result of the natural process the entropy
a) Increases b) Remains Same c) Decreases d) Either a or c

5) If Cp = 10 & Cv = 7, then the general gas constant equals:
a) 17 b) 3 c) 14 d) 21

6) Entropy is the measure of _____ of a system
a) Heat b) Kinetic energy` c) Momentum d) Disorder

7) Efficiency of the Carnot's cycle will be 100% if the temperature of cold reservoir is:
a) +273K b) -273K c) 100K d) 0K

8) During isothermal process which of the following remains constant:
a) Temperature b) Pressure c) Volume d) Heat

9) When earthquake occurs. What happens to the entropy of Earth?
a) It Increases b) It Decreases
c) It Stays the Same d) First Increases then decreases back to normal

10) If speed of a fan in a room is increased then the temperature of air in the room will
a) Decrease b) Increase c) Remain Same d) Either a or b

11) If the temperature of cold reservoir is 12C and that of hot reservoir is 27C, the efficiency of Carnot Engine will be?
a) 95% b) 5% c) 55% d) 45%

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Answers of Chapter 11 – Heat and Thermodynamics

1) All of the above
All of these act as heat pumps and transfer heat energy from a source to a sink.

2) Isothermal

3) Increases

4) Increases

5) 3
Cp – Cv = R

6) Disorder

7) 0 K
Efficiency of Carnot Engine = $\left(1-\frac{T_2}{T_1}\right)\times 100\%$
Here, T_2 is the temperature of the cold reservoir and T_1 is the temperature of hot reservoir in Kelvin.
When $T_2 = 0$
Efficiency = $\left(1-\frac{0}{T_1}\right)\times 100\% = (1-0)\times 100\% = 1\times 100\% = 100\%$

8) Temperature

9) It Increases
Every natural process tends to increase the entropy of Earth.

10) Increase
The motor in the fan produces its own heat. On increasing the speed of the fan, more heat will be produced by the motor. Remember than fan does not remove the heat, it only distributes the heat within the air.
In a perfect isolated room where no air can enter and leave the room, the temperature of the air will increase because of the continuous heat being produced by the fan.

11) 5%
Efficiency of Carnot Engine is:

$$Percentage\ Efficiency = \left(1-\frac{T_{cold}}{T_{hot}}\right)\times 100\%$$

The temperatures must be converted into Kelvin before using in the formula:
Temperature of cold reservoir = 12 C = 12 + 273 = 285 K
Temperature of hot reservoir = 27 = 27 + 273 = 300 K

$$Percentage\ Efficiency = \left(1-\frac{285}{300}\right)\times 100\% = \left(1-\frac{19}{20}\right)\times 100\% = \frac{1}{20}\times 100\% = 5\%$$

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Questions from 2nd Year Physics

Chapter 12 – Electrostatics

1) Unit of CV^2 is equivalent to that of?
a) Energy b) Work c) Power d) None

2) Two identical conducting spheres A and B carry equal charge Q. They are separated by a distance much larger than their diameters. A third identical conducting sphere C carries charge 2Q. Sphere C is first touched to A, then to B, and finally removed. As a result, the electrostatic force between A and B, which was originally F, becomes:
a) F/2 b) 15F/8 c) 5F/7 d) 2F/5

3) If the electric field is E = x/y then y is?
a) Positive test charge b) Negative charge c) Force d) None of these

4) In E = F/Q, the charge is
a) Always positive b) Always negative
c) Can be positive or negative d) Charge less

5) Two negative charges are present at a distance d. A third positive charge is placed somewhere between these charges. This positive charge will be in _____ equilibrium.
a) Stable b) Unstable c) Neutral d) None of these

6) If the potential difference between the plates of a capacitor with capacitance C is 4V, how much charge will accumulate on each of its plate?
a) 4C b) 2C c) 0 d) 8C

7) Two positive charges are separated by 3m. Another positive charge is placed between them. If the charge is moved along y axis the system will be in _____ equilibrium
a) Stable b) Unstable c) Neutral d) Depends on charge

8) Product of R and C is
a) Time b) Mass c) Current d) Unit less

9) Electric intensity between two plates of a capacitor equals:
a) $\frac{\sigma}{\varepsilon_o}$ b) $\sigma\varepsilon_o$ c) $\frac{\varepsilon_o}{\sigma}$ d) *None of these*

10) Energy stored in capacitor is represented by.
a) 1/2qv b) 1/3qv c) 1/4qv d) $1/2vq^2$

11) For a proton moving in the direction of the electric field
a) its potential energy increases and its electric potential decreases
b) its potential energy increases and its electric potential increases
c) its potential energy decreases and it electric potential increases
d) its potential energy decreases and its electric potential decreases

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12) If electron is moving along positive x axis and where V= 5x+3 then it
a) Deflect down b) Deflect up. c) Speed down d) Speed up

13) If a potential difference of V appears on the plates of a capacitor with capacitance C, then energy stored will be:
a) 2 C V^2 b) 1/2 C V^2 c) 1/2 C^2 V d) None of the above

14) The unit of the product of RC in the charging of a capacitor is:
a) Ohm b) Farad c) Second d) None of the above

15) Flux passing through an area does not depend upon
a) Medium b) Shape of hypothetical surface
c) Numbers of line passing through the area d) None of these

16) If magnitude of charges is doubled and distance between them is halved, the force between them will become?
a) F b) 4F c) 8F d) 16F

17) Unit of capacitance is:
a) Farad b) Coulomb c) Volt d) Ohm

18) Electric potential is a _____ quantity.
a) Scalar b) Vector c) Basic d) None of these

19) Flux passing through an area does not depend upon
a) Charge enclosed b) Shape of hypothetical surface
c) Medium d) Both a and c

20) If voltage of a capacitor is 60v then what will be the voltage if diamond is present as dielectric
a) Less than 60 b) More than 60 c) 60 d) None of these

21) Energy stored in capacitors connected in parallel
a) Is more than capacitor connected in series b) Is less than capacitor connected in series
c) Is equal to capacitor connected in series d) Cannot be measured

22) Energy required to charge a capacitor of 5 micro farad by connecting D.C source of 20 KV is
a) 10kJ b) 5kJ c) 2kJ d) 1kJ

23) Capacitors store
a) Equal charges b) Unequal charges
c) Equal and opposite charges d) Unequal and opposite charges

24) What is farad of electricity?
a) A/s b) 6.02×10^{23} electrons charge
c) Coulomb x volt d) None of these

25) If a 2 μF capacitor is connected, by closing a switch, to a supply of 100 volts through a 1M ohm series resistance. What will be the time constant?
a) 2 secs b) 3 secs c) 7 secs d) 4 secs

28) Value of ϵ_0 is:
a) 9×10^{9} b) 8.85×10^{-12} c) 9×10^{-12} d) None of these

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29) A proton is moving in direction of negative x-axis, what will happen to it if potential difference of $V = -10x + 7$ is applied across the field.
a) Deflect upwards b) Deflect downwards c) Slow down d) Speed up

31) Electrical effects due to friction are studied in:
a) Electrostatics b) Electrodynamics c) Thermodynamics d) Electrochemistry

32) If the medium is changed from air to diamond what would be the effect in potential difference of a capacitor?
a) Decreases b) Increases c) Remains same d) Not possible

33) A charge is situated in the center of cube. The electric flux through one of the faces of the cube is.
a) Q/Eo b) Q/2Eo c) Q/4Eo d) Q/6Eo

34) Ratio of Electrical Constant to Gravitational constant is approximately:
a) 12 b) 13 c) 14 d) 15

35) Q^2/C has the units of?
a) Charge b) Capacitance c) Voltage d) Energy

36) Unit of Electric Intensity is
a) NC b) N/C c) C/N d) None of these

37) Two charges are separated by a distance r, in presence of which of the following the force between them will be minimum?
a) Distilled Water b) Oil c) Air d) Vacuum

38) Electron volt is the unit of
a) Energy b) Voltage c) emf d) Conductance

39) The electric field of a point charge is ____ in shape.
a) Spherical b) Spherical symmetrical
c) Plane d) Cylindrical

40) Two conducting objects X and Y having a charge Q on them exert force F on each other. Now third conductor having a charge -Q is touched to X and is removed, the new force between X and Y will be:
a) F b) F/2 c) 2F d) None of these

41) Which of the following can't be used as a dielectric in a capacitor
a) Air b) Wax c) Iron d) All of the above

42) Electric flux is positive when
a) Field lines are directed inwards b) Field line are directed outwards
c) It does not depend on direction of field lines d) None of these

43) An electron is placed between two charged plates the upper plate is positively charged and the lower plate is negative charged. The electron will
a) Deflect downwards b) Deflect upwards c) Go straight d) None of these

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44) If 60 capacitors each of Capacitance C are connected in series and then in parallel what is the ratio of Cs/Cp=?
a) 1/60 b) 3600 c) 1/3600 d) 250

45) When wood is replaced by air as dielectric. The capacitance of capacitor
a) Increases b) Decreases c) Remains Constant d) None of these

46) 0.37q charge is stored on the capacitor, what will be the current?
a) 37% b) 63% c) 86% d) None of these

47) If capacitor is connected with battery and is fully charged then
a) Current will flow b) Current will not flow
c) Depends on the dielectric d) May or may not flow

48) If the angle b/w electric field and vector area A is $\pi/3$ then electric flux will be?
a) 0.866 EA b) 0.5 EA c) 0.707 EA d) EA/3

49) When some charge is given to a soap bubble it
a) Increases in size b) Decreases in size c) Remain same d) Collapses

50) What will be the change in potential energy if an electron moves 4.5m in the direction of an electric field of strength 325 N/C?
a) 5.3×10^{-16} b) 2.3×10^{-16} c) Zero d) 10

51) When two suspended objects are seem to attract each other electrically:
a) They are both charged b) They are both uncharged
c) Either of them is charged d) Both a and c

52) If a body A is charged with charge q, and is touched with neutral body B and then with neutral body C. What will be the charge on C after the contact?
a) q b) q/2 c) q/3 d) q/4

53) What will be the new Surface Density if Electric Intensity is increased to 3 times?
a) 9σ b) $\sigma/3$ c) 3σ d) $\sigma/27$

54) If two charged conductors are joined by wire, then which of following will happen?
a) Current will start flowing between them
b) Current will flow from higher to lower potential
c) After some time, both will be at same potential
d) All of them

55) Two charges of same magnitude are placed, the force between the charges will be maximum in presence of which medium?
a) Glass b) Water c) Mica d) Air

56) Unit of permittivity in free space is?
a) F/m b) F c) Fm d) C/sec

57) Unit of electric field is:
a) N/C b) Weber/sec c) Volt/C d) Joule/sec

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58) Capacitance increases by
a) Increasing supplied Voltage
b) Increasing supplied current
c) Increasing the Separation of plates
d) Increasing the Area of Plates

59) If a closed surface contains two equal and opposite charges. The net electric flux from the surface will be?
a) Positive
b) Negative
c) Zero
d) None of these

60) What happens when a positive rod is placed near a neutral sphere?
a) Sphere is attracted towards rod and remains neutral
b) Sphere is attracted and negative charge is induced in it
c) Sphere is repelled and remains neutral
d) Sphere is repelled and positive charge is induced in it

Answers of Chapter 12 – Electrostatics

1) Energy
Energy stored in a capacitor is given by:
$E = 1/2CV^2$
So, CV^2 have similar dimensions and hence units as that of energy.

2) 15F/8
When two bodies having different amount of charge are made to touch, the charge flows from higher potential to lower potential till the charge on both bodies become equal.
The equal amount of charge on each body = (Sum of charge on both bodies)/2
Same principle will be used in this problem. First A and C are touched, since they have unequal amount of charge, charge will flow from C to A till charge on both becomes equal. That amount of charge will be:

$$Q'_A = Q'_C = \frac{(Q+2Q)}{2} = \frac{3Q}{2}$$

Now C is to be touched with B and again flow of charge will occur. This time charge on C is 3Q/2.

$$Q'_B = Q''_C = \frac{Q+\frac{3Q}{2}}{2} = \frac{5Q}{4}$$

Now we got the new amount of charge on A and B. Using these values in Coulomb's formula we can get the new force:

$$F' = \frac{kQ'_AQ'_B}{r^2} = \frac{k.\frac{3Q}{2}.\frac{5Q}{4}}{r^2} = \frac{15}{8}\frac{kQQ}{r^2}$$

The original force between the charges A and B was:

$$F = \frac{kQQ}{r^2}$$

So, we can write:

$$F' = \frac{15}{8}F$$

3) Positive test charge
Given equation: E = x/y

Formula of E Is E = F/q

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Comparing both these equations we get $y = q$
To find E, a positive test charge is used. So, here y will be a positive test charge.

4) Can be positive or negative
Generally followed practice is to place a positive test charge to determine the value of E. But both negative and positive test charges can be used. Negative charge won't make any difference in value of E. However, the way this negative charge interacts with the Electric Fields of other charges will be different.

5) Unstable
Stable equilibrium: A state in which a body tends to return to its original position after being disturbed.
Unstable equilibrium: The state of a system that will move further from its original condition after experiencing a slight disturbance.
A positive charge placed between two negative charges will be an unstable equilibrium. Suppose the positive charge is first placed at point where the attraction due to both negative charges cancel each other. Now if the positive charge is disturbed by moving towards either of the charges it will be attracted towards that charge. Hence it moves away from its original condition.

6) 4C
Charge stored on each plate is given by: $Q = CV$
Using given values, we get: $Q = 4C$

7) Unstable
Suppose the 3rd charge is initially placed at a point where the force of repulsion due to the two charges is zero. When the 3rd charge is moved along y-axis, it will feel repulsion due to the two charges and will move away. Since it is not returning to its original position it is in state of unstable equilibrium.

8) Time RC = Time constant.

9) $\frac{\sigma}{\varepsilon_o}$

10) 1/2qv

11) Its potential energy decreases and its electric potential decreases

12) Speed up
$E = -dv/dr$ i.e., E = negative derivative of V. So here $E = -5i$
Which means Electric Field is in direction of negative x-axis. In other words, towards the positive x-axis there is positive potential and towards negative x-axis there is negative potential because direction of Electric Field lines is always from positive to negative. Since electron is moving in direction of positive x-axis, it will speed up due to attraction from positive potential.

13) $1/2\, C V^2$

14) Second

15) Shape of hypothetical surface
Electric flux is independent of:
i. Number of charges
ii. Way in which the charge is distributed
iii. Geometry of the closed surface (size and shape)

16) 16F

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$$F = k\frac{Q_1Q_2}{r^2}$$

$$F' = k\frac{2Q_1 2Q_2}{\left(\frac{r}{2}\right)^2} = 16\,k\frac{Q_1Q_2}{r^2} = 16\,F$$

17) Farad

18) Vector

19) Shape of hypothetical surface

20) Less than 60

Due to the presence of dielectric the voltage difference between the plates of capacitor decreases as a result of polarization.

21) Is equal to capacitor connected in series

Assume you have two identical capacitors of capacitance C and voltage rating V. (The capacitors don't have to be identical, but the results are valid for the general case, and the math is much easier this way.)
Let us calculate stored energy E for both circuits.
Stored energy in two parallel capacitors, charged to voltage V:
$E_{parallel} = 0.5\ C_{eq} V^2 = 0.5\ (2C)\ V^2 = CV^2$
Stored energy in two series capacitors,
Each capacitor stores energy = $0.5\ CV^2$
In series the energies will be summed up, so
$E_{series} = CV^2$
There is no difference! Both circuits store the same amount of energy. This should confirm a common-sense approach that would say you cannot increase total energy storage merely by reconnecting the same capacitors in different arrangements.

22) 1kJ

$E = 0.5\ CV^2 = 0.5 \times 5 \times 10^{-6} \times (20 \times 10^3)^2 = 25 \times 10^{-7} \times 400 \times 10^6 = 1000\ J = 1KJ$

23) Equal and opposite charges

24) A/s

Farad = Coulomb/Volt = A/s

25) 2 secs

Time constant = RC = (10^6) x (2 x 10^-6) = 2 seconds

28) 8.85×10^{-12}

29) Slow down

E = -(delta V)/(delta r) i.e. E equals the negative derivate of the voltage.
So in this case E = 10 i (in vector form). So the applied field is in direction of positive x-axis. The initial movement of proton was towards –ve x-axis. So the application of new field in opposite direction will slow down the proton.

31) Electrostatics

32) Decreases

Adding the dielectric increases the capacitance by a factor of K.

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To see what happens to the potential difference, look at Q = C ΔV.
Increasing C while keeping the charge the same means that the potential difference decreases.

33) Q/6Eo
According to gauss law electric field * total surface area= charge enclosed/epsilon.
Now consider a cube. Charge inside the cube is 'q'. Total surface of cube is 6*a*a(a is length of edge of cube).
The total flux through the cube is q/epsilon.
q/epsilon is the flux for 6 faces. Therefore, for one face the flux will be Q/6 epsilon.

34) 13

$$\frac{\varepsilon_o}{G} = \frac{8.85 \times 10^{-12}}{6.67 \times 10^{-11}} = \frac{88.5}{6.67} \approx 13$$

35) Energy
C = Q/V so, $Q^2/C = QV$
In terms of units we get, Coulomb x Joule/Coulomb = Joule
Which is a unit of Energy.

36) N/C E = F/q So, unit of E = N/C

37) Distilled Water
Larger the value of relative permittivity, smaller will be the force between the charges. Since the value of relative permittivity is maximum for distilled water so force would be minimum in this medium.
38) Energy

39) Spherical symmetrical

40) None of these
$F = k\,Q.Q/r^2$
When 3rd object touches X the charge on X will be reduced to zero. So now force between X and Y will be zero as Q is zero.

41) Iron Metals cannot be used as a dielectric inside the Capacitor.

42) Field line are directed outwards
Field lines directed into a closed surface are considered negative; those directed out of a closed surface are positive.

43) Deflect upwards Opposite charges attract each other.

44) 1/3600
Cs= C/60 Cp = 60C Cs/Cp = 1/3600

45) Decreases
$C = A\,\epsilon_o\epsilon_r/d$
Larger the value of Dielectric constant more the value of Capacitance. Since value of Dielectric constant of wood is more (1.4) than air (1.0) so answer is b.

46) 63%
Current flow is maximum when no charge is deposited on the plates of Capacitor and is zero when capacitor is fully charged. So, zero charge, 100% current and 100% charge, zero current. Thus at 37% charge, current flow will be (100 – 37) = 63%.

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47) **Current will not flow**
When the capacitor is fully charged, no more charge can accumulate over it and hence the capacitive current will drop to zero.

48) **0.5 EA**
Flux = E.A = EA cos (theta) = EA cos (pi/3) = EA cos (60) = EA (0.5)

49) **increases in size**
When the bubble is charged, the charge will distribute over its surface. Since like charges repel, due the repulsion there will be an increase in the size of the bubble.

50) **2.3×10^{-16}**
Energy change = Work done = Force x distance moved
Force = Electric field x Charge
Energy change = E . q . d = $325 \times 1.6 \times 10^{-19} \times 4.5 = 2.340 \times 10^{-16}$

51) **Both a and c**
When two objects are oppositely charged, they will definitely attract each other. However, if only one of them is charged and the distance between them is small, the charged body will polarize the other and as a result they both will attract each other.

52) **q/4**
When A is touched with B, half of its charge will flow towards B so that charges on both becomes equal. Now the charge on A is q/2. Now when it is touched with C, again half of its charge will flow towards C, so that charge on both A and C is equal. Thus, the charge on C will be q/4.

53) **3 σ**
The relation between Electric Intensity (E) and Surface Density(σ) is:

$$E = \frac{\sigma}{\varepsilon_o} \quad \rightarrow \quad \sigma = E\,\varepsilon_o$$

$\sigma \propto E$ → Surface Density is Proportional to Electric Intensity.
If Electric Intensity is increased to 3 times, then according to the above equation Surface Density will also be 3 times as both are directly proportional.

54) **All of them**
All of the given options are correct. Current will start flowing between them, the current will flow from conductor at higher potential to the conductor at lower potential. The flow of current will stop once both the conductors are at the same potential.

55) **Air**
The Coulomb's Force in presence of a dielectric is given as:

$$F = \frac{1}{4\pi\varepsilon_o\varepsilon_r} \times \frac{q_1 q_2}{r^2}$$

From the above equation we can see that the Force is Inversely related to the relative permittivity of the dielectric. Smaller the value of ε_r, larger will be the force between the charges. From the given options the value of ε_r is smallest for air. So, the force will be maximum in presence of air.
Values of Relative permittivity are:
Glass = 4.8 – 10 Water = 78.5 Mica = 3 – 7.5 Air = 1.0006

56) **F/m**

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The SI unit for permittivity is farad per meter (F/m or Fm^{-1}). The lowest possible permittivity is that of a vacuum. Vacuum permittivity, sometimes called the electric constant, is represented by ε_0 and has a value of approximately 8.85×10^{-12} F/m.

57) N/C

58) Increasing the Area of Plates

Value of Capacitance depends on following 4 factors:

1. The area of the plates
2. The distance between the plates
3. The type of dielectric material
4. Temperature

Of these four, temperature has the least effect in most capacitors. The value of most capacitors is fairly stable over a "normal" range of temperatures.

Capacitance (C) is directly proportional to the area of the two plates that directly overlap, the greater the overlapping area, the greater the capacitance.

Capacitance is inversely proportional to the distance between the plates. i.e., if the plates move apart, the capacitance reduces.

59) **Zero**

The electric flux through any closed surface is directly proportional to the net enclosed charge in that surface. The given closed surface contains two equal and opposite charges, so the net charge is zero. Because the net charge inside the closed surface is zero, the electric flux from the surface will also be zero.

60) **Sphere is attracted towards rod and remains neutral**

When the positively charged rod is placed near the neutral sphere, all the negative charges will be pulled on the side facing the sphere and positive charges on the opposite side of the sphere. Since the opposite charges are facing each other, they will attract each other.

The sphere overall will be neutral as the number of negative charges will be equal to the number of positive charges. However, if the sphere is touched with a grounded object, all the positive charges will flow out of the sphere, leaving behind negative charges only. In the given question we are not told that the sphere is touched with grounded object, so this means sphere carries both negative and positive charges and is a Neutral object overall.

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Chapter 13 – Current Electricity

1) Unit of emf?
a) Volts b) Henry c) Watt d) Amperes

2) Volt/ohm=
a) Sec b) Ampere c) Coulomb d) Hertz

3) If a magnetic field around a current carrying wire is anti-clockwise then the direction of current flow is
a) Upwards b) Downward c) Rightward d) Leftward

4) Value of resistivity of iron is
a) 10.52×10^{-8} b) 5.00×10^{-8} c) 11.00×10^{-8} d) 100×10^{-8}

5) In which of the following more heat energy is produced?
a) A bulb of resistance 5m ohm operated for 1 min by suppling a current of 120 A
b) An Iron producing heat energy of 2 kJ
c) A tube working for 2 mins with a supply of 50A current and offering a resistance of 0.02 ohms
d) Both a and c produce same energy.

6) What is the constant of proportionality in ohms law:
a) R b) 1/R c) I d) V

7) mho is the unit of?
a) Resistance b) Resistivity c) Conductance d) Conductivity

8) Three resistors of 7ohm, 5ohm and 8ohm are connected in series. Current flow will be maximum through:
a) 5 ohm b) 7 ohm d) 8 ohm d) Will be Same

9) Which of the following convert the heat energy into electrical energy
a) Thermocouple b) Thermometer c) Potentiometer d) None of these

10) Three resistors R1, R2 and R3 are connected in series. If R1 > R2 > R3, the equivalent resistance will be:
a) Lesser than R1 b) Equal to R1 c) Lesser than R3 d) Greater than R1

11) If voltage is 100V current is 10A and R Is 5ohm then internal resistance?
a) 10 ohm b) 15 ohm c) 5 ohm d) 1 ohm

12) The power dissipated in a resistor is 12.8 watts when 4A current is passed. How much power will be dissipated if 6A current is passed through the same resistor?
a) 16 watts b) 24 watts c) 28.8 watts d) 32.6 watts

13) Three resistors connected in series have individual voltages labeled V1, V2, and V3, respectively. Which of the following expresses the value of the total voltage V_T taken over the three resistors together?
a) $V_T = V_1 + V_2 + V_3$
b) $V_T = (1/V_1 + 1/V_2 + 1/V_3)$
c) $V_T = V_1 = V_2 = V_3$
d) $V_T = (1/V_1 + 1/V_2 + 1/V_3)^{-1}$

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14) Siemen is the SI unit of:
a) Conductivity b) Resistivity c) Conductance d) None of these

15) Temperature co-efficient of resistance is:
a) Fractional change in resistance
b) Fractional change in resistivity
c) Fractional change in resistance per kelvin change in temperature
d) Fractional change in resistance per degree change in temperature

16) Conductivity equals:
a) AR/L b) L/AR c) 1/p d) Both b and c

17) Drift velocity is of the order:
a) 10^{-4} ms^{-1} b) 10^{-3} ms^{-1} c) 10^{-2} ms^{-1} d) 10^{-1} ms^{-1}

18) Resistivity of Silver is ___ ohmmeter
a) 1.52×10^{-8} b) 2.89×10^{-8} c) 1.02×10^{-8} d) 1.82×10^{-8}

19) If length of a wire is increased two times and its cross-sectional area is reduced to half, the resistance of the wire will be:
a) 2R b) 0.5 R c) 4R d) 0.25 R

20) If three resistances R_1, R_2 and R_3 are connected in Parallel to the circuit such that $R_1 > R_2 > R_3$. Which of the following will be true for the Equivalent Resistance R'?
a) $R' > R_1 > R_3$ b) $R' < R_3$ c) $R' = R_3$ d) $R_1 < R' < R_3$

21) Resistivity of Hg is ___ ohmmeter
a) 3.5×10^{-8} b) 94×10^{-8} c) 11×10^{-8} d) 2027×10^{-8}

22) When charge flows through a wire, it produces:
a) Magnetic field b) Electric field c) Both a and b d) None of these

23) A and B are bulbs connected in series with 40-volt battery and a bulb C is connected with 40-volt battery Glow of bulbs will be:
a) Same glow in all 3 bulbs
b) Same glow in bulbs A and B but different in bulb C
c) Different glow in all 3 bulbs
d) None of these

Answers of Chapter 13 – Current Electricity

1) Volts

2) Ampere $I = V/R$

3) Upwards
Curl the fingers of right hand in direction of magnetic field thumb will point in the direction of current.

4) 11.00×10^{-8}

5) A tube working for 2 mins with a supply of 50A current and offering a resistance of 0.02 ohms

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$H = I^2 R t$

So, for option a: $H = (120)^2 \times 5 \times 10^{-3} \times 60 = 14400 \times 300 \times 10^{-3} = 4320$ J

For option b: $H = (50)^2 \times 0.02 \times 120 = 2500 \times 120 \times 2 \times 10^{-2} = 6000$ J

6) 1/R

According to Ohms law: $I \propto V$ $\qquad I = V \times \frac{1}{R}$

So the constant of proportionality in Ohms law is 1/R not R.

7) Conductance

8) Same through all of these In series combination the current flow all the resistor stays the same.

9) Thermocouple

10) Greater than R1

In series combination the equivalent resistance is the sum of all individual resistances which ofcourse is larger in value than any of the individual resistance.

11) 5 ohms

$$I = \frac{E}{R + r}$$

$$5 + r = \frac{100}{10} = 10$$

$$so, r = 5\ ohm$$

12) 28.8 watts

$P = I^2R$, so $R = P/I^2$

R = 12.8/16 = 0.8 ohm

So, in case of 6A, Power = 36 x 0.8 = 28.8 watts

13) $V_T = V_1 + V_2 + V_3$

In accordance with Kirchhoff's law: $V_T = IR_1 + IR_2 + IR_3 = V_1 + V_2 + V_3$

14) Conductance

15) Fractional change in resistance per kelvin change in temperature

16) Both b and c

17) $10^{-3}\ ms^{-1}$

18) 1.52×10^{-8}

19) 4R

The resistance R of a wire can be calculated as:

$$R = \frac{\rho L}{A}$$

Length is increased two times, so new length will be 2L. cross sectional area is reduced to half, so new area will be A/2. Value of ρ will stay the same as it depends on the material. So new value of resistance will be:

$$R' = \frac{\rho(2L)}{A/2} = \frac{4\rho L}{A} = 4R$$

20) $R' < R_3$

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When three resistors are connected in parallel, the equivalent resistance will be smaller than the smallest most resistance connected in that parallel circuit. In this case smallest most resistance is R_3. So, the equivalent resistance will be smaller than R_3, and hence will also be smaller than R_1 and R_2.

21) 94×10^{-8}

22) **Electric field**

Motion of charges in a wire produced electric current which produced electric field. Magnetic field will only be produced in case of changing electric field.

23) **Same glow in bulbs A and B but different in bulb C**

Glow or brightness of the bulb depends on the Power. Power depends on current and voltage as $P = VI$. When two bulbs A and B are connected in series, they will offer a larger equivalent resistance as compared to a single bulb C. So, the current in the circuit with bulbs A and B will be lesser as compared to the current in circuit with bulb C. Due to less current voltage drop across bulbs A and B will also be smaller as compared to bulb C. This means power consumed by bulbs A and B will be less and therefore, their glow will be less as compared to bulb C.

Glow of bulb A and B will be the same as they are experiencing the same current and voltage.

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Chapter 14 – Electromagnetism

1) If length of solenoid gets doubled while keeping N (number of turns) constant, the resultant magnetic field will be?
a) B/2 b) B/4 c) 2B d) B/3

2) ECG records _____:
a) Voltage from the heart b) Heartbeat
c) Stress d) None of these

3) EEG is related to:
a) Heart b) Brain c) Both a and b d) None of the above

4) What is the device which is used to measure magnetic field
a) Magnetometer b) Voltmeter
c) Wilson-cloud chamber d) None of the above

5) F = I L B, What is relation between I and L
a) Direct b) Inverse c) Inverse of square d) None of the above

6) In CRO, electrons are emitted from:
a) Filament b) Cathode c) Anode d) Electron Gun

7) The brightness spot on the screen in the CRO is controlled by:
a) Anode b) Cathode c) Grid d) Filament

8) Moving charge produce _____ field
a) Electric b) Magnetic c) Both a and b d) None of these

9) Ammeter is a galvanometer with:
a) High resistance in series b) High resistance in parallel
c) Low resistance in series d) Low resistance in parallel

10) Which of the following is incorrect?
a) $F \propto I$ b) $F \propto \sin\theta$ c) $F \propto L$ d) $F \propto 1/B$

11) Ammeter lies in _____.
a) Series b) Parallel c) Either a or b d) None of these

12) Unit of magnetic flux density is
a) wb/m^2 b) N/Am c) Tesla d) All of these

13) A toroid is?
I- A circular ring shape of a coil.
II- A solenoid bent in shape of a circle.
a) I only b) II only c) Both I and II d) None of these

14) If the length of a current carrying solenoid is doubled keeping the number of turns same and the current is increased to 9 times, the value of magnetic field compared to the original magnetic field B will be:
a) 2/9 B b) 9/2 B c) 18 B d) B/18

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15) If two inductors each of inductance L are introduced in a circuit in parallel, the equivalent Inductance will be:
a) 2L b) L c) 3L/2 d) L/2

16) Magnetic effect of electric current was first discovered by
a) Faraday b) Oersted c) Henry d) None of these

17) Unit of Magnetic Flux is
a) Weber b) Tesla c) Volt d) Weber/m

18) 1 tesla is equal to?
a) 10^4 Gauss b) Wb/m c) Both a and b d) None of these

19) When the ohmmeter measures the infinite resistance, its pointer lies at
a) Centre of the scale b) Left end of the scale
c) Right end of the scale d) None of these

20) A current carrying conductor is lying perpendicular to magnetic field and experiencing some force. If the conductor rotates by 60 degrees counter clock wise, the force on it will
a) Increase b) Decrease c) Will be same d) None of these

21) What is the dimension of magnetic field
a) $[L A^{-3} T^{-1}]$ b) $[M L^{-2} T^{-2}]$ c) $[M L^{-3} T A^{-1}]$ d) $[M T^{-2} A^{-1}]$

22) If current passing through a solenoid is increased, which of the following must increase:
a) Length of solenoid b) Number of turns c) Magnetic field d) All of these

23) If the current in the wire is directed into the page, and the wire is held perpendicular to the page, then the direction of magnetic circles will be:
a) Clockwise b) Anticlockwise c) Both a and b d) None of these

24) What are dimensions of Magnetic Flux?
a) $M L^2 T^{-2} I^{-1}$ b) $M L^{-3} T^{-1} I$ c) $M L T^{-2} I$ d) $M L^3 T^{-2} I^{-1}$

25) The value of permeability "μ_o" is
a) $5\pi \times 10^{-9}\ Wb/Am$ b) $4\pi \times 10^{-7}\ Wb/Am$
c) $8\pi \times 10^{-10}\ Wbm/m$ d) None of these

26) If the direction of current in two parallel wires is in opposite direction, then the wires will:
a) Attract b) Repel c) Both a and b d) None of these

Answers of Chapter 14 – Electromagnetism

1) B/2
When the length of solenoid doubled, the magnetic field B will be halved.

$$B = \mu_o n i = \frac{\mu_o N i}{l} \qquad n = \frac{N}{l}$$

When the length is doubled the new B will be:

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$$B' = \frac{\mu_o N i}{2l} = \frac{1}{2}\left(\frac{\mu_o N i}{l}\right) = \frac{1}{2}B$$

2) Voltage from the heart 3) Brain 4) Magnetometer

5) Inverse

To check the relation between two variables take them on opposite sides of equality symbol and check, following conditions will be possible:

1) Both are in numerator (Signifies direction relation)
2) Both are in denominator (Signifies direction relation)
3) One is in numerator and one in denominator (Signifies inverse relation)

In this case: F / I = LB

So, this is the case 3. Which means increasing one quantity will lead to a decrease in other.

6) Cathode 7) Grid 8) Both a and b 9) Low resistance in parallel

10) $F \propto 1/B$ $F = ILB\sin\theta$ This means F is proportion B not to 1/B

11) Series

12) All of these

The SI unit for magnetic flux density is tesla, which is symbolized by the letter T. One tesla is defined as the field intensity of 1 newton of force per ampere. One tesla is equivalent to 1 weber per square meter.

13) Both I and II

The solenoid is considered as the straight coil and the toroid is the bent solenoid which is having ring or doughnut shape. In toroid due to the ring shape the magnetic field is much stronger than solenoid at its center.

14) 9/2 B

Magnetic field in a current carrying solenoid is given as: $B = \mu_{\bullet} nI$

Value of current is increased to 9 times, so new value of current will be $9I$.

Here n is the number of turns per unit length. Since length is doubled and number of turns is the same, the number of turns per unit length will now be halved. So new value of number of turns per unit length will be n/2. Therefore, the value of magnetic field will be:

$$B_{new} = \mu_{\bullet}\left(\frac{n}{2}\right)(9\,I) = \frac{9}{2}\mu_{\bullet} nI = \frac{9}{2}B$$

15) L/2

The formulas of equivalent inductance and series are the similar to that of resistance.

For two inductors connected in parallel, the equivalent inductance will be given as:

$$\frac{1}{L_{eq}} = \frac{1}{L_1} + \frac{1}{L_2} = \frac{1}{L} + \frac{1}{L} = \frac{2}{L}$$

$$\rightarrow L_{eq} = \frac{L}{2}$$

16) Oersted

17) Weber The unit of magnetic flux is NmA^{-1} which is called weber(Wb)

18) 10^4 Gauss

19) Left end of the scale

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The reading at the left side of the scale indicates an infinite resistance. The zero point on the ohmmete is located at the extreme right side of the scale.

20) Decrease
The force of a current carrying conductor is calculated as: $F = BIL\sin\theta$
Where, θ is the angle between the conductor and the magnetic field.
At first the conductor was perpendicular to the field, so angle was 90 degree.
$F = BIL\sin(90) = BIL$
Later the conductor is tilted, and it makes an angle of 60 degrees, so now the force will be:
$F(new) = BIL\sin(60) = BIL(0.866) = 0.866\ (BIL) = 0.866\ (F)$
This shows new force is less than the original force.

21) $[M\,T^{-2}\,A^{-1}]$
The SI unit of magnetic field(B) is tesla.
1 tesla $= 1\ NA^{-1}m^{-1} = kg\ ms^{-2}\ A^{-1}m^{-1} = kg\ s^{-2}\ A^{-1}$
Therefore, dimensions of magnetic field would be: $[M\,T^{-2}\,A^{-1}]$

22) Magnetic field
Length of the solenoid and number of turns in a solenoid have nothing to do with the amount of current passing through the solenoid. We can change the length and number of turns as per our own wish. However, value of magnetic field directly depends on the magnitude of the current passing through the solenoid. More the current, more will be the magnetic field.

23) Clockwise
Right Hand Rule: If the wire is grasped in fist of right hand with the thumb pointing in the direction on the current, the fingers of the hand will circle the wire in the direction of the magnetic field.
So, if the thumb is pointing downwards into the page, the fingers of right hand will point in clockwise direction which will be the direction of Magnetic field.

24) $M\,L^2T^{-2}I^{-1}$
The unit of Magnetic Flux Is Weber, which is equal to NmA^{-1}
$$NmA^{-1} = \frac{kgm}{s^2}mA^{-1} = kg\ m^2s^{-2}A^{-1}$$
Changing this unit to Dimensions: $[ML^2T^{-2}\,I^{-1}]$

25) $4\pi \times 10^{-7}\ Wb/Am$
Magnetic permeability of the free space is denoted by μ_o and has value $\mu_o = 4\pi \times 10^{-7}$ Wb/Am

26) Repel
Two long parallel wires carrying current in opposite direction will repel each other. The wires attract when the current is in the same direction. This can be verified using the right-hand rule to find the direction of magnetic field which is the cause of this attraction and repulsion.

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Chapter 15 – Electromagnetic Induction

1) Transformer cannot step up
a) DC voltage b) AC voltage c) None of these d) Both a and b

2) Which of the following is not major application of electromagnetic induction
a) T.V b) Radio c) Transformer d) Telephone

3) A.C generator can be converted into D.C generator by
a) Slip rings b) Split rings c) Stopper d) Cannot be converted

4) A coil is placed near a magnet. Emf will be induced in it when
a) Area of coil is changed b) Coil is rotated
c) Magnet which was placed at a distance is moved closer to it. d) All of these

5) Torsion balance is used to measure:
a) Spring constant b) Electric force c) Magnetic force
d) Gravitational constant e) All of these

6) Which of the following statement is true?
i) Toroid is a solenoid bent into circular path ii) Solenoid is a toroid in open
a) i is true b) ii is true c) Both a and b d) None of these

7) Induced emf depends upon:
a) v b) B c) L d) All of these

8) If the current flow increases to 100 times, the energy stored in the inductor will increase to:
a) 100 times b) 1,000 times c) 10,000 times d) Remains same

9) A changing electric field produces
a) emf b) Current
c) Changing magnetic field d) None of these

10) What will be the energy stored in an inductor of length 2m if a current of 10A passes through it:
a) 10 J b) 100 J c) 200 J d) 50 J

11) If Ns/Np is the turn ratio, then for step up transformer
a) Ns > Np b) Ns = Np c) Ns < Np d) None of these

12) Resistance opposes current, inductor opposes
a) Current b) Change in current c) emf of a battery d) All of these

13) The direction of induced emf is given by which of the following law?
a) Faraday law b) Lenz law c) Ampere law d) None of these

14) Which electrical quantity cannot be changed by a transformer?
a) Voltage b) Current c) Power d) Inductance

15) When a conductor moves in magnetic field the induced emf is
a) Motional b) Rotational c) Transferal d) All of these

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16) Potential difference in charge between two points in a circuit is known as?
a) Emf b) Electric difference c) Intensity d) Volt

17) When carrying electricity on long distances. Step up transformer are used to:
a) Increase both voltage and current b) Increase voltage reduce current
c) Increase current reduce voltage d) None of these

18) A D.C generator is converted in A.C generator by
a) Increasing the rings b) Replacing split rings by slip rings
c) Replacing slip rings by split rings d) Decreasing the rings

19) Electric Generators work on the principle of:
a) Coulomb's law b) Newton's law of gravitation
c) Ampere's law d) Electromagnetic Induction

20) Unit of induced emf is
a) Volts b) Ampere c) Newton d) Joule

21) Which of the following statements is True about the A.C and D.C Generators?
a) Slip Rings for A.C and Split rings for D.C b) Split rings for A.C and Slip Rings for D.C
c) Either Slip rings for A.C or Split rings for D.C d) Either Split rings for A.C or Slip rings for D.C

Answers of Chapter 15 – Electromagnetic Induction

1) DC voltage
Transformer works on the principal of induction, with DC voltage current cannot be induced in the secondary coil. Without current in secondary coil, a transformer cannot be formed)

2) Telephone
All are the applications of Electromagnetic induction. However, Telephone is a digital device, so it is not a major application of electromagnetic Induction.

3) Split rings.

4) All of these
An emf can be Induced when:
i. Change the magnetic field ii. Change the area of the loop
iii. Change the angle between the field and the loop

5) All of these

6) I Is true
One can think of toroid as a *solenoid,* that has been curved and joined so no poles are open.

7) All of these

8) 10,000 times
$E = 0.5\ LI^2$
$I' = 100I$
so, $E' = 0.5\ L\ I'^2 = 0.5\ L\ (100I)^2 = 10000\ (0.5LI^2) = 10{,}000E$

9) Changing magnetic field

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10) 100 J

$$E = 0.5\,L\,I^2 = 0.5 \times 2 \times 100 = 100\ J$$

11) Ns > Np

In step up transformer, voltage in secondary coil is increased. So, Vs > Vp. Voltage is directly proportional to number of turns. So, Ns will be greater than Np for a step-up transformer.

12) Change in current

Inductors do not behave the same as resistors. Whereas resistors simply oppose the flow of electrons through them (by dropping a voltage directly proportional to the current), inductors oppose changes in current through them, by dropping a voltage directly proportional to the rate of change of current. According to the Len's Law:

"The direction of induced current is always so as to oppose the change which causes the current"

13) Lenz law

Lenz's Law states that an induced electric current always flows in a direction such that the current opposes the change that induced it

14) Power

Power cannot be changed by a transformer. If the voltage is increased the quantity of current passing through it decreases and the overall product of current and voltage remains the same.

15) Motional

16) Emf

Electromotive force (emf) is a measurement of the energy that causes current to flow through a circuit. It can also be defined as the potential difference in charge between two points in a circuit. Electromotive force is also known as voltage, and it is measured in volts. Electromotive force is not truly a force; rather, it is a measurement of energy per unit charge.

17) Increase voltage reduce current

A step-up transformer increases the voltage across secondary coil. Since the voltage is increased, the current must be reduced to keep the power constant.

18) Replacing split rings by slip rings

19) Electromagnetic Induction

20) Volts

Electromotive force (emf) is a measurement of the energy that causes current to flow through a circuit. It can also be defined as the potential difference in charge between two points in a circuit. Electromotive force is also known as voltage, and it is measured in volts.

21) Slip Rings for A.C and Split rings for D.C

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Chapter 16 – Alternating Current

1) $P = I_{rms} V_{rms}$ Is applicable for
a) AC only b) DC only c) Both a and b d) None of these

2) Power factor of pure capacitive circuit is?
a) -1 b) 0 c) +1 d) 0.5

3) Simple oscillating circuit consists of?
a) Inductor & Capacitor b) Resistance & capacitor
c) Resistance & coil d) Inductor and resistance

4) Wavelength of X-rays is of the order of?
a) Centimeter b) Micron (10^{-6} m) c) Angstrom (10^{-10} m) d) Meter

5) The process of combining low frequency waves with high frequency is called:
a) Rectification b) Amplification c) Modulation d) Magnification

6) An Inductor of 1H is connected across a 220V, 50Hz supply. The peak value of current is approximately:
a) 0.5A b) 0.7A c) 1A d) 1.4A

7) The frequency of AC used in Pakistan is
a) 30c/s b) 50 c/s c) 90c/s d) 180c/s

8) What will be the impedance for V = 10 sin(wt) and I = 20 sin(wt)
a) 200 ohm b) 2 ohm c) 0.5 ohm d) 0.707 ohm

9) Reactance of an Inductor is given by:
a) wL b) 1/wL c) wC d) 1/wC

10) At resonance, the RLC circuit behaves like:
a) Pure Inductive b) Pure Resistive c) Pure Capacitive d) All of these

12) Power factor in an AC circuit is?
a) cos theta b) sin theta c) tan theta d) None of these

13) The angle made by the coil of an AC generator at a time interval 3T/4 is?
a) 2π b) $\pi/2$ c) $3\pi/2$ d) π

14) Resistance of RCL series circuit at resonance is?
a) X_c b) R c) X_l d) $X_l \times R \times X_c$

15) Power of RCL circuit at resonance is?
a) Zero b) Minimum c) Maximum d) None of these

16) In a pure resistive circuit current and voltage are
a) In phase b) Out of phase c) Current leads d) Voltage leads

17) Voltage is _____ current in RC circuit.
a) Leading b) Lagging c) In Phase d) None of these

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18) Which of the following color has the highest energy?
a) Blue b) Green c) Violet d) Yellow

19) Impedance in RLC series circuit is given by
a) $Z = R$
b) $Z = \sqrt{R^2 + (X_L - X_c)^2}$
c) $Z = \sqrt{R^2 - (X_L + X_c)^2}$
d) $Z = \frac{X_L}{X_c}$

20) RLC circuit can be excited by
a) AC b) DC c) Both a and b d) None of these

21) Impedance of a circuit is calculated as:
a) V_{rms}/I_{rms} b) I_{rms}/V_{rms} c) $I_{rms}V_{rms}$ d) V_{rms}/R

22) Power factor of RLC circuit at Resonance is
a) 0 b) 1 c) -1 d) 0.5

23) X-rays have frequency greater than
a) Visible Light b) Ultraviolet c) Microwaves d) All of these

24) Electromagnetic waves are produced due to flow of
a) Negative charge b) Positive charge c) Both a and b d) None of these

Answers of Chapter 16 – Alternating Current

1) Both a and b

2) 0
In pure capacitive circuits the current leads the voltage by 90 degrees.
since PF = cos theta = cos(90) = 0

3) Inductor & Capacitor

4) Angstrom (10^{-10} m)

5) Modulation

6) 0.7A

$$\frac{V}{I} = 2\pi f L$$

$$I = \frac{V}{2\pi f L}$$

$$I = \frac{220}{2(3.14)50(1)} = 0.7A$$

7) 50 c/s

8) 0.5 ohm
Impedance = Z = V(rms) / I(rms)
V(peak) = 10 V(rms) = 10 / sq. root (2)
I(peak) = 20 I(rms) = 20/sq. root (2)

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So, Z = 0.5 ohms

9) wL

10) Pure Resistive

12) cos theta

13) 3π/2

14) R

At resonance, the capacitive and Inductive components cancel the effect of each other, and the circuit behaves as pure resistive circuit.

15) Maximum

$P = V_{rms} I_{rms} \cos(\text{theta})$

cos (theta) = Power Factor

The maximum value Power factor can have is 1. So, power will be maximum when power factor has a value equal to 1. At resonance P.F is 1, so power is maximum.

16) In phase

17) Lagging

18) Violet

The Mnemonic VIBGYOR lists the color of visible spectrum in decreasing order of frequency and energy. VIBGYOR stands for: Violet, Indigo, Blue, Green, Yellow, Orange and Red.

Violet has the maximum energy while red has the least energy.

19) $Z = \sqrt{R^2 + (X_L - X_c)^2}$

Option "a" Z = R gives the Impedance only when the series RLC circuit is at resonance. If the circuit is not at resonance the Impedance must be calculated by: $Z = \sqrt{R^2 + (X_L - X_c)^2}$. Therefore, option b is the correct answer.

20) AC

21) V_{rms}/I_{rms}

Impedance is the ratio of rms value of the applied voltage to the rms value of the resulting current.

$$Z = \frac{V_{rms}}{I_{rms}}$$

22) 1

The Impedance of the RLC circuit at resonance is purely resistive, so the current and voltage are in phase. The power factor is 1

23) All of these

24) Both a and b

Electromagnetic waves are produced as a result of changing electric field which produces changing electric flux. This changing electric flux gives rise to changing magnetic field and the changing magnetic flux. The changing magnetic flux creates electric field, and this process continues.

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Chapter 17 – Physics of Solids

1) If stress is doubled, then volume becomes?
a) Double b) Half c) Four times d) None of these

2) Young modulus for the perfectly rigid body is
a) 1 b) 0 c) Infinity d) 40

3) Semiconductors have conductivity of the order
a) 10^7 b) 10^{-10} to 10^{-20} c) 10^{-6} to 10^{-4} d) None of these

4) Aluminum is a
a) Metal b) Non Metal c) Photo conductor d) Semiconductor

5) Negative strain indicates that
a) Length is increased b) Length is decreased c) Length remains same d) None of these

6) In an extrinsic semi-conductor charge carriers are
a) Holes b) electron c) No charge carriers d) Both a and b

7) Dimension of modulus of elasticity:
a) $[ML^{-1}T^{-2}]$ b) $[ML^{-3}T]$ c) $[ML^{0}T^{1}]$ d) $[M^{-2}L^{-2}T^{-1}]$

8) Which type of current passes through extrinsic semiconductors diode?
a) Unidirectional b) Bidirectional c) Both a and b d) None of these

9) Pascal is equal to:
a) Newton meter squared b) Newton per meter squared
c) Newton per meter cubed d) Newton meter cubed

Answers of Chapter 17 – Physics of Solids

1) Half
Stress applied is inversely proportional to the volume of the body. So, on doubling the stress, volume will be reduced to half.

2) Infinity
Young's modulus as well as the bulk modulus of a perfectly rigid body is infinite.
Young's modulus = longitudinal stress/longitudinal strain.
Since the body is perfectly rigid, on application of pressure the body will not undergo any change in length.
Thus strain = 0, making young's modulus infinite.
Bulk modulus is given by volumetric stress/volumetric strain, and for the same reason, it will also be infinite.

3) 10^{-6} to 10^{-4}

4) Metal

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5) Length is decreased
When ΔL is positive, the object is undergoing tensile strain, which is also referred to as positive strain. This indicates that the length of the object is increased.
When ΔL is negative, the object is undergoing compressive strain, which is also referred to as negative strain. In this case the length of the object is decreased.

6) Both a and b
The doped semi-conductors are known as extrinsic semi-conductors. Both the electrons and holes play their role in electrical conduction.

7) $[ML^{-1}T^{-2}]$
Modulus of Elasticity = Stress / Strain
Since strain is a Dimensionless quantity, the units of modulus of elasticity are the same as that of stress i.e., Nm^{-2}
$Nm^{-2} = kgms^{-2}\ m^{-2} = kg\ m^{-1}\ s^{-2}$
Therefore, the dimensions of modulus of elasticity would be $[M\ L^{-1}\ T^{-2}]$

8) Unidirectional
It is unidirectional, i.e., current flows in only one direction (anode to cathode internally).When a forward voltage is applied, the diode conducts; and when a reverse voltage is applied, there is no conduction. The diode can be considered to be a one-way street i.e., it conducts electricity well in one direction but hardly any in the opposite direction. An ideal diode has no resistance in the forward direction and infinite resistance in the reverse.

9) Newton per meter squared
The pascal is the unit of pressure or stress in the International System of Units (SI). It is named after the scientist Blaise Pascal. One pascal is equivalent to one newton (1 N) of force applied over an area of one meter squared (1 m2). That is, 1 Pa = 1 N · m-2.

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Chapter 18 – Electronics

1) At least how many diodes are required to covert A.C fully into D.C?
a) 1 b) 2 c) 3 d) 4

2) When transistor is forward biased then resistance will be:
a) Nano ohms b) Kilo ohms c) Mega ohms d) Milli ohms

3) A.C is converted to D.C by:
a) Oscillator b) Rectifier c) Amplifier d) DC motor

4) A transistor cannot be used as
a) As a Switch b) As an Amplifier c) As a Power Source d) As an inverter

5) The width of depletion region increases due to:
a) Transistor b) Minority charge carriers
c) Majority charge carriers d) None of these

6) When semi-conductors dopped in ____ then they are p-type:
a) Pentavalent b) Trivalent c) Both a and b d) None of these

7) A type of metals containing alloys, ceramics etc., when heated their temperature reaches to a state called Transition temperature state and their resistance reaches to zero. These types of metals are called:
a) Conductors b) Insulators c) Semi-conductors d) Superconductors

8) If x and y are the input of the GATE, and z is the output, the following table represents:

x	y	z
0	1	1
1	0	1
0	0	1
1	1	0

a) OR GATE b) NAND GATE c) XOR GATE d) None of these

Answers of Chapter 18 – Electronics

1) 4
For a full wave rectification, 4 diodes are connected in a bridge type arrangement.

2) Nano ohms
When the transistor is forward biased it faces very small resistance of the order 10^{-9} ohms i.e., Nano ohms.

3) Rectifier

4) As a Power Source

5) Majority charge carriers

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When p-n junction is reversed biased, the positive terminal of the external battery is connected to n-side of p-n junction and its negative terminal is connected to the p-side. The positive terminal of the external battery attracts the majority carrier electrons from the n-region and its negative terminal attracts the majority carrier holes from p-region. Due to this, the majority charge carriers move away from the junction. This increases the width of the depletion layer.

6) Trivalent

Pentavalent Impurity atoms with 5 valence electrons produce n-type semiconductors by contributing extra electrons. Trivalent Impurity atoms with 3 valence electrons produce p-type semiconductors by producing a "hole" or electron deficiency.

7) Superconductors

In the superconducting state, the material has zero resistance. When the temperature of the material is reduced below the critical temperature, its resistance suddenly reduces to zero. Mercury is an example of a superconductor that shows zero resistance below 4 Degree Kelvin.

8) NAND GATE

If you observe carefully, the output is opposite of AND GATE, which means the given table represents the NAND GATE.

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Chapter 19 – Dawn of Modern Physics

1) The energy equivalent to 0.9 mg is?
a) 9×10^{9}J b) 8.1×10^{13}J c) 8.1×10^{59} J d) None of these

2) The absolute standard of rest is:
a) Earth b) Sun c) Galaxy d) Non- existent

3) Which statement is universally correct?
a) Motion can alter time but not space b) Motion can alter time and space
c) Motion cannot alter both time and space d) None of these

4) Who proposed matter waves?
a) De Broglie b) Einstein c) Stephen hawking d) Lewis

5) Twin paradox is consequence of?
a) Time dilation b) Mass dilation c) Length dilation d) None of these

6) Anti matter theory was proposed by:
a) Einstein b) Bohr c) Dirac d) Planck

7) The stopping potential depends on
a) Intensity of incident light b) Frequency of incident light
c) Both a and b d) None of these

8) Sunlight will emit photo electrons when striking which of the following
a) Plastic b) Water c) Wood d) Metallic object

9) What will be the energy of electron travelling at 10^{7} m/s
a) 283 J b) 2.83 J c) 28.3 J d) None of these

10) Which behaves as a particle as well as wave
a) Electron b) Atom c) Molecule d) All of these

11) Black body radiations were first observed by:
a) Maxwell b) Planks c) Lummer d) None of these

12) Heisenberg uncertainty principle states:
a) Position & Momentum of a particle can be accurately measured simultaneously
b) Position & Momentum of a particle can be accurately measured simultaneously only under certain conditions
c) Position & Velocity of a particle can be accurately measured simultaneously
d) Position & Momentum of a particle cannot be accurately measured simultaneously

13) In Compton's effect the wavelength of the scattered photon is
a) Increased b) Decreased c) Same d) None of these

14) The maximum Compton shift is at
a) 90 degrees b) 0 degrees c) 180 degrees d) 45 degrees

15) In $E = \sigma T^{4}$, E stands for??
a) Electric field b) Energy
c) Energy per unit area d) Energy per second per unit area

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16) A Black body is?
a) Bad absorber b) Ideal absorber c) Ideal radiator d) Both b and c

17) Value of Wien's constant is?
a) 2.9×10^3 K b) 2.9×10^3 K/m c) 2.9×10^3 m K d) 2.9×10^3 m

18) Debroglie wavelength for an electron and proton moving at same speed are L_e and L_p respectively. And frequencies are F_e and F_p respectively. Which of the following is correct.
a) $F_e < F_p$, $L_e > L_p$ b) $L_e < L_p$, $F_p < F_e$ c) $L_e < L_p$, $F_e = F_p$ d) $L_e > L_p$, $F_e > F_p$

19) Mass of a body with speed of light approaches to:
a) Zero b) Infinity c) Remains same d) None of these

20) Scattering of photon by electron is termed as:
a) Photoelectric effect b) Pair production c) Annihilation d) Compton effect

21) In Einstein's theory, the deflection of light is predicted to be exactly _____ as great as it is according to Newton's theory
a) Four times b) Thrice c) One and a half time d) Twice

22) Name the scientist who won the noble prize for discovery of energy quanta
a) Maxwell b) Newton c) Plank d) Einstein

23) What would be Compton Wave shift If X-rays are scattered at an angle of 90 degree?
a) Equal to Compton wavelength b) Zero
c) Maximum d) Minimum

24) If temperature on Kelvin scale is reduced to half, what would be the effect on the energy of radiations?
a) Increase 8 times b) Decrease 8 times c) Increase 16 times d) Decrease 16 times

25) Value of ħ is:
a) 1.05×10^{-34} b) 6.63×10^{-34} c) 2.78×10^{-19} d) None of these

26) Who was awarded Nobel Prize (1921) for explanation of Photoelectric Effect?
a) Einstein a) Planck c) Compton d) Pringshiem

27) Which of the following is correct?
$i)\ E = mc^2$
$ii)\ mc^2 = \dfrac{E_o}{\sqrt{1 - \frac{v^2}{c^2}}}$
a) Only i is correct b) Only ii is correct c) Both are correct d) None of these

28) Black body emits which of the following radiations:
a) Visible light b) Infra-red
c) UV d) All electromagnetic radiations

29) Gamma rays cause photoelectric emission when their energy is
a) Less than 0.5 Mev b) Greater than 0.5 Mev
c) Equal to 0.5 Mev d) None of these

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30) Earth is a/an frame of reference
a) Inertial b) Non-inertial c) Both d) None of these

31) Theory of was Relativity proposed by
a) Karl Heisenberg b) Davisson and Germer
c) Einstein d) Arthur Holly

32) Which of the following color has maximum energy?
a) Green b) Blue c) Red d) Orange

33) Which of the following waves has highest speed?
a) Micro waves b) Gamma Rays c) Infra-red d) All have same speed

34) Which of following has greatest energy
a) Microwave b) Radio waves c) Ultraviolet d) Infrared

35) Presence of Photon was confirmed by
a) Uncertainty principle b) De Broglie
c) Photo electric effect d) Compton effect

36) If Compton shift is half of Compton wavelength, then the scattering angle would be:
a) 60 b) 30 c) 90 d) 120

37) In Heisenberg Principle:
a) Position and Momentum cannot be measured accurately of sub-atomic particles
b) Position and Momentum cannot be measured accurately of electrons
c) Position and Momentum can be measured accurately of electrons
d) Position and Momentum can be measured accurately of sub-atomic particles

Answers of Chapter 19 – Dawn of Modern Physics

1) $8.1 \times 10^{13} J$

$E = mc^2 = 0.9 \times 10^{-3} \times (3 \times 10^8)^2 = 9 \times 10^{-4} \times 9 \times 10^{16} = 81 \times 10^{12} J$

2) Non- existent

There is no absolute standard of rest. All the standards are relative to the others.

3) Motion can alter time and space

4) De Broglie Light is, in short, the most refined form of matter (De-Broglie)

5) Time dilation

In physics, the twin paradox is a thought experiment in special relativity involving identical twins, one of whom makes a journey into space in a high-speed rocket and returns home to find that the twin who remained on Earth has aged more.

6) Dirac

7) Both

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8) Metallic object

9) None of these

$$E = \frac{1}{2}mv^2 = \frac{1}{2} \times 9.1 \times 10^{-31} \times (10^7)^2 = \frac{1}{2} \times 9.1 \times 10^{-31} \times 10^{14} = 4.55 \times 10^{-17}$$

10) Electron

11) Lummer

12) Position & Momentum of a particle cannot be accurately measured simultaneously

13) Increased

14) 180 degrees

$$\Delta\lambda = \frac{h}{m_o c}(1 - cos\theta)$$

For angle = 180, cos = -1 , so the Compton shift will be:

$$\Delta\lambda = \frac{2h}{m_o c}$$

15) Energy per second per unit area

16) Both b and c

17) 2.9×10^3 m K

18) Fe < Fp , Le > Lp

Formula of De-Broglie wavelength = h/mv

Wavelength is inversely proportional to mass. Since mass of electron is less than proton, Le will be larger than Lp. Also, wavelength is inversely proportional to frequency. So frequency of protons will be larger.

19) Infinity

20) Compton effect

21) Twice

22) Plank

23) Equal to Compton wavelength

$$\Delta\lambda = \frac{h}{m_o c}(1 - cos\theta)$$

$$For\ \theta = 90$$

$$\Delta\lambda = \frac{h}{m_o c}(1 - 0) = \frac{h}{m_o c} = Compton\ Wavelength$$

24) Decrease 16 times

$$E = \sigma T^4$$

$$T' = \frac{T}{2}$$

$$so, E' = \sigma T'^4 = \sigma \left(\frac{T}{2}\right)^4 = \frac{1}{16}\sigma T^4 = \frac{E}{16}$$

25) 1.05×10^{-34}

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26) Einstein

27) Both are correct

The first equation is the Energy-Mass relation according to the special theory of relativity. The second equation is an extension of equation of Mass variation.

$$m = \frac{m_o}{\sqrt{1 - \frac{v^2}{c^2}}}$$

Multiplying both sides by c^2, we get:

$$mc^2 = \frac{m_o c^2}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{E_o}{\sqrt{1 - \frac{v^2}{c^2}}}$$

28) All electromagnetic radiations

Black body emits radiations of different wavelengths. The radiations emitted depend on the temperature. At lower temperatures, the proportion of radiations with longer wavelength is higher. Likewise, at higher temperatures, the proportion of radiations with shorter wavelength is higher.

29) Less than 0.5 Mev

Following is the summary of occurrence of different processes depending on the energy of Gamma rays:

E < 0.5 Mev	Photoelectric Effect
0.5 Mev < E < 1.02 Mev	Compton Effect
E > 1.02 Mev	Pair Production

30) Inertial

Earth is an inertial frame of reference because the laws of Inertia are valid on it.

31) Einstein Einstein proposed the special theory of relativity in 1905

32) Blue

The mnemonic VIBGYOR lists the colors of visible light in order of decreasing energy.
VIBGYOR stands for Violet, Indigo, Blue, Green, Yellow, Orange and Red.
In this order Violet has the maximum energy and Red has the least energy. From the given options we can see that Blue occurs first and has more energy.

33) All have same speed

Speed of all the electromagnetic radiations is the same. They do have different wavelengths and frequency, but the speed is the same i.e., equal to speed of light.

34) Ultraviolet

The order of waves of Electromagnetic spectrum in increasing order of energy is:
Radio waves < Microwaves < Infrared < Visible < Ultraviolet < X rays < Gamma Rays

35) Photo electric effect

Photoelectric effect can only be explained by assuming light consists of corpuscles of energy known as photons. Thus, this proves the presence of photons.

36) 60

The formula to calculate Compton Shift is:

$$\Delta\lambda = \frac{h}{m_o c}(1 - \cos\theta)$$

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Here, $\frac{h}{m_o c}$ is the Compton wavelength. Let us rename it as $\Delta\lambda_c$

$$\Delta\lambda = \Delta\lambda_c(1 - \cos\theta) \qquad \text{Equation 1}$$

Compton shift ($\Delta\lambda$) is half of Compton wavelength ($\Delta\lambda_c$). This can be written as:

$$\Delta\lambda = \frac{1}{2}\Delta\lambda_c$$

Substituting the value of $\Delta\lambda$ in Equation 1, we get:

$$\frac{1}{2}\Delta\lambda_c = \Delta\lambda_c(1 - \cos\theta)$$

$$\frac{1}{2} = 1 - \cos\theta$$

$$\cos\theta = 1 - \frac{1}{2} = \frac{1}{2}$$

$$\theta = \cos^{-1}\left(\frac{1}{2}\right) = 60°$$

37) Position and Momentum cannot be measured accurately of sub-atomic particles

The Heisenberg uncertainty principle states that it is impossible to simultaneously measure the x-components of position and of momentum of a particle with an arbitrarily high precision. This principle is significant for subatomic particles (i.e., electron, proton, neutron) not specifically for electrons.

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Chapter 20 – Atomic Spectra

1) The wavelength of X-rays is:
a) 10^{-10} b) 10^{-8} c) 10^{-4} d) 10^{-12}

2) If an electron undergoes transition from 4th to 2nd orbit, then the color of radiations produced will be:
a) Violet b) Blue-Green c) Ultraviolet d) Red

3) Laser light is
a) Monochromatic b) Intense c) Coherent d) All of these

4) Which series is emitted when electron jumps from a higher orbit to fifth orbit?
a) Lyman b) Balmer c) Pfund d) Brackett

5) Total energy of an electron in hydrogen atom when it jumps to higher orbit from a lower orbit is
a) Less negative b) More positive c) Less positive d) Remains same

6) In hydrogen spectrum, Lyman and Balmer series belong to which region?
a) Lyman = Visible, Balmer = Ultraviolet b) Lyman = Ultraviolet, Balmer = Visible
c) Lyman = Infrared, Balmer = Ultraviolet d) None of these

7) Radiations emitted by human body lie in which of the following series?
a) Bracket b) Pfund c) Paschen d) None of these

8) When an electron jumps from outer to 5th orbit, then the spectral lines fall into _____ region.
a) Lyman b) Balmer c) Pfund d) None of these

9) If an electron jumps from 6th orbit to 7th orbit, the increase in radius will be:
a) 90% b) 25% c) 33% d) 17%

10) In hydrogen spectrum if n_l = 6, then the spectral lines lie in:
a) Balmer Series b) Paschen Series c) Pfund Series d) Humphreys series

11) The ionization energy of hydrogen is:
a) 13.6 eV b) 13.6 J c) 14 J d) 13.6 meV

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Answers of Chapter 20 – Atomic Spectra

1) 10^{-10}

2) Blue-Green

Transition of n	3→2	4→2	5→2	6→2	7→2	8→2	9→2	∞→2
Wavelength (nm)	656.3	486.1	434.1	410.2	397.0	388.9	383.5	364.6
Colour	Red	Blue-green	Violet	Violet	(Ultraviolet)	(Ultraviolet)	(Ultraviolet)	(Ultraviolet)

3) All of these

4) Pfund

5) Less negative

According to the Bohr's Model, the energy of an electron can be given as:

$$E_n = -\frac{1}{n^2}\left(\frac{2\pi^2 k^2 m e^4}{h^2}\right) = -\frac{E_o}{n^2}$$

From the above equation we can see that value of E_n is inversely related to n^2. This means if the value of n is increased, the value of energy will be smaller in magnitude. So, if an electron will jump to a higher orbit (larger n), its energy will be less negative as compared to its energy in lower orbit.

6) Lyman = Ultraviolet, Balmer = Visible

7) Paschen

Human bodies emit infra-red radiations. Paschen series lies in the infra-red region. Therefore, the radiations emitted by human body are in Paschen series.

8) Pfund

The emission spectrum of atomic hydrogen has been divided into a number of spectral series, with wavelengths given by the Rydberg formula. These observed spectral lines are due to the electron making transitions between two energy levels in an atom.

Series include:

Lyman series (n =1) : When an electron jumps from higher orbits to 1st orbit.
Balmer series (n =2) : When an electron jumps from higher orbits to 2nd orbit.
Paschen series (n =3) : When an electron jumps from higher orbits to 3rd orbit.
Brackett series (n = 4) : When an electron jumps from higher orbits to 4th orbit.
Pfund series (n = 5) : When an electron jumps from higher orbits to 5th orbit.
Humphrey's series (n = 6) : When an electron jumps from higher orbits to 6th orbit.

9) 33%

The radius of nth orbit in an atom is given as:

$$r_n = \left(\frac{\epsilon_o h^2}{\pi m e^2}\right) n^2$$

For any given atom, the parameters inside the brackets are constant. Let's name this constant as C. "n" represents the number of orbit an electron is resolving in. So, for 6th orbit n = 6 and for 7th orbit n = 7.

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Radius of 6th orbit will be given as:

$r_6 = C(6)^2 = 36C$

Radius of 7th orbit will be given as:

$r_7 = C(7)^2 = 49C$

The formula to calculate the percentage difference is:

$$\frac{New\ Value - Original\ Value}{Original\ Value} \times 100\%$$

Since, electron jumps from 6th orbit to 7th orbit, 36C will be the original value and 49C will be the new value. Substituting these values in above equation gives us:

$$Percentage\ Difference = \frac{49C - 36C}{36C} \times 100\%$$

$$= \frac{13C}{36C} \times 100\%$$

$$= \frac{13}{36} \times 100\%$$

$$\approx \frac{1}{3} \times 100\% = 0.33 \times 100\% = 33\%$$

This means if an electron jumps from 6th orbit to 7th orbit, the approximate change in radius will be 33%.

Shortcut Formula:

If an electron jumps from orbit number n_1 to orbit number n_2, then the percentage difference in the radius will be given as:

$$Percentage\ Difference = \frac{(n_2)^2 - (n_1)^2}{(n_1)^2} \times 100\%$$

For the given question n_1 is 6 and n_2 is 7. Using these values, we get the same result we obtained in previous method.

10) Humphreys series

The energy differences between levels in the Bohr model, and hence the wavelengths of emitted/absorbed photons, is given by the Rydberg formula:

$$\frac{1}{\lambda} = R_H^2\left(\frac{1}{n_l^2} - \frac{1}{n_h^2}\right)$$

n_l is the lower energy level $\qquad$ n_h is the higher energy level

For:

Lyman series (n_l = 1)
Paschen series (n_l = 3)
Pfund series (n_l = 5)
Balmer series (n_l = 2)
Brackett series (n_l = 4)
Humphrey's series (n_l = 6)

11) 13.6 eV

ionization energy is the minimum amount of energy required to remove the most loosely bound electron of an isolated neutral gaseous atom or molecule. Ionization energy of hydrogen is 2.18×10^{-18} J or 13.6 eV.

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Chapter 21 – Nuclear Physics

1) Muon has charge of?
a) -1e b) 1e c) 0.5e d) None of these

2) Which of the following consist of two quarks?
a) Leptons b) Baryon c) Meson d) None of these

3) Which of the following affects our eye?
a) Neutrons b) Alpha rays c) Gamma rays d) Laser
e) All of these

4) Which of the following has highest ionizing power and least penetrating power?
a) Alpha b) Beta c) Gamma d) Both a and c

5) Which can damage eye?
a) X-rays b) Gamma rays c) Laser d) All of these

6) Radiation cause damage in
a) Cell b) Skin c) Hair d) All of above

7) Which of the following has greater speed in space?
a) Gamma rays b) Light c) Radio waves d) All of these

8) Which of the following will be absorbed by the paper?
a) Alpha particle b) Beta particle c) Gamma rays d) X rays

9) How many quarks neutron and proton is made up of?
a) 1 b) 2 c) 3 d) 4

10) Meson consists of:
a) One quark and one anti-quark
b) One quark and two anti-quarks
c) Two quarks and one anti-quark
d) Two quarks and two anti-quarks

11) Charge on an up-quark is:
a) 2/3 e b) 1/3 e c) -2/3 e d) -1/3 e

12) Which gas is not used in GM counter?
a) Argon b) Neon c) Hydrogen d) Helium

13) Which of the following is not true about radioactivity?
a) Is a nuclear phenomenon
b) Is not altered by any physical change
c) Is not altered by any chemical change
d) Is a property relating to outside the nucleus.

14) How many neutrons are released during fusion of two deuterons?
a) 0 b) 1 c) 2 d) 3

15) Which of the following have low ionization and high penetrating power?
a) Alpha particles b) Beta particles c) Gamma particles d) None of these

16) A nucleus weighs less than its sum of nucleons, a quantity known as the
a) Mass defect b) Binding energy c) Packing fraction d) All of these

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17) Transmutation occurs when _____ rays are given out:
a) Alpha b) Beta c) Gamma d) All of these

18) In heavy nuclei the number of neutrons is _____ than protons
a) Equal b) Greater c) Lesser d) Either a or c

19) Disintegration of a radioactive element is
a) Periodic b) Random
c) Dependent on its atomic number d) None of these

20) In which of the following the pn junction is used?
a) Wilson cloud chamber b) GM tube
c) Solid state detector d) None of these

21) Energy of fast moving neutron is?
a) 1 KeV b) 0.5 KeV c) 0.02 KeV d) 0.01 KeV

22) Alpha particle has
a) Less ionization and High Penetration b) High ionization and Less Penetration
c) High ionization and High Penetration d) Less ionization and Less Penetration

23) Penetration power of gamma rays as compared to alpha rays is
a) Greater b) Less c) Equal d) Either a or c

24) Which of the following radiation detector operates under Reverse Bias?
a) GM counter b) Wilson Cloud Chamber
c) Solid state detector d) Both a and c

25) What is correct about alpha and x rays?
a) Both produce ionization b) Both are deflected by Magnetic field
c) Both are deflected by Electric field d) All of these

26) Which one of these is used in the treatment of Cancer?
a) Helium b) Xenon c) Krypton d) Cobalt

27) There are ___ leptons.
a) 3 b) 4 c) 5 d) 6

28) What's relation between penetrating power and ionization power
a) Inverse b) Direct
c) Depends on radiation d) None of these

29) Human body emits which of the following radiation?
a) X-rays b) Ultraviolet c) Infrared d) Gamma rays

30) Nuclear fission reaction takes place in controlled conditions by the use of
a) Moderators b) Control rod c) Protons d) Heavy water

31) The half-life of iodine is
a) 8 days b) 8 hours c) 15 days d) 15 hours

32) Which of the following can cause least Ionization but has high penetrating power?
a) Alpha b) Beta c) Gamma d) None of these

33) Which of the following gives the correct expression of Decay Constant?

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a) $\lambda T_{1/2} = 0.693$ b) $\frac{\lambda}{T_{1/2}} = 0.693$ c) $\frac{T_{1/2}}{\lambda} = 0.693$ d) None of these

34) If half-life of an element is 4 minutes, then 3/4th of it is decayed in:
a) 4 min b) 6 min c) 8 min d) 10 min

Answers of Chapter 21 – Nuclear Physics

1) -1e

2) None of these
Meson consists of one quark and one antiquark. Baryon is made up of three quarks.

3) All of these
All the given radiations can damage eye tissues under certain conditions.

4) Alpha 5) All of these 6) All of above 7) All of these

8) Alpha particle
Due to low penetration power and ionization power, alpha particles are easily absorbed by paper.

9) 3 Protons are made of 2 Up and 1 Down quark. The neutron is made of 2 Down and 1 Up quark.

10) One quark and one anti-quark 11) 2/3 e

12) Hydrogen
The gas of a Geiger Mueller detector consists of two components: a fill gas and a quench gas. The fill gas is usually neon, but other gases are sometimes used, e.g., helium, argon, or krypton. There are two main types of quench gas: halogen quench gases and organic quench gases Chlorine is the most common halogen quench gas, but bromine is also used. Although the textbooks usually mention alcohol as an example of an organic quench gas, isobutane is far more common. A halogen quenching agent is used if the fill gas is neon, argon, or krypton, while helium filled tubes usually employ an organic quench gas.

13) Is a property relating to outside the nucleus.

14) 1 The reaction equation is: $^{2}_{1}H + ^{2}_{1}H \rightarrow ^{3}_{2}He + ^{1}_{0}n + Energy$

15) Gamma particles 16) Mass defect 17) All of these

18) Greater
The number of protons and neutrons in the initial light elements of the periodic table is almost equal but in the later heavy elements the number of neutrons is greater than the number of protons. The larger number of neutrons are vital for the stability of the nucleus else due to the electrostatic repulsion between protons the nucleus would have been very unstable.

19) Random Radioactivity is a random process and is not affected by physical or chemical change.

20) Solid state detector

21) 1 KeV
Neutrons whose kinetic energy is above about 1 KeV are generally classified as fast neutrons.

22) High Ionization and Less Penetration
Compared to beta and gamma rays, alpha rays have higher ionization power while lesser penetration power.

23) Greater

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Gamma rays have higher penetration power compared to both alpha and beta rays. The order of penetration power is: Alpha < Beta < Gamma

24) Solid state detector

25) Both produce Ionization

Both alpha rays and x-rays can produce ionization. X-rays do not carry any charge and are not affected by Electric and Magnetic fields. Therefore, option "a" is the correct answer only.

26) Cobalt Radiotherapy with x-rays from Cobalt-60 is often used in the treatment of cancer.

27) 6

Leptons are the particles that do not experience strong nuclear force. There are 6 types of leptons: electron, electron neutrino, muon, muon neutrino, tau, tau neutrino

28) Inverse

There is an inverse relation between penetration power and the ionization power. Considering the example of alpha, beta and gamma rays, alpha rays have highest ionization power and least penetration power. Likewise, gamma rays have least ionization power and highest penetration power. This shows that there is an inverse relation between the two.

29) Infrared

30) Control rod

Cadmium Control rods are inserted into the nuclear reactor to absorb the excess neutrons and control the fission reaction.

31) 8 days

Iodine – 131 is a radioisotope with a very short half-life of 8.02 days, making it highly radioactive.

32) Gamma

Gamma rays have huge penetration power and require several inches of dense material (like lead) to shield them. Gamma rays may pass all the way through a human body without striking anything. They are considered to have the least ionizing power(because they carry no charge) and the greatest penetration power.

33) $\lambda T_{1/2} = 0.693$

The time required for half of the original population of radioactive atoms to decay is called the half-life. The relationship between the half-life, $T_{1/2}$, and the decay constant is given by: $T_{1/2} = \frac{0.693}{\lambda}$

34) 8 min

Half-life of any radioactive element is the time required for the quantity of that element to fall to half of its initial value. So, after one half-life, we will have 1/2 or 50% of the element remaining, as 50% will be decayed. And after 2 half-lives, we will have 1/4 or 25% of the substance remaining. In other words, 3/4 of the element will be decayed in 2 half-lives. As one half-life is 4 minutes, the $3/4^{th}$ of the element will be decayed in 2 half-lives i.e., 8 minutes.

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Miscellaneous Questions

1) 1m = _____ inches
a) 12 b) 24 c) 36 d) 39

2) Value of acceleration due to gravity on mars?
a) 3.72 b) 4.92 c) 9.84 d) 3.53

3) Which is most sensitive to human eye?
a) Red b) Blue c) Green d) Yellow

4) A red colored cloth _____ red light
a) Transmit b) Reflect c) Refract d) Absorbs

5) Which is evaporating cooler?
a) Air conditioner b) Desert cooler c) Room cooler d) Projector

6) Which of the following has greater wavelength than red light?
a) Infrared b) X-rays c) UV d) Gamma rays

7) Which material is used as common conductor in daily use?
a) Copper b) Aluminium c) Steel d) Nickle

8) In modern day electrical arrangements, which of the following is connected in series with the others?
a) Fan b) Bulb c) Tube Lights d) None of these

9) The time duration between two consecutive heartbeats of a normal human being is
a) 8×10^{-1} s b) 1s c) 10^{-1} s d) 0.5s

10) Forces in nature always occur in
a) Triplet b) Quadrupled c) Isolation d) Pair

11) In hot day white clothes are worn because they are good
a) Absorbers b) Emitters c) Reflectors d) None of these

12) What happens to bulk of potential energy of a glass that falls from a table and breaks
a) Converted into kinetic energy b) Wasted in air
c) Converted into sound d) Consumed in breaking of glass

13) 1 pascal = _____ atm
a) $9.87\ 10^{-6}$ b) 0.00075 c) 101325 d) None of these

14) Alpha scattering experiment was conducted in which year?
a) 1908 b) 1922 c) 1925 d) 1911

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15) Center of gravity of a cup lies?
a) At the handle of cup
b) Outside cup
c) In space inside the cup
d) On the surface of cup

Answers of Miscellaneous Questions

1) 39

2) 3.72

$$mg = \frac{GM_{planet}\, m}{r_{planet}^2}$$

$$g = \frac{GM_{planet}}{r_{planet}^2}$$

$G = 6.67384 \times 10^{-11} m^3 kg^{-1} s^{-2} = 6.67384 \times 10^{-11} Nm^2 kg^{-2}$

$M_{planet} = M_{Mars} = 6.4185 \times 10^{23} kg$

r = mean radius of Mars = $3389920m$

We get:

$g = 3.72761 ms^{-2}$

3) Green

4) Reflect

A red colored cloth reflects the red color and absorbs the other colors. The reflected color (red) enters our eyes and we are able to detect the red object.

5) Desert cooler

6) Infrared

7) Copper

8) None of these

All appliances are connected in parallel, so that in case fault in one device, others are not affected.

9) 8×10^{-1} s

10) Pair

11) Reflectors

12) Consumed in breaking of glass

13) $9.87\ 10^{-6}$

14) 1911

In 1911 Rutherford studied the scattering of high-speed alpha particles emitted from a radioactive metal.

15) In space inside the cup

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Past Paper Questions from Chemistry Portion of NETs

The number of Chemistry questions in NETs out of 200 are:

- NET Engineering and Computer Science: 30 MCQs
- NET Medical (Applied Bio Sciences) : 60 MCQs
- NET BS Chemistry : 170 MCQs

No Chemistry questions are added in the test of the rest of the fields.

The Questions in the chemistry portion are from both Fsc 1st year and Fsc 2nd year. So every chapter must be prepared. However, some chapters are more important than the rest and these important chapters must be prepared well. List of important chapters for chemistry are:

FSc First Year:

- Chapter 1 – Basic Concepts
- Chapter 4 – Liquids and Solids
- Chapter 6 – Chemical Bonding
- Chapter 8 – Chemical Equilibrium

FSc Second Year:

- Chapter 3 – Group IIIA and IVA Elements
- Chapter 5 – Halogens and Noble Gases
- Chapter 8 – Aliphatic Hydrocarbons
- Chapter 11 – Alcohols, Phenols and Ether
- Chapter 13 – Carboxylic Acids

The following pages contain the Chemistry Questions from Past Papers of NUST (2013 Onwards) along with their answers and solutions.

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MCQs from 1st Year Chemistry

Chapter 1 – Basic Concepts

1) To find the number of molecules in a given compound which of the following is employed?
a) Chromatography
b) Le-Chatelier's principle
c) Kc
d) None of these

2) What is the percentage by mass of Nitrogen in $NH_4(NO_3)$?
a) 40%
b) 50%
c) 35%
d) 30%

3) Mass spectrometer can be used to find:
a) Mass of atom
b) Mass of ion
c) Charge to mass ratio of atom
d) Charge to mass ratio of ion

4) 4 gram atoms of carbon has a mass of:
a) 12
b) 24
c) 48
d) 56

5) 0.5 mole of SO_2 contains _____ gram of oxygen?
a) 32
b) 12
c) 16
d) None of these

6) In combustion analysis method CO_2 is absorbed by?
a) $Mg(OH)_2$
b) KOH
c) $Mg(ClO_4)_2$
d) None of these

7) 1 amu is?
a) 1.66×10^{-27} kg
b) 1.602×10^{-27} kg
c) 1.66×10^{-31} kg
d) None of these

8) Mass of a neutron in amu is?
a) 1.008386
b) 1.007376
c) 0.0005
d) None of these

9) Mass spectrometer is used to determine which of the following quantity?
a) Atomic mases
b) Atomic number
c) Both a and b
d) None of these

10) Chemical properties of an atom depends upon number of
a) Electrons
b) Neutrons
c) Protons
d) Nucleons

11) One mole of Oxygen has _____ number of atoms as compared to one mole of Nitrogen.
a) Equal
b) Half
c) Double
d) Quarter

12) In mass spectrometry, ionization occurs in _____ form.
a) Solid
b) Liquid
c) Vapor
d) No ionization occurs during the process.

13) Physical and chemical properties of an element depend upon
a) Atomic mass only
b) Atomic number only
c) Atomic mass and atomic number respectively
d) Atomic number and atomic mass respectively

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14) Which one of the following has no isotope?
a) Hydrogen b) Helium c) Nitrogen d) None of these

15) Molecular formula = n (Empirical formula). What does "n" represents in this formula?
a) Molecular number b) Integer c) Odd number d) Sum of 2 numbers

16) If you need to produce carbon dioxide from 12 grams of carbon, how many grams of oxygen would you need?
a) 32 b) 4 c) 16 d) 8

17) What will be the mass in grams of 12 gram atom of carbon atoms?
a) 12.66×10^{-24} b) 1.66×10^{-24} c) 1.992×10^{-23} d) 2.660×10^{-23}

18) Which of the following molecule is expressed in empirical formula:
a) $C_6H_{12}O_6$ b) C_6H_6 c) $Na_2S_4O_6$ d) C_2H_5

19) How many moles of SO2 contain 16 grams of oxygen?
a) 0.5 b) 1 c) 2 d) 2.4

20) Which of the following represents Empirical Formula of Glucose?
a) CH_2O b) CHO c) C_2HO d) CHO_2

21) Actual yield is always _____ experimental yield.
a) Less than b) More than c) Same as d) None of the above

22) What is the mass of 10^{-3} moles of $MgSO_4$?
a) 120 grams b) 12 grams c) 1.2 grams d) 0.12 gram

Answers of Chapter 1 – Basic Concepts

1) None of these
None of the given methods can be used to find the number of molecules of a compound. Chromatography is used for the separation of components of a mixture, Le-Chatelier's principle is used to study the effects of concentration, pressure, and temperature on equilibrium of a reaction. Kc is the equilibrium constant.

2) 35%
Molecular mass of $NH_4(NO_3)$ = 2(Nitrogen Mass) + 4(Hydrogen Mass) + 3(Oxygen Mass)
Molecular mass of $NH_4(NO_3)$ = 28 + 4 + 48 = 80
Mass of Nitrogen in $NH_4(NO_3)$ = 14 + 14 = 28
Percentage of an element in a compound = Mass of element in that compound/Total Mass of compound x 100%
So, percentage of Nitrogen by mass in $NH_4(NO_3)$ = 28/80 x 100 = 35%

3) Charge to mass ratio of Ion
When the ions fall on an electrometer, their m/e value can be determined by using the values of H, r and E. Here, option c: "charge to mass ratio of atom" is not the correct choice because the atoms are converted into ions at the very first stage of spectrometry. So, what we can calculate is "Charge to Mass ratio of ion"

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4) 48

4 gram atoms means 4 moles.

Mass of 1 mole of Carbon = 12.

So, Mass of 4 moles of Carbon = 48

5) 16

Mass of oxygen in 1 mole of SO_2 = 32 grams

Dividing both sides by 2 gives us:

Mass of oxygen in 1/2 (Or 0.5) moles of SO_2 = 32/2 = 16 grams

6) KOH

During combustion analysis, H_2O is absorbed in $Mg(ClO_4)_2$ and CO_2 is absorbed in 50% KOH.

7) 1.66×10^{-27} kg

Atomic mass unit is always 1.66×10^{-27} kg

8) 1.008386

Mass of proton = 1.0073 amu Mass of neutron = 1.0087 amu Mass of electron = 5.486×10^{-4}amu

9) Atomic mases

Mass spectrometer is an instrument which is used to measure the exact masses of different isotopes of an element.

10) Electrons

Chemical properties of an element depend on the number and the configuration of their (valence) electrons. Elements with same number of valence electrons have similar chemical properties.

11) Equal

A mole is defined as the amount(mass) of a substance that contains 6.022×10^{23} number of particles (atoms, molecules, or formula units). Since we have 1 mole of both gases, the number of atoms in them will be the same.

12) Vapor form

Ionization will convert them into vapors.

13) Atomic mass and atomic number respectively

Physical properties of an element depend upon the number of nucleons (atomic mass) and chemical properties depend upon the number of electrons. Since number of electrons is the same as the number of protons (atomic number), so we can say that chemical properties depend on atomic mass.

14) None of these

All of the listed elements have isotopes. Hydrogen has 3 isotopes, Helium has 7 isotopes and Nitrogen has 2 isotopes.

15) Integer

16) 32

The balanced chemical equation for the reaction between Carbon and Oxygen is:

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$C + O_2 \rightarrow CO_2$

1 mole of Carbon needs 1 mole of Oxygen to produce 1 mole of Carbon Dioxide.

1 mole of Carbon = 12 grams, and 1 mole of Oxygen = 32 grams

So, we can write:

1 mole of Carbon (12 grams) needs 1 mole of oxygen (32 grams) to produce 1 mole of Carbon Dioxide. Therefore, the answer to this question is 32 grams.

17) 1.992×10^{-23}

From the basic definition of amu, we know that 1 amu is the mass of 1/12th of mass of 1 Carbon atom.

$1\ amu = \frac{1}{12}$ of Mass of 1 Carbon Atom

Multiplying both sides by 12, we get:

12 amu = Mass of 1 Carbon atom or Mass of 1 carbon atom = 12 amu

So, Mass of 1 carbon atom = $12 \times 1.66 \times 10^{-24} = 1.992 \times 10^{-23}$

18) C_2H_5

Except option "d", all the given choices are molecular formula which can be reduced to the empirical formula.

19) 0.5

1 mole of SO2 contains 2 oxygen atoms. Mass of each oxygen atom is 16 grams. This means:

Amount of oxygen in 1 mole of SO2 = 32 grams

Dividing both sides by 2 gives us:

Amount of oxygen in (1/2) mole of SO2 = (32/2) grams

Amount of oxygen in 0.5 mole of SO2 = 16 grams

Thus, 16 grams of oxygen is present in 0.5 moles of SO2

20) CH_2O

An empirical formula is a formula that shows the elements in a compound in their lowest whole-number ratio. Glucose is an important simple sugar with molecular formula $C_6H_{12}O_6$. Since each of the subscripts is divisible by 6, the empirical formula for glucose is CH_2O.

21) Less than

Actual yield is always less than the experimental or theoretical yield as not all reactants react to give the desired amount of product or some product may be lost during the experiment.

22) 0.12 gram

Molar Mass of Magnesium = 24 Molar Mass of Sulfur = 32 Molar Mass of Oxygen = 16

So, mass of 1 mole of $MgSO_4$ = 24 + 32 + 4(16) = 120 grams

Mass of 10^{-3} moles of $MgSO_4$ would be = 120×10^{-3} grams = 0.12 gram

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Chapter 2 – Experimental Techniques in Chemistry

1) Water and mercury can be separated by:
a) Evaporation b) Sublimation c) Filtration d) Solvent extraction

2) How will you separate water and kerosene oil?
a) Distillation b) Filtration c) Sublimation d) Crystallization

3) If the distribution co-efficient is small then the solute will:
a) Distribute itself equally b) Flow down the mobile phase
c) Remain in mobile phase d) Remain in stationary phase

4) The rate of filtration can be considerably increased by using
a) Fluted filter paper b) Suction flask c) Stirrer d) None of these

5) _____ is the process of transition of a substance directly from the solid to the gas phase without passing through the intermediate liquid phase.
a) Vaporization b) Evaporation c) Sublimation d) None of these

6) Which of the following is the safest way to dry crystals during crystallization?
a) Pressing between folds of paper b) Boiling
c) Cooling d) Vacuum desiccator

7) If during crystallization more solute could not be dissolved in the solution, the solution is:
a) Saturated solution b) Dilute solution
c) Concentrated solution d) None of these

8) Which of the following can be employed instead of filter papers?
a) Gooch Crucible b) Sintered Glass Crucible
c) Both a and b d) None of these

9) Slow cooling yields crystals of _____ length?
a) Medium sized b) Small c) Bigger d) None of these

10) Which of the following will be separated by filtration?
a) Salt and water b) Sugar and water c) Alcohol and water d) None of these

11) The process of changing a solid directly into gas upon heating is known as:
a) Sublimation b) Liquefaction c) Condensation d) None of these

12) Filtration process could be very time consuming if it is not aided by a gentle suction which is developed:
a) If the paper covers the funnel up to its circumference
b) If the paper has got small sized pores in it.
c) If the stem of the funnel is large so that it dips into the filtrate
d) If the paper fits tightly all around the upper circumference of the funnel

13) A residue is obtained in which of the following methods?
a) Crystallization b) Filtration c) Condensation d) Decantation

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Answers of Chapter 2 – Experimental Techniques in Chemistry

1) Evaporation

Mercury boils at a much higher temperature than water, and water is much more volatile than mercury, so water will simply evaporate much faster than will mercury, leaving behind the mercury.

2) Distillation

Mixture of water and Kerosene oil can be separated via distillation, water has a lower boiling point and will evaporate early. Kerosene oil will evaporate at higher temperature. The liquids can be obtained by collecting the vapors and condensing them.

3) Remain in stationary phase

The component of a mixture with small value of K(distribution co-efficient) mostly remains in the stationary phase as the moving phase flows over it. The component with a larger value of K dissolves in the mobile phase and passes over the stationary phase.

4) Suction flask

All of the given options can be used to increase the rate of filtration, but since we are to choose one option and the question statement asks which one of these increases the rate considerably so we are to select the option which will maximize the rate. Therefore, suction flask would be the correct answer as it increases the filtration rate more than the other two given choices.

5) Sublimation

6) Vacuum desiccator

The safest and reliable method of drying crystals is through a vacuum desiccator. Option "a" is not the safest as because of pressing the crystals are crushed to a fine powder.

7) Saturated solution

Saturated means you cannot add more. So, this solution will be a saturated solution.

8) Both a and b

Gooch Crucible and Sintered Class Crucible both are the filtration devices.

9) Bigger

Slow cooling yields bigger crystals which are likely to include considerable amount of solvent carrying impurities with it.

10) None of these

Filtration is used to separate insoluble particles from liquids. All three salt, sugar and alcohol get dissolved in water and hence cannot be separated by filtration.

11) Sublimation

12) If the paper fits tightly all around the upper circumference of the funnel

13) Filtration

During the process of filtration, the insoluble solid left on the filter paper is called residue while the liquid which passes through the filter paper is called filtrate.

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Chapter 3 – Gases

1) 2 gasses at STP, with equal volume and equal pressure will have same
a) K.E
b) Mass
c) Number of molecules
d) Weight

2) Which of the following is constant during an isothermal process?
a) Volume
b) Pressure
c) Temperature
d) Both b and c

3) According to Charles Law, when temperature is reduced to half the volume will be
a) Doubled
b) Half
c) Quarter
d) Same as original

4) Gases behave ideal at
a) Low pressure and High temperature
b) High temperature and Low pressure
c) Low pressure and Low temperature
d) High temperature and High pressure

5) Statement of Graham's Law is
a) The rate of diffusion is directly proportional to the square root of its density
b) The rate of diffusion is inversely proportional to the square of its density
c) The rate of diffusion is inversely proportional to its density.
d) The rate of diffusion is inversely proportional to the square root of its density

6) Real gases deviate significantly from ideal gas behavior at
a) Low temperature and high pressure
b) High temperature and low pressure
c) Both a and b
d) None of these

7) Liquid crystals are used for:
a) Making LCD
b) Optical Imaging
c) Making thermometers
d) All of these

8) Excluded volume is not equal to the actual volume of gas molecules and is represented by:
a) b
b) x
c) n
d) a

9) All the gasses at 212.44 cm^3 have
a) Same mass
b) Different mass
c) Can't be predicted
d) None of these

10) Statement of Charles Law:
a) V is directly proportional to P
b) P is inversely proportional to V
c) V is directly proportional to T
d) All of these

11) Choose the correct equation:
a) $(P + n^2a/v^2)(v - nb) = nRT$
b) $(P - n^2a/v^2)(v + nb) = nRT$
c) $PV = NRT$
d) All of these

12) The Vander Waal's constant 'b' of a gas is four times the:
a) Actual volume
b) Free volume
c) Volume of vessel
d) Volume

13) 1 atmospheric pressure is equal to
a) 1 kg/cm^2
b) 1.033 kg/cm^2
c) 1.1 kg/cm^2
d) 1.133 kg/cm^2

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14) When gases expand, this causes:
a) Cooling b) Heating c) Remain constant d) None of these

15) Gases can be converted into liquid by:
a) Increasing temperature and decreasing pressure
b) Decreasing temperature and increasing pressure
c) Same temperature and pressure
d) Increasing pressure and temperature

Answers of Chapter 3 – Gases

1) Number of molecules
Avogadro's law: "Equal volumes of all the ideal gases at the same temperature and pressure contain equal number of molecules."

2) Temperature
Isothermal: Process during which the temperature remains constant.
Isobaric: Process during which the pressure remains constant.
Isochoric: Process during which the volume remains constant.

3) Half
According to Charles Law, the volume of the given mass of a gas is directly proportional to the absolute temperature when pressure is kept constant. So, the change in temperature will be the same as the change in volume.

4) Low pressure and High temperature
At low pressure and high temperatures, the intermolecular attractions are reduced significantly so gases behave ideally under these conditions.

5) The rate of diffusion is inversely proportional to the square root of its density

6) Low temperature and high pressure
Gases become non-ideal at high pressure and low temperature due to the intermolecular attractions and the finite volume occupied by the gas.

7) All of these
8) Excluded volume is represented by "b" and is 4 times the actual volume of gas i.e. b=4V.

9) Different mass
At equal volume, the number of molecules in the gases are the same but masses are not the same. Mass depends upon the type of molecules. For example, 1 dm^3 of H_2 and 1 dm^3 of O_2 have the same number of molecules but different masses.

10) V is directly proportional to T

11) $(P + n^2a/v^2)(v - nb) = nRT$

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Option a is the correct Van Der Waals equation for non-ideal gases. Option c is not correct as the general gas equation is:
PV = nRT , where n is the number of moles of a gas.
N represents the number of molecules of gas in a vessel

12) Actual volume
b= 4V, where V is the actual volume of the gas.

13) 1.033 kg/cm²

14) Cooling
When gas expands, the decrease in pressure causes the molecules to slow down. This causes the gas to cool down.

15) Decreasing temperature and increasing pressure
Gas can be converted into liquid by two ways:
1: By increasing pressure of gas: When you apply pressure on a gas, its constituent particles start getting closer. At a particular pressure when these particles are bound with the force of attraction between each other, phase transition takes place, and the gas is converted to liquid. The situation is reverted as soon as the pressure is released.
2: By decreasing temperature of the gas: When you decrease temperature of a gas, the kinetic energy of constituent particles decreases as a result of which particles start settling down and getting closer to each other. At a particular temperature, the particles get so close that they are bound in force of attraction and here the phase transition takes place. The gas is converted to liquid.

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Chapter 4 – Liquids and Solids

1) Vapor pressure depends on:
a) Intermolecular forces
b) Surface area
c) Quantity of liquid
d) Size of the molecules
e) Both a and d

2) Which of the following is not a property of liquid?
a) Random movement of molecules
b) Molecules have the same position with respect to one another
c) Takes shape of the container
d) Are less common than solids and gases

3) Molecular solids are different from others because they
a) Are formed by only non-polar molecules
b) Have low melting point
c) Have high conductivity
d) Have high density

4) Which one of the following has crystalline structure?
a) Diamond
b) Sugar
c) Boron Nitride
d) Lithium Carbide
e) All of these

5) Covalent bond is stronger than hydrogen bond by:
a) 10 times
b) 20 times
c) 30 times
d) 50 times

6) Which of the following is not a property of liquids:
a) No motion
b) Collision of molecules
c) Diffusion
d) All of these

7) Vapor pressure depends on
a) Size of the container used to collect the gas
b) Current atmospheric pressure
c) Temperature of the liquid
d) Kind of gas that is being collected

8) Crystal structure of diamond is
a) Trigonal
b) Tetrahedral
c) Cubic
d) None of these

9) Increasing the temperature of a liquid will decrease all except:
a) Surface tension
b) Density
c) Viscosity
d) Vapor pressure

10) Molecular substances differ from ionic substances in:
a) Low boiling points
b) Low melting points
c) Less electrical conductance
d) All of these

11) Which one is not possible
a) Ionic crystal
b) Covalent crystal
c) Metallic crystal
d) Atomic-crystal

12) Which of the following has the higher bond forces among its molecules?
a) Water
b) Hydrogen
c) Neon
d) Hydrogen Fluoride

13) If electrons are loosely packed then:
a) The boiling point of solid is high
b) The solid conducts electricity

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c) They add to the solidity

14) Loose electrons present in outer shell means:
a) High melting point b) High boiling point c) High conductivity d) The melting point of solid is high

15) Viscosity of HF is:
a) Greater than H_2O b) Smaller than H_2O c) Equal to H_2O d) None of these

16) Which one of the following is an example of covalent solid?
a) NaCl b) Diamond c) Mercury d) None of these

17) Which of the following compound has the highest boiling point?
a) Water b) HCl c) Ammonia d) HF

18) Which statement about liquids is not correct?
a) Can diffuse b) Have definite volume
c) Molecules have negligible K.E d) All of these

19) Water boils when:
a) Vapor pressure becomes equal to Atmospheric Pressure
b) Vapor pressure is less than Atmospheric Pressure
c) Vapor pressure is greater than Atmospheric Pressure
d) All of the above

20) If the crystal structure of Graphite is Hexagonal, the crystal system of Diamond will be:
a) Tetrahedral b) Pyramidal c) Cubic d) Pentagonal

21) Vapor pressure of a liquid depends upon
a) Nature of liquid b) Temperature
c) Atmospheric pressure d) Both a and b

22) Hybridization in diamond is _____?
a) sp b) sp^2 c) sp^3 d) dsp^2

23) Which of the following bonds is the weakest?
a) Ionic b) Covalent c) Dative Covalent d) Hydrogen Bonding

Answers of Chapter 4 – Liquids and Solids

1) Both a and d

The values of vapor pressure of various liquids depend fairly upon the nature of liquids i.e., on the sizes of molecules and intermolecular forces.

2) Molecules have the same position with respect to one another

3) Have high density

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Molecular solids can be formed by both polar and non-polar molecules. The intermolecular force in them is much weaker than the forces of attraction in ionic crystals and covalent crystals, thus they have low melting and boiling points. They are poor conductors of electricity and have low densities.

4) All of these
All of the given solids have crystalline structures. Sugar is an example of molecular crystal, while Diamond, Boron Nitride and Lithium Carbide are examples of covalent crystals.

5) 20 times
Covalent bond is the strongest of all the bonds. Its 20 times stronger than Hydrogen bond

6) No motion

7) Temperature of the liquid
Vapor pressure depends on the nature of liquids (i.e., intermolecular forces and the size of molecules) and on the temperature of the liquid.

8) Cubic
In cubic crystal system the unit cell is in the shape of a cube. Diamond is one of the most common and simplest shapes found in cubic crystals.

9) Vapor pressure
When temperature rises, the molecules become more energetic, and it becomes easier for the liquid molecules to vaporize which causes an increase in the vapor pressure. Also due to heating the molecules move apart, therefore reducing the viscosity and surface tension. Density = Mass divided by Volume. At increased temperature, the volume is increased and so according to above equation the density decreases.

10) All of these
Due to weak intermolecular forces, molecular solids have low melting and boiling points as compared to ionic solids. Also, these are bad conductors of electricity.

11) Atomic crystal
There are 4 types of crystalline solids depending upon the type of bonds present in them:
1) Ionic 2) Covalent 3) metallic 4) molecular

12) Water
Water has the stronger forces due to the presence of hydrogen bonds. Although hydrogen bond is also present in HF, but in water the number of hydrogen bonds is greater, thus resulting in stronger force of attraction and higher boiling point.

13) The solid conducts electricity

14) High conductivity
If the valence electron is loosely held it is easier to remove it from its shell making the element highly conductive.

15) Smaller than H_2O

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HF is less viscous than water due to presence of strong Hydrogen - bonding in H_2O as compared to HF. Each molecule of water can make upto 4 hydrogen bonds whereas only 2 hydrogen bonds are possible on average for HF.

16) Diamond

17) Water
Water has the strongest intermolecular forces among the given options due to its ability to form 2 hydrogen bonds per molecule.

18) Molecules have negligible K.E
Molecules of liquid are in constant state of random motion which adds to the K.E of molecules.

19) Vapor pressure becomes equal to Atmospheric Pressure
The boiling point of a liquid is the temperature at which its vapor pressure is equal to the external atmospheric pressure. The normal boiling point of a liquid is the temperature at which its vapor pressure is equal to 1 atmosphere (760 torr).

20) Cubic
The crystal structure of Diamond is cubic. In cubic crystalline structure all the three axes are of equal length and all are at right angles to one another.

21) Both a and b
Liquids, which have weak inter-molecular forces, are volatile and have greater vapor pressure. Vapor pressure increases with increase in temperature. So, vapor pressure depends on both Nature of the Liquid and the Temperature. Vapor Pressure is independent of atmospheric pressure. Boiling point, however, depends on the external atmospheric pressure.

22) sp^3
There are 4 electrons in the outermost shell of Carbon. The four atomic orbitals (One 2s and Three 2p) undergo sp^3 hybridization to give four sp^3 hybridized orbitals. These are directed in space along the four corners of a tetrahedron.

23) Hydrogen Bonding
Increasing order of strength of the bonds is:
Ionic bond > Covalent bond > Dative covalent bond > Hydrogen bond
Hydrogen bond is weaker than ionic and covalent bonds. Hydrogen bond is formed by the partial electrostatic attraction between a hydrogen atom and a more electronegative atom such as nitrogen, oxygen, fluorine, and other adjacent atoms bearing a lone pair of electrons.
Ionic bond is the strongest bond as it is formed by complete transfer of electrons by the atoms. Covalent bond is weaker than the ionic bond as it is formed by the sharing of electrons. Coordinate(Dative) covalent bond can form when one atom provides a lone pair of electrons to the bond. Covalent bond is stronger than Dative Covalent because both atoms involved share their outer shell electrons.

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Chapter 5 – Atomic Structure

1) The correct order of orbitals is:
a) 1s,2s,2p,3s, 3p, 4s, 3d, 4p, 5s
b) 1s,2s,2p,3s, 3p, 3d, 4p, 4s, 5s
c) 1s,2s,2p,3s, 3p, 3d, 3f, 4s, 5d
d) 1s,2s,2p,3s, 3p, 4s, 4p, 4d, 5s

2) Diameter of Hydrogen atom is?
a) 105.8×10^{-2} A
b) 1.061 A
c) 0.55 A
d) 131.3×10^{-2} A

3) If an electron makes a transition from 4th orbit to inner orbits, then the wavelength for which the radius is maximum, lies in which of the following series?
a) Lyman series
b) Paschen series
c) Brackett series
d) Pfund series

4) If an electron of hydrogen atom jumps from 5th orbit to 7th orbit, its atomic radius increases by
a) 97%
b) 98%
c) 50%
d) None of these

5) Breaking of neutron produces?
a) Electron, proton and neutrino
b) Electron, positron and neutrino
c) Proton and positron
d) Alpha particles

6) P.E of an electron in the orbit of an atom is
a) Zero
b) Less than zero
c) Greater than zero
d) None of these

7) The velocity of electron in outermost shell is?
a) Minimum
b) Maximum
c) Intermediate
d) None of these

8) Spectrum of which series is in the visible region?
a) Lyman series
b) Balmer series
c) Paschen series
d) Pfund series

9) Spectrum of which series is in the UV region?
a) Lyman series
b) Balmer series
c) Paschen series
d) Pfund series

10) Which orbitals always possess same energy:
a) Hybrid orbitals
b) Degenerate orbitals
c) None of these
d) Both a and b

11) In a discharge tube, at room pressure there is
a) Maximum discharge
b) Minimum discharge
c) No discharge
d) Moderate discharg

12) Which of the following quantum numbers are for p-subshell?
a) $\ell = 1, m = +1, 0, -1$
b) $\ell = 0, m = +1, 0, -1$
c) $\ell = 2, m = +1, 0, -1$
d) $\ell = 3, m = +1, 0, -1, +2, -2$

13) Which quantum number decides energy of orbitals?
a) Magnetic quantum number
b) Principal quantum number
c) Azimuthal quantum number
d) All of these

14) d subshell has
a) 3 orbitals
b) 5 orbitals
c) 7 orbitals
d) 12 orbitals

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15) When alpha particles are bombarded on beryllium ___ is formed.
a) C b) O c) P d) S

16) Bracket series of H-atom is in which of the following regions of electromagnetic spectrum?
a) Infrared b) Far infrared c) Near infrared d) Visible

17) If an electron jumps from fourth to first orbit, which of the following series will it show?
a) Lyman b) Balmer c) Pfund d) None of these

18) Number of transitions possible for an electron in the 6th shell are
a) 10 b) 15 c) 20 d) 25

19) What are the values of orbital quantum number(ℓ) and magnetic quantum number(m) for p-subshell?
a) ℓ = 1, m = 0, +1 , -1
b) ℓ = 0, m = 0
c) ℓ = 2, m = 0, +/-1, +/- 2
d) ℓ = 3, m= 0, +/-1, +/- 2, +/-3

20) If an election jumps from 6th orbit to 2nd orbit then decrease in radius will be?
a) 90% b) 60% c) 30% d) 20%

Answers of Chapter 5 – Atomic Structure

1) 1s, 2s, 2p, 3s, 3p, 4s, 3d, 4p, 5s

2) 105.8×10^{-2} A

Radius of Hydrogen atom = 0.529 A
So, diameter = 2 x 0.529 = 1.058 A = 105.8×10^{-2}A

3) Paschen series

4) 50%
$r = 0.529\ n^2$
For n=5, $r_5 = 0.529 \times 25$ For n=7, $r_7 = 0.529 \times 49$

Percentage change is given by:

$$\frac{Difference\ in\ radius}{Original\ radius} \times 100\%$$

$$= \frac{New\ radius - Original\ radius}{Original\ radius} \times 100\%$$

$$= \frac{r_5 - r_7}{r_7} \times 100\%$$

$$= \frac{0.529(25) - 0.529(49)}{0.529(49)} \times 100\% = \frac{0.529(25-49)}{0.529(49)} \times 100\% = -\frac{24}{49} \times 100\% \approx -50\%$$

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The negative sign indicates that the radius has decreased from the original value.
Note: A shortcut for such questions is given in the explanation of question number 20 of this Chapter.

5) Electron, proton, and neutrino

$^{1}_{0}n \rightarrow {}^{1}_{1}P + {}^{0}_{-1}e + {}^{0}_{0}n$

6) Lesser than zero

P.E of an electron is always negative, as given by its formula:

$$P.E = -\frac{Ze}{4\pi\varepsilon_0 r}$$

7) Minimum

Velocity is maximum in the shell nearest to the nucleus. As you move away from the nucleus the velocity decreases and is minimum in the outermost shell.

8) Balmer series

9) Lyman series

10) Degenerate orbitals

Degenerate orbitals will always have the same energy. Hybrid orbitals are of different types e.g., sp, sp^2, sp^3 etc. The energy of sp and sp^3 hybrid orbitals will be different. Only the energy of similar hybrid orbitals will be the same. Since, the question asks which orbitals always possess the same energy, hybrid orbitals will not be our answer as different type of hybrids will have different energy levels.

11) No discharge

Current does not flow through the discharge tube at ordinary pressure even at high voltage of 5000 volts. When the pressure inside the tube is reduced and high voltage is applied, then an electric discharge takes place through the gas.

12) l = 1, m = +1,0,-1

13) Principal quantum number

The different energy levels are represented by Principal Quantum Numbers. Azimuthal Quantum Number represent the subshells and Magnetic Quantum Numbers show the orientation of orbitals.

14) 5 orbitals

Number of orbitals = $2l + 1$

For d subshell, $l = 2$, so number of degenerate orbitals for d subshell= 5

15) C

$^{4}_{2}He + {}^{9}_{4}Be \rightarrow {}^{12}_{6}C + {}^{1}_{0}n$

16) Infrared

17) Lyman

Lyman series is a hydrogen spectral series of transitions and resulting ultraviolet emissions lines of the hydrogen atom as an electron goes from n > 2 to n = 1 (where n is the principal quantum number), the lowest energy level of the electron.

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18) 15

Number of possible spectral line is given by the formula:

$$\frac{n(n-1)}{2}$$

Where n represents the number of shell where the electron is. For this case, n = 6. Using the value in the above formula, we get:

$$\frac{6(6-1)}{2} = 15$$

Therefore, for an electron in the 6th shell, 15 transitions are possible.

19) ℓ = 1, m = 0, +1 , -1

The second quantum number, known as the angular or orbital quantum number, describes the subshell and gives the magnitude of the orbital angular momentum through the relation. In chemistry and spectroscopy:

ℓ = 0 is called an s orbital,
ℓ = 1 is p orbital,
ℓ = 2 is d orbital,
ℓ = 3 is f orbital.

The magnetic quantum number, called m, specifies the z component of the angular momentum for a particular orbital. For example, for an s orbital, l = 0, and the only value of m is zero. For p orbitals, l = 1, and m can be equal to −1, 0, or +1.

20) 90%

The radius of nth orbit in an atom is given as:

$$r_n = \left(\frac{\epsilon_o\, h^2}{\pi m e^2}\right) n^2$$

For any given atom, the parameters inside the brackets are constant. Let's name this constant as C. "n" represents the number of orbit an electron is resolving in. So, for 6th orbit n = 6 and for 2nd orbit n = 2. Radius of 6th orbit will be given as:

$$r_6 = C(6)^2 = 36C$$

Radius of 2nd orbit will be given as:

$$r_2 = C(2)^2 = 4C$$

The formula to calculate the percentage difference is:

$$\frac{New\ Value - Original\ Value}{Original\ Value} \times 100\%$$

Since, electron jumps from 6th orbit to 2nd orbit, 36C will be the original value and 4C will be the new value. Substituting these values in above equation gives us:

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$$Percentage\ Difference = \frac{4C - 36C}{36C} \times 100\%$$

$$= \frac{-32C}{36C} \times 100\%$$

$$= -\frac{32}{36} \times 100\%$$

$$= \frac{-8}{9} \times 100\% = -0.89 \times 100\% = -89\% \approx -90\%$$

The negative sign indicates that the radius has decreased. This means if an electron jumps from 6th orbi to 2nd orbit, the approximate change in radius will be 90%.

Shortcut Formula:

If an electron jumps from orbit number n_1 to orbit number n_2, then the percentage difference in the radius will be given as:

$$Percentage\ Difference = \frac{(n_2)^2 - (n_1)^2}{(n_1)^2} \times 100\%$$

For the given question n_1 is 6 and n_2 is 2. Using these values, we get the same result we obtained in previous method.

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Chapter 6 – Chemical Bonding

1) How many orbitals intermix in sp hybridization?
a) 2 b) 3 c) 4 d) 5

2) Which noble gas has highest ionization energy?
a) He b) Ne c) Ar d) Kr

3) How many bonds are there in CO?
a) 1 b) 2 c) 3 d) 4

4) Which of the following has greatest electronegativity?
a) Cl_2 b) Br_2 c) I_2 d) Cs

5) Structure of ammonia is:
a) Linear b) AB4 (bent or angular)
c) AB3 (Trigonal) d) AB4 (Trigonal pyramidal)

6) Paramagnetism is due to:
a) Unpaired electron b) Paired electron
c) Complete valence shell d) Ionization

7) Which of the following is paramagnetic
a) Nickle b) Vanadium c) Uranium d) Oxygen

8) Which of the following has maximum Ionization energy?
a) He b) Ne c) Ar d)Kr

9) Hybridization in $BeCl_2$ is
a) sp^3 hybridization b) sp^2 hybridization c) sp hybridization d) None of these

10) Geometry of SF_6 is:
a) Octahedral b) Hexagonal c) Decahedral d) Trigonal

11) The bond angle of NF_3 is:
a) 102.5 b) 104 c) 107.5 d) 120

12) Co-ordinate covalent bond is not formed in which of the following:
a) PH_3 b) NH_3 c) CH_4 d) None of these

13) In period, moving from left to right
a) Electro negativity decreases b) Electronegativity increases
c) Electro negativity remains same d) None of these

14) Ionization energy depends upon:
a) Nuclear charge b) Shielding effect c) Atomic radius d) All of the above

15) Which type of hybridization doesn't exist?
a) Sp^4 b) Sp^3 c) Sp^2 d) Sp

16) Second ionization energy of Mg atom is:

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a) Higher than first ionization energy
b) Lower than first ionization energy
c) Very low
d) None of these

17) Which theory deals with hybridization of orbitals?
a) VBT
b) MOT
c) VSEPR
d) None of these

18) Down the group atomic radii increases due to?
a) Increase in screening effect
b) Repulsion between the electrons of valence shell
c) Increase in nuclear charge
d) All of these

19) Methane has geometry
a) Tetrahedral
b) Hexagonal
c) Planner
d) Bent

20) Every sp^3 orbital is oriented in space in such a way that angle between them is:
a) 109.5
b) 104.5
c) 120
d) 180

21) Bond angle in water is:
a) 104.5
b) 109
c) 120
d) 107

22) Electronegativity is defined as the power of an atom in a molecule to
a) Repel electrons towards itself
b) Attract electrons towards itself
c) Expand itself
d) All of the above

23) Which one of these is paramagnetic?
a) N
b) Be
c) He
d) None of these

24) Which of the following has the largest dipole moment?
a) H_2
b) HI
c) HBr
d) HCl

25) In water molecules, oxygen atom is hybridized as
a) sp2
b) sp3
c) sp4
d) sp3d2

26) Bond angle of Ethane is:
a) 109.5
b) 120
c) 180
d) Different

27) Dipole moment of H_2 is:
a) 1.03
b) 1.45
c) 0.78
d) 0

28) Which of the following is the highest electronegative element?
a) F
b) N
c) Cl
d) O

29) Which of the following has a lone pair of electrons on the central atom?
a) PCl_5
b) NH^{+4}
c) PCl_3
d) CH_4

30) Ionization potential
a) Increases down the group.
b) Decreases down the group

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c) Stays same in a group

d) None of these

Answers of Chapter 6 – Chemical Bonding

1) 2

In sp hybridization, one 's' and one 'p' orbitals intermix to form two sp-hybridized orbitals.

2) He

Ionization energy decreases down the group, so He has the maximum value of ionization energy among the noble gases.

3) 3

Carbon monoxide consists of one carbon atom and one oxygen atom, connected by a triple bond that consists of two covalent bonds as well as one dative covalent bond.

4) Cl_2

Electronegativity decreases down the group and increases from left to right in a period. So from the given options Cl_2 has the higher value of electronegativity.

5) AB_4 (Trigonal pyramidal)

6) Unpaired electron

7) Oxygen Oxygen has two unpaired electrons in its valence shell giving it paramagnetic property.

8) He

Ionization energy is the amount of energy required to remove the most loosely held electron. Since Noble Gases have a full outer shell, it would take a lot of energy to rip an electron from it. Noble Gases have high ionization energy, and Helium has the highest ionization energy.

9) sp hybrization

10) Octahedral

11) 102.5

12) CH_4

PH3 forms a coordinate covalent bond with proton. NH3 forms a coordinate covalent bond with BF_3. CH4 does not form any coordinate covalent bond, however it loses one electron to form a molecular ion.

13) Electronegativity increases

14) All of the above

15) Sp^4

16) Higher than first ionization energy

When one electron is removed from Mg atom, the atom is positively charged. The dominant positive charge holds the electrons tightly and thus further removal of electrons becomes difficult.

17) VBT

18) Increase in screening effect

The increase in atomic radii in a group is due to increase in number of shells and the screening effect.

19) Tetrahedral

20) 109.5

21) 104.5

22) Attract electrons towards itself

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23) N

The magnetic properties of a substance can be determined by examining its electronic configuration: If it has unpaired electrons, then the substance is paramagnetic and if all electrons are paired, the substance is diamagnetic.

He: $1s^2$ subshell is filled. No unpaired electrons

Be: $1s^2 2s^2$ subshell is filled. No unpaired electrons

N: $1s^2 2s^2 2p^3$ subshell is not filled.

So, N is paramagnetic and He, Be are diamagnetic.

24) HCl

Dipole moment of H_2 is 0 D

Dipole moment of HBr is 0.78 D

Dipole moment of HI is 0.38 D

Dipole moment of HCl is 1.03 D

25) sp3

During formation of water molecule, one 2s and three 2p orbitals of oxygen hybridize to form four sp3 hybrid orbitals which will have tetrahedral arrangement. Two of these orbitals are completely filled with electrons and other two undergo sp3 – s overlap with hydrogen atoms to form two sigma bonds.

26) 109.5

In ethane, carbon undergoes sp3 hybridization and gives a tetrahedral geometry with carbon at the center and hydrogen atoms at four corners of a regular tetrahedron, resulting in a bond angle of 109.5.

27) 0

Symmetrical diatomic molecules of A2 type such as hydrogen, bromine and nitrogen do not have any value dipole moment i.e., their Dipole moment is 0.

28) F

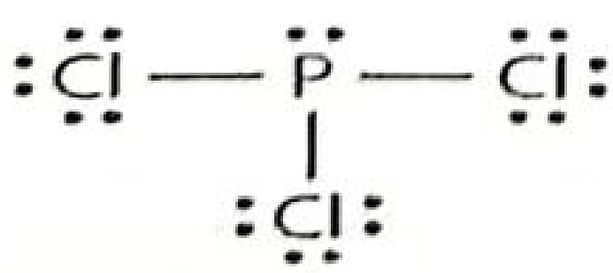
Electronegativity is the tendency of an atom to attract shared pair of electrons towards itself. Fluorine has highest electronegativity among all elements of the periodic table, while francium is the least electronegative element.

29) PCl_3

PCl_5 has no lone pair of electrons.

In case of NH^{4+} (1s2 2s2 2p3), three P electrons are covalently bonded with 3 hydrogen bonds. H+ ion does not have any electron and a lone pair of electrons is donated by nitrogen to H+ ion to form a covalent bond. Thus, there is no lone pair of electrons on nitrogen in NH4+

PCl_3 has 1 lone pair.



CH_4 has zero lone pair.

30) Decreases down the group

Ionization potential is the amount of energy required to remove an electron from the valence shell of an atom. Moving down the group, the size of an atom increases, and the screening effect also increases. This results in a reduced attraction of nucleus on valence shell electrons, and as a result it gets easier to remove the electron. Therefore, the ionization potential of elements in any group decreases from top to bottom.

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Chapter 7 - Thermochemistry

1) Which of following is NOT state variable of thermodynamics?
a) Entropy b) Internal energy c) Volume d) Density

2) If a system absorbs heat, the surrounding temperature
a) Increases b) Decreases
c) Remains same d) Decreases then suddenly Increases

3) Which of the following has the maximum specific heat?
a) Copper b) Aluminium c) Iron d) Ice

4) Heat of vaporization of water is _____ kcal/kg
a) 574 b) 674 c) 474 d) 364

5) During a chemical reaction, heat of Formation is:
a) Evolved b) Absorbed
c) Either Evolved or Absorbed d) None of the above

6) Heat of Neutralization is defined as:
a) Heat of formation of one mole of salt b) Heat of formation of one mole of water
c) Both a and b d) None of these

7) Burning of fuel is
a) Endothermic b) Exothermic c) Both a and b d) None of these

8) Value of heat capacity of water is:
a) 4.51 J/g b) 4.18 J/g c) 4.92 J/g d) 4.21 J/g

Answers of Chapter 7 - Thermochemistry

1) Density
A state variable is also called a state function. Examples include temperature, pressure, volume, internal energy, enthalpy, and entropy.

2) Decreases
A reaction that absorbs heat is endothermic. Its enthalpy will be positive, and it will cool down its surroundings i.e., decreases temperature.

3) Copper
Specific heat capacity is directly proportional to mass (m) of an element.
$Q = mC\Delta T$
Mass of Cu = 63.5 Al = 26.9 Fe = 55.8 H_2O = 18
Ice has the minimum molecular mass and copper has the maximum among all choices.

4) 574

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The specific heat of vaporization of water is 574 kcal/kg.

5) Either Evolved or Absorbed
Heat of formation, also called standard heat of formation, enthalpy of formation, or standard enthalpy of formation, the amount of heat absorbed or evolved when one mole of a compound is formed from its constituent elements, each substance being in its normal physical state (gas, liquid, or solid).

6) Both a and b
The heat (or enthalpy) of neutralization (ΔH) is the heat evolved when an acid and a base react to form a salt plus water.

7) Exothermic
All combustion reactions are exothermic reactions. During a combustion reaction, a substance burns as it combines with oxygen. When substances burn, they usually give off energy as heat and light.

8) 4.18 J/g
The heat capacity of liquid water is 4.184 J/g or 4,184 J/kg. This means, water has to absorb 4,184 Joules of heat (1 calorie) for the temperature of one kilogram of water to increase by 1°C.

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Chapter 8 – Chemical Equilibrium

1) Equilibrium constant has no units if?
a) The number moles are same on both sides of the chemical equation
b) The number of moles is different on both sides.
c) The number of moles is greater in the product
d) If the rate of reaction is constant

2) Le Chatelier's principle explains effect of all of the following except
a) Pressure b) Temperature c) Concentration d) Time

3) Buffer capacity depends upon
a) pH b) pOH c) Remains same d) Both a and b

4) Buffer solution of every liquid is
a) Same b) Different c) Depends upon pH d) None of these

5) Buffer solution is a solution which resists change in?
a) pH b) Concentration c) Number of moles d) Rate of reaction

6) The Haber Process is used to produce ammonia commercially according to the following equilibrium:
$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)} + \text{energy}$
Which of the following conditions will produce the highest yield of ammonia?
a) Increase temperature and increase pressure
b) Increase temperature and decrease pressure
c) Decrease temperature and increase pressure
d) Decrease temperature and decrease pressure

7) If the value of Kc is large than the ratio [products]/[reactants], the reaction:
a) Is at equilibrium
b) Is not at equilibrium
c) The reaction moves in the forward direction
d) The direction will move in the reverse direction

8) A solution has pH of 10. What is the value of $[OH^-]$?
a) 10^{-4} b) 10^{4} c) 10^{6} d) 10^{-7}

9) What is correct relation between K_w, K_a and K_b?
a) $K_w = K_a/K_b$ b) $K_w = K_a \times K_b$ c) $K_w = K_b - K_a$ d) $K_w = K_b/K_a$

10) For the following reaction:
$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$
How can we avoid maximum yield of ammonia?
a) By increasing temperature b) By continuous withdraw of ammonia
c) By decreasing pressure d) By increasing pressure

11) If concentration of OH^- ions is 0.1 molar. What is the pH of the solution?
a) 13 b) 9 c) 6 d) 3

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12) Which one of these shows Henderson equation?
a) pH = PKa - log [salt]/[acid]
b) pH = PKa - log[acid]/ [salt]
c) pOH = PKb- log [salt]/[base]
d) Both a & c

13) If Kc = 1, then reaction is:
a) At equilibrium
b) Moves in forward direction
c) complete
d) None of these

14) For the following reaction:
$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$
How can we get maximum yield of ammonia?
a) By continuous with-drawl of ammonia
b) By increasing pressure
c) By decreasing temperature
d) All of the above

15) In a exothermic process, forward direction reaction is favored by:
a) Increase in temperature
b) Decrease in temperature
c) Increase and decrease repeatedly
d) None of these

16) $2N+O_2 \Leftrightarrow 2NO$
If Kc = 1×10^{-15} it shows:
a) High amount of energy
b) Low amount of energy
c) Same amount of energy
d) Insufficient data

17) For a reversible reaction to reach an equilibrium state the reaction should be carried out in:
a) Glass vessel
b) Iron vessel
c) Open vessel
d) Closed vessel

18) A solution having pH = 0 is
a) Strongly basic
b) Weakly basic
c) Neutral
d) Strongly acidic

19) If Kc < 1, then the reaction proceeds:
a) Forwards
b) Backwards
c) Is at Equilibrium
d) None of these

Answers of Chapter 8 – Chemical Equilibrium

1) The number moles are same on both sides of the chemical equation
Because the units of reactants and products cancel out each other in the formula.

2) Time
Le Chatlier's principle, also known as "Chatelier's principle" or "The Equilibrium Law" states that when a system experiences a disturbance (such as concentration, temperature, or pressure change), it will respond to restore a new equilibrium state.

3) Both a and b
Buffer capacity depends on the concentration of both protons and hydroxide ions in the solution.

4) Depends upon pH

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5) pH

6) Decrease temperature and increase pressure
Formation of ammonia is an exothermic process and according to Le-Chatelier's Principle following three ways can be used to maximize the formation of ammonia:
i) By continual withdrawal of ammonia after intervals.
ii) Increase the pressure iii) Decrease the temperature

7) The reaction moves in the forward direction
If the value of Kc is large than the ratio, this implies that more of the product is required to attain the equilibrium, therefore, the reaction will proceed in the forward direction.

8) 10^{-4}
pH + pOH = 14 10 + pOH = 14 so, pOH=4
Also, pOH = - log [OH^-]
4 = - log [OH^-] or - 4 = log[OH^-]
Now from the given options check that log of which value equals - 4.
Since, log[10^{-4}] = - 4, so this will be our answer.

9) Kw = Ka x Kb

10) By decreasing pressure
By increasing the pressure and decreasing the temperature, maximum yield is obtained. To avoid maximum production, we decrease the pressure and increase the temperature.

11) 13
[OH] = 0.1
pOH = - log [OH^-] = - log [0.1] = 1
pOH + pH = 14, so, pH = 14 – 1 = 13

12) Both a & c 13) At equilibrium 14) All of these

15) Decrease in temperature

16) Low amount of energy
Equilibrium constant is small, so reaction will proceed slowly implying low energy content.

17) Closed vessel
If a chemical reaction happens in a container where none of the reactants or products can escape, you have a closed system. Reversible reactions that happen in a closed system eventually reach an equilibrium.

18) Strongly acidic
The pH scale ranges from 0 to 14. A pH of 7 is neutral. A pH of less than 7 is acidic. A pH greater than 7 is basic. Hence, 0 pH indicates strongest acidity.

19) Backwards
When Kc is greater than 1, products exceed reactants (at equilibrium). When much greater than 1, the reaction goes almost to completion. When Kc is less than 1, reactants exceed products. When much less than 1 (Kc can never be negative, so when it is close to zero) the reaction hardly occurs at all.

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Chapter 9 – Solutions

1) An ideal solvent dissolves maximum solute at?
a) Boiling point
b) Saturation point
c) At room temperature
d) At Freezing point

2) The number of moles of solute dissolved per dm^3 of the solution is called
a) Molarity
b) Molality
c) Motality
d) Mole fraction

3) Lowering of vapor pressure is directly proportional to?
a) Number of solute particles
b) Temperature
c) Chemical Formula
d) Number of solvent particles

4) Definition of Raoult's law is,
a) The lowering of vapor pressure is equal to the mole fraction of solute
b) The relative lowering of vapor pressure is directly proportional to the mole fraction of solute.
c) The relative lowering of vapor pressure is equal to the mole fraction of solute
d) The relative lowering vapor pressure is equal to the mole fraction of solvent

5) The reaction in which a molecule is broken down by Water is known as
a) Hydration
b) Salvation
c) Electrolysis
d) Hydrolysis

6) Colligative Properties depend upon:
a) Solute
b) Solvent
c) Both a and b
d) None of these

7) For colligative properties, the solution should be:
a) Electrolyte
b) Saturated
c) Diluted
d) Concentrated

8) Which one is the correct formula for molar mass of solute in case of boiling point elevation?
a) $M_2 = 1000\ Kb\ W_2M_1 / Tb\ W_1$
b) $M_2 = 1000\ Kb\ W_2 / Tb$
c) $M_2 = Kb\ W_1\ Tb/1000$
d) $M_2 = 1000\ Tb\ W_2 / Kb$

9) Lowering of vapor pressure is directly proportional to:
a) Temperature
b) Mole fraction of Solute
c) Mole fraction of Solvent
d) Amount of solution

10) Percentage of weight of NaCl if 2g NaCl is dissolved in 18g water
a) 10
b) 20
c) 30
d) 40

11) In depression of freezing point, freezing constant is divided by
a) Molarity
b) Molality
c) Molar fraction
d) All of these

12) What is the molality of 92 g toluene in 250 g benzene?
a) 4 mol/kg
b) 1 mol/kg
c) 6 mol/kg
d) 3 mol/kg

13) Which of the following is the smallest unit?
a) Molarity
b) Molality
c) PPM
d) Mole Fraction

14) 12% W/W alcohol in water solution contains water:
a) 100 cm^3
b) 12 cm^3
c) 88 cm^3
d) 112 cm^3

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Answers of Chapter 9 – Solutions

1) Boiling point 2) Molarity 3) Number of solute particles

4) The relative lowering of vapor pressure is equal to the mole fraction of solute

5) Hydrolysis Hydro means water and lysis means breakdown

6) Both a and b

Colligative properties are the physical changes that result from adding solute to a solvent. Colligative Properties depend on: how many solute particles are present as well as the solvent amount, but they do NOT depend on the type of solute particles.

7) Diluted

Colligative properties are the properties of only dilute solution which are supposed to behave as ideal solutions.

8) $M_2=1000\ K_b\ W_2M_1/\ T_b\ W_1$

9) Mole fraction of Solute

Raoult's law states that the freezing and boiling points of an ideal solution are respectively depressed and elevated relative to that of the pure solvent by an amount proportional to the mole fraction of solute.

10) 10

Percentage of weight = Mass of solute/Mass of solution x 100 % = 2/(2+18) x 100% = 10%

11) Molality

12) 4 mol/kg

Molality is defined as:

$$m = \frac{moles\ of\ solute}{kilograms\ of\ solvent}$$

Here solute is 92g toluene (C_7H_8)

$$Moles\ of\ toluene\ = \frac{Mass}{Molar\ Mass} = \frac{92}{92} = 1\ mol$$

Mass of benzene = 250 g = 0.25 kg So, Molality = 1 mole / 0.25 kg = 4 mol/kg

13) PPM

The molality of solution is always greater than the molarity. Molarity is the number of moles of solute dissolved per dm3 of the solution, while Molality is the number of moles of solute in 1kg of the solvent. Mass of solvent is always less than the volume of solution and thus the molality will be greater. Mole fraction is the ratio of number of moles of a component to the total number of moles of all components present in the solution. Ppm or Parts Per Million is used for very low concentrations of solutions. For example, to express the impurities in water.

14) 88 cm^3

Percentage weight/weight is the weight of a solute dissolved per 100 parts by weight of solution. So, 12% w/w alcohol solution in water will contain 12 cm^3 of alcohol dissolved in 100 cm^3 of the solution. This means, the solution will contain 88 cm^3 of water.

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Chapter 10 – Electrochemistry

1) Standard reduction potential of F_2, Br_2 is:
a) +2.87, +1.08 b) +0.332, +2.87 c) -0.78, -1.66 d) None of thes

2) Zn can be deposited on iron by?
a) Galvanizing b) Cathode Coating c) Neutral suspension d) All of these

3) Oxidation number of Cr in $K_2Cr_2O_7$ & $K_2Cr_2O_4$ is:
a) +6, +3 b) +5, +2 c) +7, +3 d) +6, +4

4) Oxidation state of sulphur in H_2SO_4?
a) +2 b) +6 c) +4 d) -2

5) What is the oxidation state of Mn in K_2MnO_4?
a) 12 b) 8 c) 7 d) 6

6) Two half cells of a galvanic cell are connected with a salt bridge, the electrons flow from:
a) Anode to cathode through external circuit b) Cathode to anode through external ci
c) Anode to cathode through salt bridge d) Cathode to anode through salt bridge

7) Which one has valency other than one?
a) Mn in $KMnO_4$ b) K in KCL c) Br in Br_2O d) Na in NaCl

8) Definition of electrode potential is?
a) Tendency of metals to form ions when dissolved in 1M solution of its own solution
b) Tendency of ions to form atoms when dissolved in 1M solution of its metal
c) Both a and b
d) None of these

9) On balancing the following chemical equation:
$K_2CrO_4 + HCl \longrightarrow KCl + 2CrCl_3 + Cl_2 + H_2O$
The co-efficient with HCl will be?
a) 12 b) 14 c) 13 d) 16

10) Oxidation state of P in $Mg_2P_3O_5$ is
a) +2 b) -2 c) -1 d) +1

11) Highest oxidation state of chlorine is
a) +7 b) -7 c) +1 d) +1

12) Which one of the following is the oxidation number of Iodine in I_2?
a) 0 b) 1 c) 2 d) None of these

13) Standard Electrode Potential is measured at temperature:
a) 348K b) 298K c) 20K d) 235K

14) +3 and +5 oxidation states are often shown by:
a) Cl b) F c) Zn d) Cu

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15) In Lead-Acid battery, product formed at anode during discharging is:
a) PbSO4 b) Pb c) SO2 d) SO4

16) Oxidation is defined as:
a) Loss of electron b) Gain of electron c) Gain of oxygen d) Both a and c

17) Which of the following exhibits an oxidation state of -3?
a) P b) O c) Cl d) Na

18) What is the oxidation number of S in SO_2^{-2}?
a) 6 b) 2 c) – 6 d) 8

Answers of Chapter 10 – Electrochemistry

1) +2.87, +1.08

2) Galvanizing
Galvanizing means coating (iron or steel) with a protective layer of zinc.

3) +6, +3
Oxidation number of K = +1 Oxidation number of O = -2
Let the oxidation number of Cr = x
For $K_2Cr_2O_7$, we can write:
Sum of oxidation states = 0 → 1(2) + x(2) + (-2)(7) = 0
From here we get x = 6, so the oxidation number of Cr in $K_2Cr_2O_7$ is +6
Likewise, for $K_2Cr_2O_4$, the oxidation number of Cr in $K_2Cr_2O_4$ is +3.

4) +6
H_2SO_4, two hydrogen atoms have a charge of +2 and four oxygen atoms has a charge of -8, the total charge of two hydrogen and four oxygen atoms is 2 – 8 = -6. So, Sulfur must have a charge of +6 to "stable" the compound.

5) 6
Sum of oxidation states must be zero, so:
1 + Mn + (-2)4 = 0 , Mn = 7

6) Anode to cathode through external circuit

7) Mn in $KMnO_4$
Mn has valency of +7 and all others have valency of +1.

8) Tendency of metals to form Ions when dissolved in 1M solution of its own solution

9) 16
$16\ HCl + 2\ K_2CrO_4 \rightarrow 2\ CrCl_3 + 4\ KCl + 3\ Cl_2 + 8\ H_2$

10) +2
Oxidation number of Mg = +2 Oxidation number of O = -2

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Let the oxidation number of P = x

So, $+2(2) + x(3) + (-2)(5) = 0$, $4 + x(3) - 10 = 0$, $x = 2$

11) +7

The oxidation number of chlorine can be - 1, 0, +1, +3, +5 or +7, depending on the substance containing the chlorine.

12) 0

The oxidation number for an atom in its elemental form is always zero.

A substance is in elemental form if both of the following are true:

i) Only one kind of atom is present. ii) Overall charge is 0.

13) 298K

The potential set up when an electrode is in contact with one molar solution of its own ions at 298K is known as standard electrode potential or standard reduction potential of the element. It is represented as E°.

14) Cl

Chlorine shows oxidation states of - 1, +1, +3, +5, +7.

F shows oxidation state of - 1.

Zn shows oxidation state of 2.

Cu shows oxidation states of 1, 2 and 3.

15) PbSO4

In a lead-acid battery, the cathode is made of lead-dioxide, and the anode is made of metallic lead. The two electrodes are separated by an electrolyte of sulfuric acid. During the discharging process, lead ions from anode combine with sulfate ions of electrolyte to form Lead Sulfate, which is deposited in the anode.

16) Both a and c

Oxid tion occurs when a species loses one or more electrons or when it gains oxygen. If a species gains one or more electrons or losses oxygen, we say that it is reduced.

17) P

Oxidation states of Phosphorus are: +3, -3, and +5

Oxidation state of Oxygen is: -2

Possible Oxidation states of Chlorine are: -1, 0, +1, +3, +4, +5, or +7 (However, in most cases oxidation state of Chlorine is -1).

Oxidation state of Sodium is: +1

18) 2

Oxidation number of SO_2^{-2}

Let the oxidation state of S be x

x + 2 (oxidation state of oxygen) = - 2

$x + 2(-2) = -2$

$x - 4 = -2$

$x = -2 + 4 = 2$

Thus, oxidation state of S is +2

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Chapter 11 – Reaction Kinetics

1) Solar energy is stored through solar panels in?
a) Dry cell
b) Nickel Cadmium battery
c) Magnesium cell
d) None of these

2) Half-life of iron is? (A=59)
a) 44.5 days
b) 1.3 million years
c) 3.8 days
d) 2.5 billion years

3) Half-life of an element is 5 days. If we have 50,000 of its atoms, then how many atoms would be left after 10 days?
a) 15000
b) 25000
c) 50000
d) None of these

4) The process of bringing an element in use after its complete half-life is:
a) Rejuvenation
b) Revoking
c) Recycling
d) None of these

5) What is the effect of catalyst in a reaction?
a) Increases the rate of reaction
b) Decreases the rate of reaction
c) Keeps the rate constant
d) None of these

6) The rate of reaction is equal to the specific rate constant, when:
a) Concentration of reactants collectively is unity
b) Concentration of each of the reactants is unity
c) Either a or b
d) None of these

Answers of Chapter 11 – Reaction Kinetics

1) Nickel Cadmium battery

2) 44.5 days

3) None of these
10 days = 2 half-lives
1st half-life = 50,000/2 = 25,000 atoms, 2nd half-life = 25,000/2 = 12,500 atoms

4) Rejuvenation

5) Increases the rate of reaction

6) Concentration of each of the reactants is unity
The rate equation is expressed as: Rate of reaction = $k[A]^a[B]^b$
Here, k is the specific rate constant, and [A] and [B] represent the concentration of reactants. Now, rate of reaction will be equal to k, only if the concentration of each of the reactants is 1.
For concentration equal to 1(or unity) the above equation changes to:
Rate of reaction = $k[1]^a[1]^b$
1 raised to any value is 1. So, the above equation changes to:
Rate of reaction = k [1] [1] = k
From here we can conclude that when the concentration of each of reactants is unity, the rate of reaction will be equal to the specific rate constant.

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MCQs from 2nd Year Chemistry

Chapter 1 – Periodic Classification of elements and Periodicity

1) Number of elements in 6th period is:
a) 34 b) 18 c) 32 d) 16

2) Triads were introduced by
a) Newland b) Dobreiner c) Mendeleev d) Al-Razi

3) Variable valency is shown by which of the following elements?
a) Na b) Co c) Mg d) Al

4) Which one of the following is acidic?
a) $B(OH)_3$ b) $Ca(OH)_2$ c) $Mg(OH)_3$ d) NaOH

5) Element that is not found in Free State is?
a) O b) H c) C d) None of these

6) Which of following pair has highest conductivity?
a) Gold, Aluminium b) Gold, Tungsten c) Silver, Copper d) Carbon, Gold

7) Smallest element in the periodic table is?
a) Hydrogen b) Fluorine c) Lithium d) Uranium

8) Covalent hydrides are:
a) Gaseous b) Solid c) Liquids d) Both a & c

9) Which group of elements shows greatest electrical conductivity?
a) Alkali metals b) Alkaline earth metals
c) Halogens d) Coinage Metals

10) Which group has coinage metals?
a) IB b) IIB c) IIIA d) IA

11) Hydrogen has properties similar to:
a) Alkali metals b) Halogens c) Both a and b d) None of these

12) Metals usually produce hydrogen gas with acids. Which of the following produces hydrogen gas with NAOH?
a) Zn b) Cu c) Al d) Ni

13) Who started the development of the First Periodic Table?
a) Antoine Bequerel b) Dimitri Mendeleev c) Robert Boyle d) John Newlands

14) Hydration energy increases with
a) With high charge density
b) Distance between nucleus and outer most electron
c) Size of the atom
d) None of these

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15) What is the charge on a hydrogen ion?
a) +1 b) – 1 c) +2 d) –2

16) Periodic table is divided into groups A and B:
a) To differentiate between normal and transition elements
b) To differentiate between metals and non-metals
c) To differentiate between d and f block elements
d) None of these

17) 6th period of periodic table contains _____ elements:
a) 26 b) 24 c) 32 d) 36

18) 7th Period of the Periodic Table is:
a) Complete b) Incomplete c) Called Long Period d) None of these

Answers of Chapter 1 – Periodic Classification of Elements and Periodicity

1) 32

2) Dobreiner

3) Co
Transition elements due to greater number of valence electrons in partially filled d-orbitals show variable valency.

4) $B(OH)_3$
The hydroxides of alkali and alkaline earth metals are strong bases. Moving from left to right on periodic table the acidic character of hydroxides increases. Boron belongs to group IIIA and produces acidic hydroxide.

5) None of these
All of these elements can be found in the free state. Hydrogen and Oxygen exist in the open atmosphere and Carbon is available in form of graphite, diamond etc.

6) Silver, Copper
Metals of group IB Copper, Silver and Gold also known as coinage metals have extraordinarily high values of electrical conductance. The pair Silver, Copper belongs to coinage metals and thus will have the highest conductivity. In all other pairs only one of the metals is from coinage group.

7) Hydrogen

8) Both a & c
Covalent hydrides are usually gases or volatile liquids.

9) Coinage Metals
Group IB elements have unpaired electrons, which are easier to delocalize over the metal. These electrons are the reason for their high conductivity and contribute to their relatively high melting and boiling points.

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10) IB

11) Both a and b
Hydrogen resembles with alkali metals only in possessing one electron in the s orbital of the outermost shell. It also resembles with halogens in that it is a non – metal and forms H- ion by gaining electron from strong electro – positive metals. It is also a gas consisting of diatomic molecules (H_2) like F_2 and Cl_2.

12) Zn
Bases react with certain metals like zinc or aluminum to produce hydrogen gas. Zinc reacts with sodium hydroxide to produce zincate sodium and hydrogen. This reaction takes place at a temperature near 550°C.

13) Dimitri Mendeleev

14) With high charge density
Hydration energy depends on charge to size ratio of the atom.
Moving from left to right in the periodic table, the charge density increases which increases the charge to size ratio and as a result the hydration energy increases.

15) +1
A hydrogen atom is made up of a nucleus with one proton and a single electron. A hydrogen ion, which would have lost an electron will have a charge of +1.

16) To differentiate between normal and transition elements
Each group is divided into two subgroups, A and B. The subgroups containing the representative or normal elements, are labelled as subgroup A. Whereas, B subgroup contain less typical elements called Transition elements which are arranged into the center of the periodic table.

17) 32
In 6th period, there is a Lanthanides series which contains 14 elements & the general period contains 18 elements. So, in total 32 elements in the 6th period.

18) Incomplete
There are total 7 periods (6 complete and 1 incomplete) in the modern periodic table. The first period is the shortest period containing only 2 elements. The second and third periods are short periods. The population of each short period is eight elements. The fourth and fifth periods are long periods and contain 18 elements each. Sixth period is the longest and contains 32 elements in it. Seventh period is the incomplete period.

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Chapter 2 – s Block elements

1) Li is an element of group?
a) II-A b) III-A c) I-A d) IV-B

2) Sodium is prepared by
a) Down's cell b) Castner-kellner process
c) Dutch's method d) Nelson's process

3) Which of the following is unstable?
a) Li_2CO_3 b) $MgCO_3$ c) Both a and b d) Both are stable

4) Rocky crust of earth is mainly composed of?
a) Oxygen and Silicon b) Oxygen and Carbon
c) Oxygen and Hydrogen d) Carbon and Hydrogen

5) Melting point of Group I-A elements is _____ than Group II-A elements
a) Higher b) Lower c) Same d) Varies

6) Which of the following do not occur in Free State?
a) Li b) Mg c) Both d) None of these

7) Gypsum supplies _____ to soil
a) Carbon b) Sulpuhr c) Nitrogen d) Calcium
e) Both b and d

8) Which of the following is not true about caustic soda?
a) It causes painful burns b) It has purgative smell
c) It is manufactured by *Castner–Kellner process* *d) It is used as an anti-acid*
e) Both b and d

9) Formula of Epsom salt is:
a) $MgSO_4.H_2O$ b) $MgSO_4.7H_2O$ c) $CaSO_4.2H_2O$ d) $PbCr_2O_7$

10) Group 1A and 11A are known as:
a) Alkali b) Alkaline earth c) s block elements d) P block elements

11) The basic character of alkali metal oxides:
a) Decreases down the group b) Increases down the group
c) Remains same d) None of these

12) Which one of these reacts rapidly with water at room temperature?
a) Na b) Al c) Fe d) Ca

13) When alkali metal react with water the fire is produced due to:
a) Ions b) Hydrogen gas c) Water d) None of these

14) Color of Epsom salt Is
a) White b) Pink c) Blue d) Green

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15) For Alkali Metals, decrease in the ionization potential is because of the increasing:
a) Charge on the nucleus
b) Distance between nucleus and outer most electron
c) Size of the atom
d) None of these

16) Which one of the following is a common mineral of calcium?
a) Feldspar b) Limestone c) Diamond d) None of these

17) Which of the following is a major mineral of Lithium?
a) Spodumene b) Rock salt c) Carnallite d) Alunite

18) What is the chemical formula of Epsom Salt?
a) MgSO4.7H2O b) MgCO3 c) MgCO3.CaCO3 d) Mg(SiO3)4

Answers of Chapter 2 – s Block Elements

1) I-A

2) Down's cell

3) Li_2CO_3
Lithium has low electropositive character; thus its carbonate and nitrate are not so stable and therefore decompose giving lithium oxide.

4) Oxygen and Silicon
Most of the earth's crust is composed of insoluble alumino-silicates of alkali metals.

5) Lower
Melting points of group IIA elements are considerably higher than those of group IA elements because each atom in them provides two binding electrons.

6) Both a and b
Due to high reactivity alkali and alkaline earth metals do not occur in free state. They are found in form of compounds.

7) Both b and d

8) It has purgative smell
Sodium Hydroxide is a strong base so can be used as anti-acid, to counter the effect of acid. On industrial scale sodium hydroxide can be prepared by the following methods:
1) Castner - Kellner Process. 2) Gibb's Method. 3) Nelson's Method
It can cause severe burns and is odorless.

9) $MgSO_4.7H_2O$
Hepta hydrate ($MgSO_4.7H_2O$) is the best-known form of magnesium sulphate and is commonly known as Epsom salt.

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10) s block elements

11) Increases down the group

12) Na
Very rapid reaction occurs when alkali metals react with water even at room temperature.

13) Hydrogen gas
The energy produced during the reaction causes the hydrogen to burn as the reaction takes place. So, the fire is produced due to the Hydrogen gas

14) White

15) Distance between nucleus and outer most electron
Ionization potential is also known as Ionization Energy.
Ionization energy decreases down the group as the size of the atom increases because of the shielding effect. Increase in the size means that the distance between nucleus and outermost valence electrons is also increased. So, if the distance between nucleus and outermost electrons is increasing, the ionization potential will decrease.

16) Limestone

17) Spodumene
Lithium deposits, usually in the form of complex minerals, are widely scattered over the earth. An important commercial source of lithium is the mineral spodumene, $LiAl(SiO3)2$. Carnallite and Alunite are minerals of Potassium. Rock Salt (NaCl) is the mineral of Sodium.

18) $MgSO4.7H2O$
Epsom salt is a magnesium sulfate compound. Epsom salt has been used for hundreds of years as a healing agent and pain reliever. Today, it is most often added to hot baths and foot soaks to reduce stress.

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Chapter 3 – Group IIIA and IVA elements

1) Aluminium is _____ agent?
a) Good oxidizing
b) Good reducing
c) Weak reducing
d) Both oxidizing and reducing agent

2) Aluminium is a_____
a) Insulator
b) Conductor
c) Semi-Conductor
d) Photo Conductor

3) Which element of group 4A shows inert pair effect?
a) Ge
b) Pb
c) Si
d) C

4) Which of the following elements of Group 3 is non-metallic in character?
a) B
b) In
c) Tl
d) Ga

5) Orthoboric acid can NOT be obtained by which of the following?
a) Metaboricacid
b) Tetraboric acid
c) Pyroboric acid
d) Boric anhydride

6) Solubility of Borax decahydrate at 100°C is?
a) 63 grams
b) 113 grams
c) 99.3 grams
d) 58.5 grams

7) The oxidation states of Boron are:
a) +1,+2 and +3
b) -1, -2 and -3
c) +1 and -1
d) +3 and -3

8) Aluminum reacts with H_2SO_4 to produce
a) $Al_2(SO_4)_3$
b) SO_3
c) SO_2
d) Al

9) What is the chemical name of SANDUR?
a) Tetraplumbic oxide
b) Triplumbic oxide
c) Triplumbic tetraoxide
d) Lead dioxide

10) Which one of the following is metalloid?
a) C
b) Si
c) S
d) O

11) Borax bead test is used to separate:
a) Metallic cations
b) Metallic anions
c) Non-metallic cations
d) Non-metallic anions

12) Which element among the following forms a protective oxide coating on exposure to air?
a) Nitrogen
b) Aluminium
c) Boron
d) Lithium

13) Which one is not the type of Boric Acid?
a) Ortho boric Acid
b) Nano boric acid
c) Meta boric Acid
d) Pyro boric acid

14) Which one of the following is an acid?
a) H_3BO_3
b) $Al(OH)_3$
c) $Ca(OH)_2$
d) NaOH

15) Which of the following is used to make container for nitric acid?
a) Iron
b) Aluminium
c) Sodium
d) Plastic

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16) Chemical formula of powder used in carom board is?
a) $NaHCO_3$ b) H_3BO_3 c) Na_2CO_3 d) K_2CO_3

17) Silicon can be obtained from which one of the following compounds?
a) Water b) Sand c) Potash d) None

18) Ability of carbon to form long chains and rings is known as?
a) Catenation b) Supplementation c) Adulteration d) Addition

19) Aluminium is _____ in Nature
a) Acidic b) Basic c) Amphoteric d) Salt

20) Boric acid is used in
a) Washing wounds b) Eye-wash c) Detergents d) Washing powder

21) Which of the following forms a layer of oxide on its exposure to moisture?
a) Aluminum b) Iron c) Steel d) Copper

22) Aluminum silicate is used in:
a) Cement b) Glass c) Urea d) None of these

23) Burning of amorphous Boron in air forms
a) $B(OH)_3$ b) B_2O_3 c) BN d) Mixture of B_2O_3 & BN

24) The formula of cryolite is:
a) Na2AlF6 b) Na3AlF3 c) Na3AlF6 d) Na2AlCl6

Answers of Chapter 3 – Group IIIA and IVA Elements

1) Good reducing
Aluminium is a good reducing agent and thus can be used for this reason in chemical and steel industries.

2) Conductor
Aluminium is an excellent conductor of both heat and electricity.

3) Pb
The pair of valence electrons that do not readily take part in chemical combination is termed as inert pair. The inert pair effect is mostly observed elements with higher atomic masses e.g., Lead.

4) B
The small size and high nuclear charge make Boron non-metallic while all other elements of the group are metallic in nature.

5) Boric anhydride
Meta, Tetra and Pyro boric acids are stable in solid form, but they change into orthoboric acid in the solutions.

6) 99.3 grams

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7) +3 and -3

Boron uses all the three valence electrons for bonding purposes and its common oxidation states are +3 and -3.

8) $Al_2(SO_4)_3$

Aluminium does not react with dilute sulfuric acid. However, it is oxidized by hot concentrated sulfuric acid to liberate sulfur dioxide gas. The reaction equation is: $2Al + 6H_2SO_4 \rightarrow Al_2(SO_4)_3 + 6H_2O + 3SO_2$

9) Triplumbictetraoxide

10) Metallic cations

12) Aluminum

Pure aluminum naturally forms a thin surface layer of aluminum oxide on contact with oxygen in the atmosphere through a process called oxidation, which creates a physical barrier to corrosion or further oxidation in most environments.

13) Nano boric acid

14) H_3BO_3

H_3BO_3 is known as boric acid. It dissociates weekly in water and gives only one proton. Therefore, it is monobasic.

15) Aluminum

Aluminum does not react with Nitric acid at any concentration. Nitric acid is, therefore, frequently transported in Aluminum containers.

16) H_3BO_3

Boric Acid, the Carom Powder is also called as the Orthoboric acid and Boracic acid, which is a crystalline chemical compound made up of Hydrogen, Boron and Oxygen. The chemical compound has the chemical formula H_3BO_3 and it is a weak acid.

17) Sand

Silicon makes up a quarter of the earth's crust by weight, and is found in most minerals, including sand. However, silicon does not exist in a free state; it is always in combination with other elements.

18) Catenation

19) Amphoteric

Aluminium oxide is an amphoteric substance, meaning it can react with both acids and bases, such as hydrofluoric acid and sodium hydroxide, acting as an acid with a base and a base with an acid, neutralizing the other and producing a salt.

20) Eye-wash

21) Aluminum

When a piece of aluminum sheet is exposed to moist air it acquires a thin, continuous coating of aluminum oxide, which prevents further attack on the metal by atmospheric oxygen and water under normal conditions. Because of this aluminum sheets are said to be corrosion free.

22) Glass

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Aluminosilicate glass is a type of glass that contains aluminum oxide, usually at levels between 20% and 40%. There are different types of Aluminosilicate glass, based on their chemical compositions, with a particular focus on the oxide composition.

23) Mixture of B_2O_3 and BN

Air contains a mixture of Oxygen, Nitrogen, and some other gases. Amorphous boron on burning in the air gives a mixture of boron trioxide and boron nitride. Boron burns with a brilliant flame in oxygen. The reaction can be given as follow:

$4B + 3O_2 \rightarrow 2B_2O_3$ $\qquad$ $2B + N_2 \rightarrow 2BN$

24) Na3AlF6

Cryolite is the important mineral of Aluminum with chemical formula Na3AlF6. Chemical name of cryolite is Sodium aluminum fluoride.

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Chapter 4 – Group VA and VIA elements

1) Which of the following does not occur in Free State?
a) Nitrogen b) Phosphorous c) Oxygen d) Sulphur

2) Formula of laughing gas is?
a) NO b) NH_4 c) N_2O d) NO_3

3) H_3PO_3 is
a) Weak reducing agent b) Strong reducing agent
c) Strong oxidizing agent d) Weak oxidizing agent

4) In which of the following the oxidation state of S is the highest?
a) SO_2 b) SCl_2 c) H_2SO_4 d) H_2SO_3

5) Which of the following has allotropic forms:
a) Oxygen b) Sulphur c) Both d) None of these

6) In rhombic sulphur there are ____ atoms in each molecule?
a) 7 b) 8 c) 6 d) 9

7) H_2SO_4 is used in industries of?
a) Paint b) Textile c) Rubber d) Aluminum

8) Which member of 5A group has no stable isotope?
a) Phosphorous b) Bismuth c) Nitrogen d) Arsenic

9) Which one of the following does not have allotropes?
a) N b) P c) As d) Sb

10) Both O_2 and O_3 are Oxidizing agents but O_3 is preferred because:
a) It is relatively unstable than O_2 b) It provides an extra oxygen atom then O_2
c) It provides Nascent Oxygen d) All of above

11) Which of these is not an isotope of Phosphorus?
a) Red Phosphorus b) Black Phosphorus c) White Phosphorus d) Gray Phosphorus

12) Nitrogen has _____ oxides:
a) 2 b) 3 c) 1 d) Several

13) Copper reacts with hot concentrated H_2SO_4 in presence of
a) Air b) Water c) Ammonia d) Strong heat

14) Which one of the following is a vulcanizing agent?
a) Sodium b) Iron c) Sulphur d) Potassium

15) Gas which has percentage equal to 78% in air is the
a) Oxygen b) Hydrogen c) Carbon dioxide d) Nitrogen

16) Which one of the following elements has six valence electrons?
a) O b) S c) Cd d) Fe

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17) The formula of Chile Peter salt is
a) NaCl b) $NaNO_3$ c) NaOH d) $NaNO_4$

Answers of Chapter 4 – Group VA and VI Elements

1) Phosphorous
Non-metals generally occur in free state except silicon and phosphorus. In combined state they occur as oxides, carbonates, sulphides, sulphates, phosphates, nitrites and halides.

2) N_2O

3) Strong reducing agent
Phosphorous acid is a diprotic acid and is a good reducing agent, although not necessarily quick to react. It is oxidized to phosphoric acid or its salts. It reduces solutions of noble metal cations to the metals.

4) H_2SO_4
The oxidation number for sulfur in
SO_2 = +4 SCl_2 = +2 H_2SO_4 = +6 H_2SO_3 = +4

5) Both a and b

6) 6

7) Textile

8) Bismuth

9) N

10) All of above

11) Gray Phosphorus

12) Several

13) Water
Hot concentrated Sulfuric acid reacts with aqueous solution of Copper to produce Copper Sulfate.

14) Sulphur

15) Nitrogen
Percentages:
Nitrogen — 78 percent. Oxygen — 21 percent.
Argon — 0.93 percent. Carbon dioxide — 0.04 percent.
Trace amounts of neon, helium, methane, krypton, and hydrogen, as well as water vapor.

16) S

17) $NaNO_3$

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Chapter 5 – The halogens and The Noble Gases

1) The reduction of which of the following produces Hydrofluoric acid?
a) XeF_2 b) XeF_4 c) XeF_6 d) All of the above

2) Bleaching powder is _____ agent?
a) Oxidizing b) Reducing c) Both a and b d) None of these

3) Which of the following is bleaching powder's formula?
a) $Ca(ClO)_4$ b) $Ca_2(ClO)_2$ c) $Ca(ClO)_2$ d) $Ca(Cl_2O)_2$

4) Which of the following is a component of TEAR GAS:
a) Bromine b) Fluorine c) Chlorine d) Argon

5) From the following which is used as bleaching agent
a) Flourine b) Chlorine c) Bromine d) Iodine

6) Which halogen is used as a refrigerant?
a) F b) Cl c) Br d) I

7) _____ is used in electric light bulbs, in fluorescent tubes, in radio tubes and Geiger counters
a) Radon b) Neon c) Argon d) Both a and b

8) What is the heat of vaporization of radon?
a) 1.77 b) 9.7 c) 18.0 d) 6.5

9) Which of the following halogen does not form stable oxyacids?
a) Cl b) F c) Br d) I

10) The order of decreasing power as an oxidizing agent is
a) $F_2 > Br_2 > Cl_2 > I_2$ b) $F_2 > Cl_2 > Br_2 > I_2$ c) $F_2 < Cl_2 < Br_2 < I_2$ d) $F_2 < Br_2 < Cl_2 < I_2$

11) Which of the following is the formula of Potassium permanganate?
a) $KMnO_4$ b) K_2MnO c) $KMnO_2$ d) None of these

12) Which of the following has highest boiling point?
a) He b) Ne c) Ar d) Kr

13) Which of the following show halogens?
a) F to At b) N to Bi c) C to Sn d) H to Cs

14) Fluorine is reactive due to its:
a) Low Ionization potential b) Low dissociation energy
c) Low electro negativity d) Large size

15) Oxides of xenon are formed from:
a) XeF_6 b) XeF_4 c) XeF_2 d) All of these

16) Percentage of Chlorine present in bleaching powder is:
a) 5-10 b) 20-25 c) 35- 40 d) 90

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17) What is the chief ore of fluorine?
a) Cryolite b) Fluorspar c) Dolomite d) Both a and b

18) Sulfur with HI acts as a:
a) Strong oxidizing agent b) Weak oxidizing agent
c) Strong reducing agent d) Weak reducing agent

19) Noble gasses have?
a) High ionization energy b) Low ionization energy
c) Zero ionization Energy d) None of these

20) Which of the following is the highest oxidizing agent?
a) F_2 b) Cl_2 c) Br_2 d) I_2

21) Which halogen is present in Teflon?
a) Chlorine b) Bromine c) Fluorine d) Iodine

22) Which of the following can be bleached using Bleaching power?
a) Cotton b) Wool c) Silk d) All of these

23) Electrons are most loosely bound in which of the following halogen?
a) Iodine b) Bromine c) Chlorine d) Fluorine

24) Which of the following is a result of reaction between Iodine and Oxygen?
a) Iodine Hexaoxide b) Iodine Pentaoxide c) Iodine Dioxide d) Iodine Heptaoxide

25) The halogens are known as:
a) Salt formers b) Rare earth elements c) Alkali metals d) Noble gases

Answers of Chapter 5 – The Halogens and The Noble Gases

1) All of the above

2) Oxidizing

3) $Ca(ClO)_2$

4) Chlorine
The chemical formula of tear gas is $C_{10}H_5ClN_2$.

5) Chlorine

6) F

7) Argon

8) 18.0

9) F

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It does form HOF (hypoflorous acid) at very low temperatures. When F_2 is passed over ice at very low temperatures (around -40c), HOF is formed.
$H_2O + F_2 \rightarrow HF + HOF$
But it is very unstable at room temperature and explodes.

10) $F_2 > Br_2 > Cl_2 > I_2$

11) $KMnO_4$

12) Kr
The boiling point of noble gases increases down the group with the increase in size.

13) F to At

14) Low dissociation energy

15) XeF_6

16) 35- 40
The average percentage of available chlorine in bleaching power is 35 – 40%

17) Both a and b

18) Strong oxidizing agent
Sulfur oxidizes HI to elemental Iodine. The reaction equation is: $2HI + S \leftrightarrow I_2 + H_2S$

19) High ionization energy
Ionization energy is the amount of energy required to remove the most loosely held electron. Since Noble Gases have a full outer shell, it would take a lot of energy to rip an electron from it. So Noble Gases have high values of ionization energy.

20) F_2
Since all the halogens have a strong tendency to accept electrons. Therefore, halogens act as strong oxidizing agents and their oxidizing power decreases from fluorine to iodine.

21) Fluorine
Teflon is the best-known brand name PTFE based formula, which is Polytetrafluoroethylene $(C_2F_4)n$. It contains fluorine atoms.

22) Cotton
Bleaching powder can be used for bleaching cotton, linen and paper pulp. Delicate fabrics like wool, silk etc. cannot be bleached with it as these could be damaged by chlorine.

23) Iodine
On moving down the halogen group, the number of electron shells increases. With increase in the distance between valence electrons and nucleus, less energy is required to remove valence electrons as they are less tightly held to the nucleus.

24) Iodine Pentaoxide
Iodine forms following oxides: Iodine pentaoxide(I2O5), Iodine Iodate(I4O9), and Iodine tetraoxide(I2O4).

25) Salt formers
The elements of Group VIIA (fluorine, chlorine, bromine, iodine, and astatine) are called the halogens. The term "halogen" means "salt-former" because these elements will readily react with alkali metal and alkaline earth metals to form halide salts.

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Chapter 6 – Transition Elements

1) Transition elements are colored because of:
a) d-d transition b) d-p transition c) p-p transition d) s-d transition

2) d-d transitions in transition metals gives?
a) Crystalline structure b) Characteristic color c) Hardness d) Higher reactivity

3) Transition elements are colored in which type of compounds?
a) Ionic b) Covalent c) Both a and b d) None of these

4) Which of the following has the lowest boiling point?
a) Titanium b) Chromium c) Manganese d) Vanadium

5) Which of the following doesn't has an incomplete d-orbital?
a) Ag b) Au c) Cu d) All of these

6) Which element of 5th group doesn't have unpaired valence electrons in d-sub shell?
a) V b) Nb c) Ta d) La

7) What is NOT true about $K_2Cr_2O_7$?
a) Blue crystalline solid b) Not soluble in water
c) Strong oxidizing agent d) Used in formation of lead chromate

8) Acidified $K_2Cr_2O_7$ is also called:
a) Ceramic acid b) Chromic Acid c) Dichromate d) None of these

9) What is not true about transition metals?
a) They can make colored complexes b) They can be used as a catalyst
c) They have only one valency d) They are d block elements

10) Number of unpaired electrons in ferrous ion is:
a) 2 b) 3 c) 5 d) 4

11) Which metal is not attracted by magnet?
a) Copper b) Zinc c) Iron d) Nickel
e) Both a and b

12) Which element does not show magnetic properties?
a) Zn b) Fe c) Co d) Mn

13) Which of the following is the reason that Iron is the most abundant element?
a) Oldest metal b) Binding energy c) Less stability d) Ferromagnetic

14) Which of the following states of copper is more stable?
a) Cu^{+1} b) Cu^{+2}
c) Both a and b d) Depends on environment

15) Which of following transition complex will have most stable square planar structure?
a) $[MnCl4]^{2-}$ b) PCl5 c) $[Cu(NH3)4]^{2-}$ d) $[Co(NH3)6]^{2-}$

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16) Lanthanide Contraction is phenomenon of block :
a) f block b) s block c) d block d) p block

17) Higher Transition elements are:
a) d-type b) f-type c) Both a and b d) None of these

Answers of Chapter 6 – Transition Elements

1) d-d transition

2) Characteristic color

3) Both a and b

4) Manganese
Manganese shows an anomalous character exhibiting lower boiling point than the neighboring elements.

5) All of these
All three coinage metals possess a complete d-orbital.

6) Nb

7) Blue crystalline solid
It is an orange red crystalline solid which melts at 396 C and is soluble in water.

8) Chromic Acid

9) They have only one valency
With few exceptions, transition elements show variable valency or oxidation state.

10) 4

11) Both a and b
Manganese, Iron, cobalt and nickel are magnetic. Metals that have iron in them attract magnets well. Steel is one. Metals like brass, copper, zinc and aluminum are not attracted to magnets.

12) Zn
Magnetic property is due to presence of unpaired electrons. Since Zinc does not have any unpaired electron, it is not attracted by magnet.

13) Binding energy
Iron is plentiful because of its nuclear stability and high binding energy.

14) Cu^{+2}
Cu^{+2} is more stable than Cu^{+1}. Stability depends on the hydration energy (enthalpy) of the ions when they bond to the water molecules. The Cu^{+2} ion has a greater charge density than Cu^{+1} ion and thus forms much stronger bonds releasing more energy. The extra energy needed for the second ionization of the copper

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is more than compensated for by the hydration, so much so that the Cu^{+1} ion loses an electron to become Cu^{+2} which can then release this hydration energy.
In aqueous solution Cu^{+1} disproportionate to Cu^{+2} and Cu

$$2Cu^{+1} \rightarrow Cu^{+2} + Cu.$$

15) $[Cu(NH3)4]^{2-}$
The Geometry of given complexes are:
$[MnCl4]^{2-}$ = Tetrahedral
PCl5 = Trigonal Bipyramidal
$[Cu(NH3)4]^{2-}$ = Square Planar
$[Co(NH3)6]^{2-}$ = Octahedral

16) f block
Lanthanide contraction is the gradual decrease in the atomic and ionic size of lanthanoids with an increase in the atomic number.
Causes of lanthanide contraction: With an increase in the atomic number, the positive charge on nucleus increases by one unit and one more electron enters same 4f subshell. The electrons in 4f subshell imperfectly shield each other. Shielding in a 4f subshell is lesser than in d subshell. With the increase in nuclear charge, the valence shell is pulled slightly towards the nucleus. This causes lanthanide contraction.

17) f-type
f-block elements are also known as inner transition elements i.e., lanthanides and actinides. Whereas d-block elements are known as outer transition elements.

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Chapter 7 – Fundamental Principles of Organic Chemistry

1) Which of the following is/are organic?
a) Protein b) Carbohydrates c) Both a and b d) None of these

2) The coal used for domestic purposes is: -
a) Lignite b) Anthracite c) Bituminous d) Sub bituminous

3) Isomerism is:
a) Same molecular formula but different structure
b) Same molecular formula and same structure
c) Different molecular formula but same structure
d)None of these

4) Which process is used to produce volatile compounds?
a) Reforming b) Cracking c) Polymerization d) Distillation

5) The type of isomerism in which the position of functional group changes is called?
a) Tautomesrism b) Metamerism
c) Cis-Trans Isomerism d) Functional Group Isomerism

6) Example of metamerism is:
a) Dimethyl ether and methyl alcohol b) 1-Butene and 2-Butene
c) Diethyl ether and methyl n-propyl ether d) n-pentane and iso-pentane

7) Carbonyl group is present in
a) Glycol b) Glycerol c) Dihydrid alcohol d) None of these

8) Na, Ca & Mg are
a) Organic b) Inorganic metals
c) Inorganic non-metals d) Organic metals

9) Proton transfer within a molecule is known as:
a) Position isomerism b) Tautomerism c) Metamerism d) Isomerism

10) Which of the following is not an isomer of other three:
a) 2,2-Dimethyl pentane b) 2-Methylhexane
c) 2,3- Dimethyl pentane d) 2,2- Dimethyl butane

11) Which of the following has shortest C - C bond length?
a) Acetylene b) Methyl Alcohol c) Benzene d) Methane

12) Which of the following is an organic compound?
a) Explosives b) Paper c) Plastic d) All of these

13) Study that deals with hydrocarbons and its derivatives is known as:
a) Inorganic chemistry b) Organic chemistry c) Analytical chemistry d) Physical chemistry

14) Wohler prepared urea from:
a) Bakelite b) Cyanic acid c) NH4CNO d) Formaldehyde

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Answers of Chapter 7 – Fundamental Principles of Organic Chemistry

1) Both a and b

2) Anthracite
Anthracite coal can be used as a smokeless fuel in domestic and industrial contexts.

3) Same molecular formula but different structure

4) Cracking
Cracking breaks higher hydrocarbons having higher boiling points into smaller hydrocarbons which are more volatile (low boiling points)

5) Metamerism

6) Diethyl ether and methyl n-propyl ether
In metamerism there is an unequal distribution of carbon atoms on either side of the functional group and the resulting compounds belong to same homologous series. From the given options Diethyl ether and methyl n-propyl ether are metamers.

7) None of these
8) Inorganic metals
9) Tautomerism
10) 2,2- Dimethyl butane

11) Acetylene
C – C Bond length in Acetylene is 1.201 A. C – C Bond length in Benzene is 1.397 A.
In Methane and Methly Alcohol, there is no C – C bond, so these two cannot be the correct answers. Therefore, the correct option is Acetylene.
Bond length is defined as the distance between the centers of two covalently bonded atoms. The length of the bond is determined by the number of bonded electrons (the bond order). The higher the bond order, the stronger the pull between the two atoms and the shorter the bond length. Generally, the length of the bond between two atoms is approximately the sum of the covalent radii of the two atoms. Therefore, bond length increases in the following order: triple bond < double bond < single bond. Multiple bonds are shorter than single bonds between the same two elements because the additional bonding electrons attract the nuclei more strongly and pull the atoms closer together.

12) All of these
Organic compounds are a class of chemical compounds in which one or more carbon atoms are covalently paired with other atoms, most commonly hydrogen, oxygen, or nitrogen. Paper is made from the wood, and wood is primarily composed of Carbon, Hydrogen and Oxygen. This makes paper an organic compound. Plastics are composed of various elements such as carbon, hydrogen, oxygen, nitrogen, chlorine, and sulfur. This makes them an Organic compound. Explosives are also composed of a variety of compounds, and almost all of them are organic in nature.

13) Organic chemistry
Organic chemistry is the study of the structure, properties, composition, reactions, and preparation of carbon-containing compounds like hydrocarbons.

14) NH4CNO
The Wohler synthesis is the conversion of ammonium cyanate into urea. Wohler was attempting to make ammonium cyanate, but when the ammonia cyanate was formed it decomposed and formed urea.

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Chapter 8 – Aliphatic Hydrocarbons

1) Which metal is used to form alkanes from alkyl halides?
a) Zn b) N c) Both a and b d) None of these

2) KOLBE's method is used to prepare?
a) Ethane b) Ethene c) Ethyne d) All of these

3) In which of the following C-C bond length is the minimum?
a) Alkane b) Alkene c) Benzene d) Same length in all

4) If 2-butene is treated with $KMnO_4$, the product is:
a) Butanoic acid. b) Propanoic acid c) Butyric acid. d) Acetic acid

5) Formula of Thionyl chloride is
a) SCl_3 b) S_2Cl_2 c) $SOCl_2$ d) $SOCl_3$

6) The IUPAC name of the compound having structural formula $CH_3 – CH(OH) – COOH$ is:
a) 2-hydroxy propanoic acid b) Lactic acid
c) a-hydroxy propanoic acid d) Both a and b

7) Boiling point of heptane is:
a) 140 b) 160 c) 200 d) 98

8) Which one of these is/are gasses?
a) Methane b) Ethane c) Propane d) All of these

9) When $CH_2 = CH_2$ reacts with a halogen acid, the product formed is:
a) Alkyl halide b) Alkane c) Alkyl d) Alkene

10) Which gas among the following can be dried by bubbling in H_2SO_4?
a) Ammonia gas b) HCl gas c) Ethyne d) Oxygen gas

11) Acetylene with Cl_2 gives:
a) 1, 2-dicholropropane b) 1, 1, 2, 2-tetrachloroethane
c) Ethane dichloride d) 1, 1, 2, 2-tetrachloromethene

12) Sp hybridization is found in which of the following?
a) Ethane b) Ethene c) Ethyne d) None of these

13) Which one of the organic compounds is the most reactive?
a) Alkane b) Alkyne c) Alkene d) None of these

14) What is Lindlar Catalyst?
a) Fe_2O_3 and Al_2O_3 b) Al_2O_3 ,SiO_2, Cr_2O_3
c) Pd, $CaCO_3$ and Lead salts d) Charcoal

15) Which one of the following has the least C – C bond length?
a) Benzene b) Ethane c) Ethene d) Ethyne

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16) Formula of propene is
a) C_2H_5 b) C_3H_6 c) C_4H_8 d) C_6H_5

17) In alkanes all carbon atoms are linked by _____ bonds?
a) Double b) Single c) Triple d) Alternative

18) Which one of the following is saturated hydrocarbon?
a) Octane b) Nonane c) Decane d) All of the above

19) Unsaturated Compound containing double bond is:
a) Alkane b) Alkene c) Alkyne d) Alkylene

20) In Alkenes the Carbon atoms are connected to each other by a _____
a) Single bond b) Double bond c) Triple bond d) Not connected

21) Molecular Formula of Propane is:
a) C3H8 b) C4H10 c) C6H12 d) C7H14

22) The general formula of Methane Dichloride is:
a) CH3Cl2 b) CH4Cl2 c) CH2Cl2 d) None of these

Answers of Chapter 8 - Aliphatic Hydrocarbons

1) Zn

When alkyl halide is treated with nascent hydrogen [H], it produces alkane. The nascent hydrogen is obtained by the action of HCl with "Zn"

2) Ethane

Kolbe's electrolytic method is suitable for the preparation of symmetrical alkanes that is alkanes containing even number of carbon atoms

3) Alkene

4) Propanoic acid

Potassium permanganate can give a two-step oxidation reaction with alkenes. The first step, at ordinary temperatures, oxidizes the 1-butene to a double alcohol 1,2-butanediol. At elevated temperatures the butanediol can be further oxidized to form two carboxylic acids, propionic acid and formic acid. Other products are potassium hydroxide and manganese dioxide (from the KMnO4) and if the oxidation proceeds to form the formic and propionic acids, these combine with the KOH to form potassium formate and potassium propionate.

5) $SOCl_2$

6) 2-hydroxy propanoic acid Lactic acid is common name and 2-hydroxy propanoic acid is IUPAC name.

7) 98

8) All of these Alkanes containing up to four carbon atoms are colorless, odorless gases.

9) Alkyl halide $CH_2 = CH_2 + HCl \longrightarrow CH_3CH_2Cl$

10) HCl gas

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In the preparation of chlorine, HCl gas is bubbled through Water, to remove any traces of Hydrochloric Acid gas, that may be present and then it is dried by bubbling it through concentrated Sulphuric Acid.

11) 1, 1, 2, 2-tetrachloroethane

12) Ethyne

13) Alkyne Reactivity order: Alkyne > Alkene > Alkane

14) Pd, $CaCO_3$ and Lead salts

15) Ethyne

Ethyne would have the shortest bond length due to the presence of triple bond. Bond length increases in the following order: triple bond < double bond < single bond.

Bond length of Benzene is less than the single bond (Ethane) and more than double bond (Ethene). Therefore, the answer to this question is Ethyne.

16) C_3H_6

17) Single

Alkanes or Hydrocarbons are compounds made from carbon and hydrogen atoms joined by covalent bonds. Alkanes are saturated, they have only single bonds. Alkenes have double bonds and they are unsaturated.

18) All of the above

They all are Alkanes. Alkanes are saturated hydrocarbons as they have only single bonds in their structure.

19) Alkene

Alkanes have only single bonds between carbon atoms and are called saturated hydrocarbons. Alkene is the unsaturated hydrocarbon in which carbon atoms are bounded together by double covalent bond. Alkyne or alkylene is the hydrocarbon in which carbon atoms are bounded together by triple bond.

20) Double bond

Alkenes have at least one double bond in addition to single bond as they are unsaturated hydrocarbons.

21) C3H8

Propane is a 3-carbon alkane with a molecular formula C3H8. It is separated in large quantities from natural gas, light crude oil, and oil-refinery gases and is commercially available as liquefied propane or as a major constituent of liquefied petroleum gas (LPG).

22) CH2Cl2

The name "Methane" indicates that there is only 1 Carbon atom in the compound. Dichloride means 2 Chlorine atoms are attached to Carbon. Since the valency of Carbon is 4, two Hydrogen atoms must be attached to it, to complete the outer orbit. From here we can conclude that the general formula of Methane Dichloride is CH_2Cl_2 .

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Chapter 9 – Aromatic Hydrocarbons

1) n-Heptane can be converted into benzene by catalysts:
a) Al_2O_3, SiO_2, Fe_2O_3 b) SiO_2, K_2O, Cr_2O_3 c) Al_2O_3,SiO_2, Cr_2O_3 d) None of these

2) Which type of hybridization takes place in benzene?
a) Sp^3 b) Sp^2 c) Sp d) Sp^2 and Sp^3

3) Benzene with nitrating mixture gives?
a) Nitro benzene b) Nitro Toluene c) Nitro methane d) Acrylonitrile

4) The reaction of benzene with bromine gives?
a) Allkyl bromide b) Hydrogen bromide c) Bromo-phenol d) Bromo cyclohexane

5) Benzene is prepared in laboratory by distillation of phenol with
a) H2O2 b) Zn dust c) Ethyl bromide d) HOCl

6) Which of the following statements is incorrect about benzene?
a) All of the carbon atoms are sp hybridized.
b) The carbon-carbon bond lengths are all the same.
c) It has delocalized electrons.
d) The carbon-hydrogen bond lengths are all the same.
e) All twelve atoms lie in the same plane

7) How many Dewar Structure of Benzene are present?
a) 2 b) 3 c) 4 d) Infinite

8) Friedel craft's reaction gives?
a) Benzene b) Nitrobenzene c) Toluene d) Alkene

9) Benzene when reacted with chlorine in ultraviolet rays produces:
a) Hexacholorocyclohexane b) P-dichlorobenzene
c) Benzotrichloride d) Benzalchloride

10) Boiling point of benzene is:
a) 70.3 b) 80.1 c) 133 d) 79.41

11) The hybridization of benzene is:
a) sp_3 b) sp_2 c) sp d) None of these

12) Stability of benzene is due to_____.
a) Alternate double bonds b) Electrons' cloud
c) Double bonds d) Delocalization of electrons

13) C_6H_5 is:
a) Phenyl b) Methyl c) Ethyl d) Hexyl

14) Which of the following is formula of Benzyl Alcohol?
a) C_6H_5CHO b) $C_6H_5CH_2O_2CC_6H_5$ c) $C_6H_5CH_2OH$ d) C_5H_5N

15) Acetylene upon heating at 300 C gives:

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a) Benzene b) Alkene c) Alkane d) Alcohol

16) Friedel-Crafts Reaction can be used for the preparation of :

a) Toluene b) Benzene c) Phenol d) PABA

Answers of Chapter 9 – Aromatic Hydrocarbons

1) Al_2O_3, SiO_2, Cr_2O_3

2) Sp_2

The three sp2 hybrid orbitals on each carbon are utilized to form three sigma-bonds, two with adjacent carbon atoms and one with hydrogen.

3) Nitrobenzene

4) Bromocyclohexane

5) Zn dust

6) All of the carbon atoms are sp hybridized

7) 3

8) Toluene

9) Hexacholoro cyclohexane

10) 80.1

11) sp_2

There is sp_2 type of hybridization in benzene. S, 2px and 2py are hybrid orbitals. All the 2pz orbitals of six carbon atoms overlap in parallel fashion and create a delocalized electronic cloud. In short you can say unhybrid 2pz orbitals form π bonds.

12) Delocalization of electrons

In benzene there is delocalization of pi electrons thus it gives electrophilic substitution reaction rather than addition reaction, which is a normal property of alleges. Also due to resonance the resonance energy increases thus stability also increases.

13) Phenyl

The phenyl group or phenyl ring is a cyclic group of atoms with the formula C_6H_5. Phenyl groups are closely related to benzene and can be viewed as a benzene ring, minus a hydrogen, which may be replaced by some other element or compound to serve as a functional group.

14) $C_6H_5CH_2OH$

Benzyl alcohol(Or phenyl methanol) is an aromatic alcohol with the formula $C_6H_5CH_2OH$. The structure of Benzyl Alcohol contains methanol group (CH_2OH-) attached to a phenyl ring(C_6H_5-).

15) Benzene

Benzene is formed by passing acetylene under pressure over an organo-nickel catalyst at 70C.

16) Toluene

Benzene reacts with Methyl Chloride in presence of anhydrous Aluminum chloride, to produce Toluene. Anhydrous Aluminum chloride acts as catalyst in this reaction . This reaction is called as Friedel-Crafts Alkylation.

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Chapter 10 – Alkyl Halides

1) Catalyst used in the preparation of alkyl halide from alcohol is?
a) Platinum/charcoal b) LiH4 c) Rock salt d) $ZnCl_2$

2) Alcohols react with aqueous acid to produce alkyl halides in presence of
a) $ZnCl_2$ b) KOH c) SO_2 d) Pyridine

3) (NH_3) is a:
a) Nucleophile b) Neutrophile c) Electrophile d) Electrolyte

4) When Grignard reagent reacts with H_2O, which of the following is formed
a) Parent alkane b) Alkyl halide c) Alcohol d) All are possible

5) In alkyl halide, the halide ion has _____ charge on it when attached to C-atom.
a) Positive b) Negative c) Partial positive d) Partial negative

6) Reaction by Grignard reagent are mostly
a) Exothermic
b) Endothermic
c) Room temperature
d) Is highly reactive by both endothermic and exothermic

7) Which one the following can act as nucleophile?
a) Diethyl ether b) Anilinium ion
c) Acylium ion d) Dichloro methylene carbine

8) Which of the following is true about SN2 reactions:
a) They follow a two-step bimolecular mechanism
b) they do not undergo rearrangements
c) Methyl and primary substrates react faster than secondary and tertiary substrates
d) the rate of the reactions depend on both the substrate and nucleophile concentration

9) Grignard reagent when added to dry ice gives:
a) Primary Alcohol b) Alkyl Halide c) Tertiary Alcohol d) Carboxylic Acid

10) Grignard's reagent on hydrolysis give
a) Lower hydrocarbon b) Higher hydrocarbon c) Alcohols d) Alkyl halides

11) Alkyl Halides that go through SN1 reactions are
a) Primary b) Secondary c) Tertiary d) All of these

12) Which of the following Alkyl Halide is most reactive?
a) R-F b) R-Cl c) R-Br d) R-I

13) Which of the following Alkyl Halide is least reactive?
a) R-I b) R-Cl c) R-Br d) R-F

14) Tertiary alkyl hallides follow which of the following mechanism when attacked by a Nucleophile?
a) SN_2 b) SN_1 c) Both SN_1 and SN_2 d) None of these

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15) When Grignard reagent react with water they give _____ as a product
a) Ether b) Amine c) Alkane d) Alcohol

16) The term "Nucleophile" means:
a) Nucleus Loving b) Nucleus hating c) Amphiphilic d) None of these

Answers of Chapter 10 – Alkyl Halides

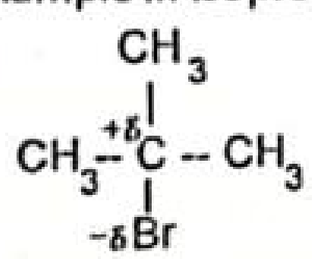
1) $ZnCl_2$

2) $ZnCl_2$

3) Nucleophile

4) Parent alkane

5) Partial negative
In alkyl halides, the C-X bond is polar because C-atom is attached to a highly electro-negative halogen atom. Therefore in alkyl halides carbon atom is electrophilic and halogen has a nucleophilic character. For example in isopropyl bromide, C-atom has partial positive charge and Br-atom has partial negative charge.



6) Exothermic

7) Diethyl ether
The O atom present in ether is electron rich and makes it to act as nucleophile.

8) They follow a two-step bimolecular mechanism

9) Carboxylic Acid
Grignard reagents react with dry ice (CO_2) to give carboxylic acids.

10) Lower hydrocarbon
Grignard's reagent on hydrolysis gives alkane.

11) Tertiary

12) R-I
The reactivity of Alkyl Halides depends on the electronegativity of the halogen. Larger value of electronegativity means stronger bond and therefore lesser reactivity. So, the reactivity of alkyl halides in order of most to least reactive is:

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I , Br , Cl , F

This means, R – I bond will be the most reactive and R – F bond will be the least reactive alkyl halide bond.

13) R-F

The reactivity of Alkyl Halides depends on the electronegativity of the halogen. Larger value of electronegativity means stronger bond and therefore lesser reactivity. So, the reactivity of alkyl halides in order of most to least reactive is:

I , Br , Cl , F

This means, R – I bond will be the most reactive and R – F bond will be the least reactive alkyl halide bond.

14) SN_1

15) Alkane

Grignard reagents react with water in presence of ether to form alkanes.

$$CH_3 - CH_3 - Mg - Br + H_2O \rightarrow CH_3 - CH_3 + Mg(OH)Br$$

16) Nucleus Loving

Nucleophile means "nucleus loving" which describes the tendency of an electron rich species to be attracted to the positive nuclear charge of an electron poor species, the electrophile.

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Chapter 11 – Alcohol, Phenol and Ethers

1) Melting point of methyl alcohol is:
a) -97 C b) -89 C c) -100 C d) -23 C

2) 2-methyl 2-propanol is:
a) Secondary butyl alcohol
b) Tertiary butyl alcohol
c) Primary butyl alcohol
d) Quaternary butyl alcohol

3) IUPAC name of wood spirit is
a) Ethanol b) Methanol c) Propanol d) None of these

4) Melting point of methyl alcohol is?
a) -97.6 °C b) -37.6 °C c) -64.7 °C d) -94.6 °C

5) Ethers are very good:
a) Solvent b) Oxidizing agent c) Reducing agent d) Dehydrating agent

6) Phenol is derived from?
a) Benzene b) Carboxylic acid c) Alcohols d) Aliphatic compounds

7) 25 to 35 degree centigrade temperature is good for which of the following process?
a) Dow's method
b) Preparation of formalin
c) Fermentation
d) Methanol

8) The reactivity of alcohol when O-H bonds break
a) Tertiary Alcohol < Secondary Alcohol < Primary Alcohol
b) Primary Alcohol > Secondary Alcohol > Tertiary Alcohol
c) Primary Alcohol > Secondary Alcohol < Tertiary Alcohol
d) Tertiary Alcohol > Primary Alcohol > Secondary Alcohol

9) Which of the following process is not use for the preparation of alcohol?
a) Reaction of alkyl halide with Grignard reagent
b) Hydration of alkene
c) Reaction of Grignard reagent from aldehyde
d) From water gas

10) Phenol is reduced to benzene on reaction with:
a) Zn b) NaOH c) KMnO4 d) HCl

11) Which is more soluble in ethanol?
a) Propane b) chlorine c) Calcium carbonate d) Potassium chloride
e) iron

12) Which of the following is not soluble in alcohol?
a) Resins and varnishes b) Soaps and varnishes c) Rubbers and plastics d) Dyes and drugs

13) Which of the following are not usually named using IUPAC system?
a) Alkenes b) Alkanes c) Ethers d) Alcohols.

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14) Ethanol and Methanol can be separated by:
a) Cannizzaro's reaction
b) Lucas Test
c) Iodoform test
d) Tollen's test

15) Alkoxides react with alkyl halide to form?
a) Ether
b) Ester
c) Carboxylic acid
d) Alcohol

16) Phenol, alcohol and ethers are the derivatives of?
a) Carboxylic acid
b) Alkenes
c) Organic derivatives of water
d) Benzene

17) Phenol has all characters except?
a) Can be reduced to benzene
b) Insoluble in water
c) Acidic in nature
d) Used as a disinfectant

18) Alkyl groups in ethers are connected by?
a) An oxygen atom
b) A carbon atom
c) A nitrogen atom
d) A benzene ring

19) Boiling point of C2H5OH is high than phenol because:
a) Of its stability
b) Presence of intermolecular H-bond
c) Both a & b
d) Its flammable

20) The aromatic compound having the functional group "OH" attached to it is?
a) Carbolic acid
b) Phenol
c) Alcohol
d) None of these

21) Propane-1 ol when combines with HCl in the presence of $ZnCl_2$, it gives:
a) 1- Chloropropane
b) 2- Chloropropane
c) Dichloropropane
d) 1-Cholropropene

22) With which of the following alcohols do not react to form alkyl halides?
a) HCl
b) $SOCl_2$
c) Br_2
d) PCl_3

23) Methyl alcohol is used for production of
a) Dyes
b) Drugs
c) Perfumes
d) Antifreeze

24) Boiling point of Ethyl Alcohol is?
a) 20.2 C
b) 100 C
c) 80.1 C
d) 78.3 C

25) Methylated spirit is _____ % methanol and _____ % ethanol:
a) 5 and 95
b) 20 and 80
c) 60 and 40
d) 50 and 50

26) Higher order alcohols
a) Have more than 1 carbon
b) Have more than 2 carbons
c) Have more than 3 carbons
d) Have more than 4 carbons

27) Either is dangerous in which of the following states?
a) Humid
b) Dry
c) Wet
d) Hot

28) Primary, Secondary and Tertiary alcohols can be distinguished by Lucas test in which _____ appears:
a) Oily Layer
b) Brown color
c) Both a and b
d) None of these

29) Phenol acts as a:

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a) Mild agent b) Oxidizing agent c) Reducing agent d) All of the above

Answers of Chapter 11 – Alcohols, Phenols and Ether

1) -97 C

2) Tertiary butyl alcohol
Tertiary Butyl alcohol, also called tertiary butanol or 2-methylpropan-2-ol, is the simplest tertiary alcohol, with a formula of $(CH_3)_3OH$.

3) Methanol

4) -97.6 °C

5) Solvent
Due to its polarity, ethers are usually nonpolar and so are organic compounds. Since "like dissolves like" ethers are excellent solvents.

6) Benzene

7) Fermentation

8) Primary Alcohol > Secondary Alcohol > Tertiary Alcohol

9) Reaction of alkyl halide with Grignard reagent
Grignard's reagent reacts with alkyl halide to form alkane not alcohol.

10) Zn

11) Potassium chloride
1. Ethanol is slightly polar. This is because it contains Oxygen which is electronegative and tends to accumulate electrons from the neighboring group.
2. Potassium Chloride has more tendency to dissolve as it can overcome the hydrogen bonds formed by ethanol a bit and dissolve.

12) Rubbers and plastics

13) Ethers
IUPAC names are not common as they are difficult. Usually, ethers are known by their common names.

14) Iodoform test
Methanol does not react during Iodoform test while ethanol does. So, using this data these two can be separated.

15) Ether
This process is called Williamson ether synthesis.

16) Organic derivatives of water

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17) Insoluble in water

Phenol is moderately soluble in water. It is due to its ability to form hydrogen bonding with water molecules. However, the large part of phenol molecule is phenyl group that is nonpolar and hence its solubility is limited in water. However, the polarity of this part too increases in phenoxide ion.

18) An oxygen atom

In ethers alkyl groups are bonded with oxygen atoms (R = O = R).

19) Presence of intermolecular H-bond

20) Phenol

21) 1- Chloropropane

22) Br_2

23) Antifreeze

Methanol is used as a solvent for dyes, varnishes, fats and oil. Its principal use is in the production of fuels, antifreeze and as a denaturant for ethanol.

24) 78.3 C

25) 5 and 95

26) Have more than 2 carbons

Higher alcohols (also called Fusel oil) are alcohols that have more than 2 carbons and thus have higher molecular weight and higher boiling point.

27) Hot

Ethers are flammable, diethyl ether $(C_2H_5)_2O$ is classified as extremely flammable. Ethers only require a hot surface such as hot plate, steam pipes, lamp bulbs or a static electrical discharge to easily ignite. A mobile phone could be an ignition source. Ether can form an explosive atmosphere with air at the concentration between 1.9 – 36% (by volume).

28) Oily Layer

Solution of $ZnCl_2$ in concentrated HCl is known as Lucas reagent. It is used to differentiate primary, secondary and tertiary alcohols. On adding the alcohol to Lucas reagent, a tertiary alcohol reacts immediately forming an oily layer of alkyl chloride which separates out in these reactions.

1. Tertiary alcohols form an oily layer immediately
2. Secondary alcohols form an oily layer in five to ten minutes
3. Primary alcohols form an oily layer only on heating.

29) Reducing agent

The antioxidant capacity of phenolic compounds is mainly due to their redox properties, allowing them to act as reducing agents, hydrogen donors, singlet oxygen quenchers or metal chelators.

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Chapter 12 – Aldehydes and Ketones

1) Ketones undergo reaction with which compound in the presence of acid to form oximes?
a) Hydroxy methane b) Hydroxyl amine c) Phenyl hydrazine d) None of these

2) Metaformaldehyde is a result of?
a) Condensation b) Reduction c) Polymerization d) Oxidation

3) In Cannizzaro's reaction out of two moles, one makes salt of an acid the other makes
a) Ester b) Alcohol c) Carboxylic Acid d) Alkane

4) Oxidation of alcohol converts it into?
a) Aldehyde b) Tertiary Alcohol c) Alkane d) Carboxylic Acid

5) What should be added to methane to produce HCN?
a) Ammonia b) Nitrogen c) Water d) H+

6) Aldehyde is prepared industrially by air oxidation of ethylene using catalyst
a) NaCN + HCl b) $PdCl_2 + CuCl_2$
c) 20% H_2SO_4 + 1% $HgSO_4$ d) $K_2Cr_2O_7 + H_2SO_4$

7) Which one of the following is used in making lozenges?
a) Methanol b) Acetaldehyde c) Acetone d) Formaldehyde

8) IUPAC name of propionaldehyde is:
a) Methanal b) Acetaldehyde c) Propanal d) Butanal

9) Paraldehyde is formed by:
a) Formaldehyde b) Acetaldehyde c) Acetone d) None of these

10) Ketones and aldehydes are reduced in the presence of catalyst:
a) Pd b) Al_2O_3 c) R-Mg-X d) $SOCl_2$

11) Simplest aromatic aldehyde has _____ number of hydrogen atoms.
a) 5 b) 6 c) 7 d) 8

12) Tollen's test is used for the detection of:
a) Aldehydes b) Ketones c) Carbonyl group d) None of these

13) Methyl Magnesium Bromide reacts with formaldehyde. The product will be:
a) Methyl Alcohol b) Acetone c) Ethyl Alcohol d) Ethane

14) Ketone can be prepared by the oxidation of:
a) Primary alcohol b) Secondary alcohol c) Tertiary alcohol d) None of these

15) Meta-formaldehyde molecule has ___ Oxygen atoms:
a) One b) Two c) Three d) Five

16) In which of the following reaction alkyl ketones are converted into carboxylic acid with one carbon atom less than the parent compound?
a) Haloform b) Cannizzaro c) Aldol d) None of these

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17) Odour of formaldehyde is:
a) Pungent b) Aromatic c) Pleasant d) Obnoxious

18) IUPAC Name of formaldehyde is
a) Ethanal b) Methanal c) Ethanol d) Methyl alcohol

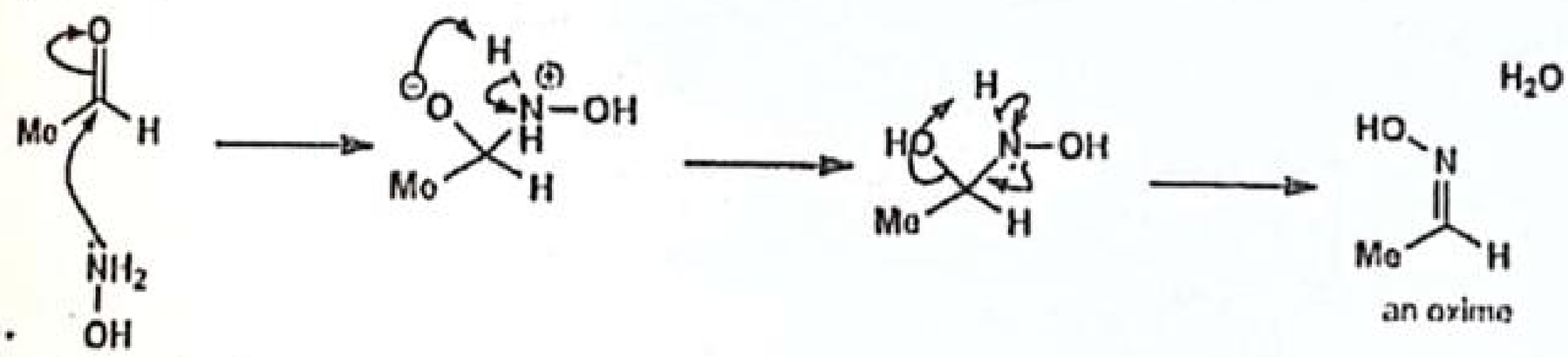
19) Formaldehyde is Industrially Prepared from:
a) Methanol b) Ethyl alcohol c) Methyl alcohol d) Oxidation of ethylene

20) Which of the following represent the formula of Ketone?
a) $R_2C=O$ b) RCHO c) ROR' d) RCOOH

21) H – CHO is:
a) Formaldehyde b) Acetaldehyde c) Ketone d) Ester

Answers of Chapter 12 – Aldehydes and Ketones

1) Hydroxylamine



2) Polymerization

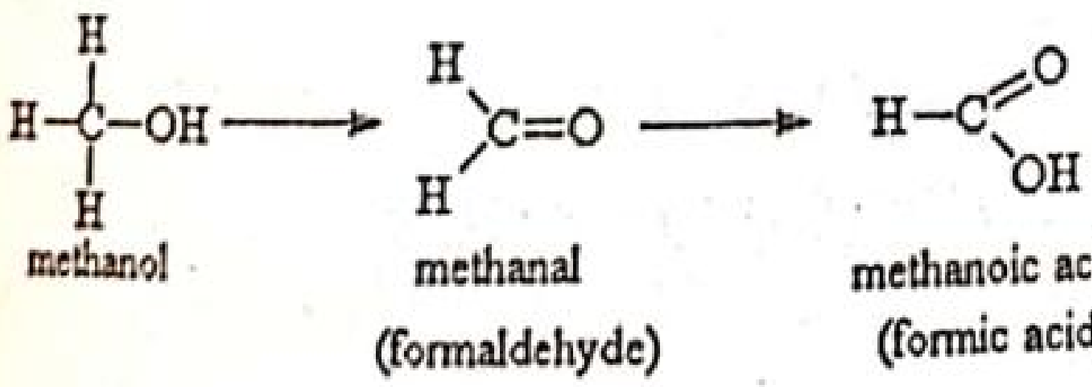
3) Alcohol

The Cannizzaro reaction represents the disproportionation of an aldehyde into a carboxylic acid and an alcohol.

4) Aldehyde

Oxidation of primary alcohol converts it into aldehyde and further oxidation gives carboxylic acid.

1° alcohol $\xrightarrow{[O]}$ aldehyde $\xrightarrow{[O]}$ carboxylic acid



5) Ammonia

Ammonia reacts with methane in the presence of air to form HCN.

6) $PdCl_2 + CuCl_2$

Wacker process, an industrial process for the manufacture of ethanol by oxidizing ethene with catalyst Palladium chloride and copper chloride.

7) Formaldehyde

8) Propanal

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9) Acetaldehyde

Paraldehyde is commercially prepared the polymerization of acetaldehyde with a small amount of sulfuric acid; then neutralization with calcium carbonate and purifying by fractional distillation are followed.

10) Pd

11) 6

Benzaldehyde (C_6H_5CHO) is an organic compound consisting of a benzene ring with a formyl substituent. It is the simplest aromatic aldehyde and one of the most industrially helpful.

12) Aldehydes

The Tollen's test is used to detect the presence of aldehyde groups. It is also used to distinguish between an aldehyde and a ketone. It exploits the fact that aldehydes are readily oxidized, whereas ketones are not.

13) Ethyl alcohol When Grignard's reagent reacts with formaldehyde it gives primary alcohols.

14) Secondary alcohol

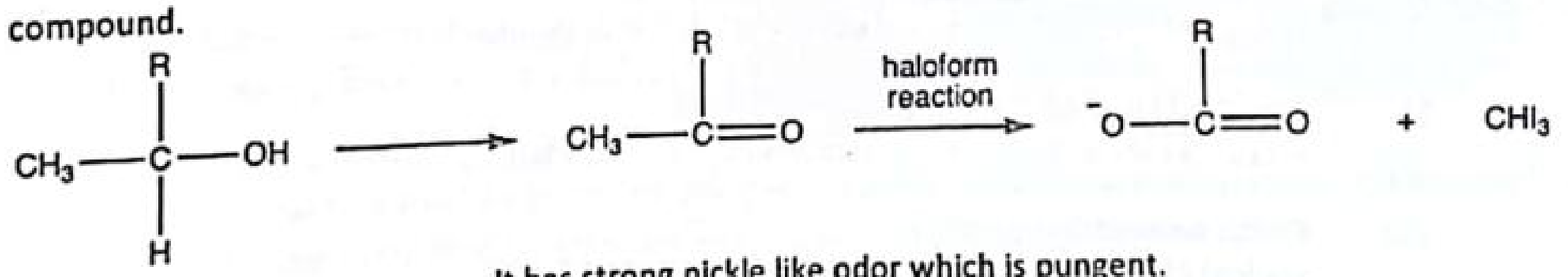
Secondary alcohol on oxidation produces ketone, reagent used is $Na_2Cr_2O_7/H_2SO_4$.

15) Three

Meta formaldehyde or 1, 3, 5 – Trioxane, sometimes also called trioxane or trioxin, is a chemical compound with molecular formula $C_3H_6O_3$.

16) Haloform

In this reaction, the methyl group of a methyl ketone is converted to a haloform such as iodoform, and the carbonyl carbon atom is oxidized to a carboxylic acid with one carbon atom less than the parent compound.



17) Pungent It has strong pickle like odor which is pungent.

18) Methanal

19) Methanol

Industrially, Formaldehyde is manufactured by passing a mixture of methanol vapors and air over iron oxide molybdenum oxide or silver catalyst at 500 C. $2CH_3OH + O_2 \xrightarrow{Catalyst} 2CH_2O + 2H_2O$

20) $R_2C=O$

In chemistry, a ketone is a functional group with the structure $R_2C=O$. Ketones contain a carbonyl group (a carbon-oxygen double bond). The simplest ketone is acetone in which the Carbon atom is connected to 2 Methyl Groups. Formula of acetone is CH3C(O)CH3.

21) Formaldehyde

Formaldehyde is a naturally occurring organic compound with the formula CH_2O. It is the simplest of the aldehydes. Formula of Acetaldehyde is C2H4O.

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Chapter 13 – Carboxylic Acids

1) Which one of these is a soluble carbohydrate:
a) Fructose b) Starch c) Cellulose d) Amylase

2) Which of the following is used as coagulation for latex in rubber industry
a) Acetic acid b) Amino acid c) Ethyl alcohol d) Rayon

3) Carboxylic acids can be prepared by action of _____ and carbon dioxide
a) Sodium hydroxide b) Grignard's reagent c) Alcoholic KOH d) Alkaline $KMnO_4$

4) To get the carboxylic acid containing C atoms less than C atoms in parent aldehyde we do hydrolysis of:
a) Cyanohydrins b) Amino Acids c) Esters d) Amides

5) If 2-butene is treated with $KMnO_4$ the product formed will be:
a) Butanoic acid. b) Propanoic acid c) Butyric acid. d) Acetic acid

6) For preparation of carboxylic acid, alkyl nitrile is required. Alkyl nitrile can be prepared by treating KCN with:
a) Alkyl halide b) Alcohol c) Water d) Acetaldehyde

7) Which of the following is not a use of acetic acid?
a) As a coagulant for latex in rubber industry b) manufacture of pickles
c) Used in silvering of mirrors d) None of these

8) Vinegar is basically _____ acid:
a) Acetic b) Citrus c) Formic d) Butyric

9) Acetic acid is used in making
a) Leather shoes b) Rubber shoes c) Plastic shoes d) None of these

10) Which one has fruity smell?
a) Alcohol b) Ethers c) Esters d) Carboxylic Acids

11) Which one is the carbonyl protecting group?
a) Carboxylic acid b) Ester c) Alcohol d) Amino Derivatives

12) What is the least number of carbon atoms in amino acids?
a) 1 b) 2 c) 3 d) 4

13) There is double bond in oleic acid between carbon numbers:
a) 7-8 b) 8-9 c) 10-11 d) 9-10

14) What is correct order of acidic strength?
a) Carboxylic acid > alcohols > phenol > water b) Carboxylic acid > phenol > water > alcohol
c) Water > alcohol > carboxylic acid > phenol d) Phenol > alcohol > water > carboxylic acid

15) In esterification, alcohol reacts with:
a) Acetaldehye b) Halogens c) Carboxylic acid d) None of these

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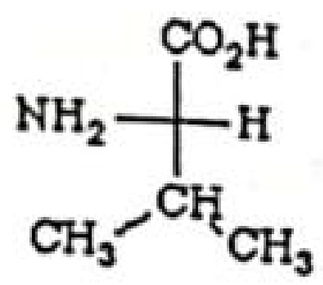
16) Chemical formula of Malonic acid:
a) $C_3H_8O_4$ b) $C_6H_{12}O_6$ c) $C_2H_2O_4$ d) $C_3H_4O_4$

17) Lysine is a _____ amino acid
a) Acidic b) Basic c) Neutral d) Amphoteric

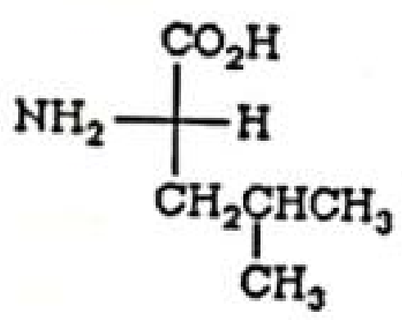
18) Amino acids are prepared by?
a) Strekers synthesis b) Williamson's synthesis
c) Dow's method d) Sabatier-Sendern's synthesis

19) Amino acid is usually known by
a) Common name b) IUPAC name c) Both a and b d) None of these

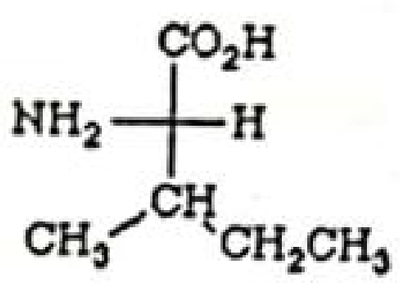
20) Which of the following is branched amino acid?
a)



b)



c)



d) All of these

21) Which one of the following is neutral amino acid:
a) Alanine b) Glycine c) Valine d) All of these

22) Chemical formula of Malonic Acid is?
a) $C_3H_4O_4$ b) $C_4H_4O_4$ c) $C_6H_{10}O_4$ d) $C_5H_{10}O_4$

23) The same carboxylic acid is obtained either by hydrolysis of a nitrile X or by oxidation of alcohol Y. Which pair could be X and Y?

	X	Y
a)	CH_3CH_2CN	CH_3CH_2OH
b)	$C_6H_5CH(CH_3)CN$	$C_6H_5CH_2CH(OH)CH_3$
c)	$(CH_3)_2CHCN$	$(CH_3)_3COH$
d)	$C_6H_5CH_2CN$	$C_6H_5CH_2CH_2OH$

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24) Which of the following is not an aromatic compound?
a) Phthalic acid b) Tartaric acid c) Picric acid d) Salicylic acid

25) Solubility of carboxylic acids in water decrease with
a) Increase in molecular mass b) Decrease in molecular mass
c) Both a and b d) None of these

26) Acetic acid is used in treatment of?
a) Ear canal infection b) Pneumonia c) Abdominal pain d) Vomiting

27) Acetic acid is used in curing of?
a) Meat b) Fish c) Vegetables d) Both a and b

28) Fatty Acids are:
a) Aliphatic Monocarboxylic Acids b) Contain a suffix "al"
c) Obtained from sugars d) With low boiling point

29) The carbonic acid which is named after butter is:
a) Capric acid b) Enanthic acid c) Butyric Acid d) Formic acid

Answers of Chapter 13 – Carboxylic Acids

1) Fructose

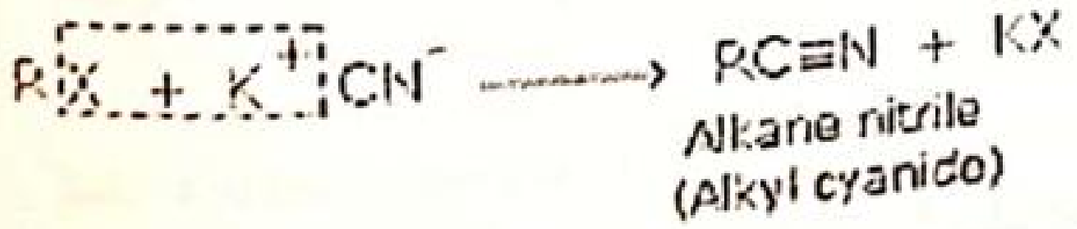
2) Acetic acid

3) Grignard's reagent

4) Esters

5) Propanoic acid

6) Alkyl halide
Alkyl nitrile can be prepared by treating alkyl halide with alcoholic potassium cyanide.



7) Used in silvering of mirrors

8) Acetic

9) Leather shoes

10) Esters

11) Amino Derivatives

12) 2

13) 9-10

14) Carboxylic acid > phenol > water > alcohol

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15) Carboxylic acid

16) $C_3H_4O_4$

17) Basic

18) Strekers synthesis

19) Common name

20) All of these
Valine, Leucine and Isoleucine are branched chain amino acids.

21) All of these

22) $C_3H_4O_4$
Malonic acid is a dicarboxylic acid with structure $CH_2(COOH)_2$.

23) $C_6H_5CH_2CN$ $C_6H_5CH_2CH_2OH$
In option d, hydrolysis of nitrile ($C_6H_5CH_2CN$) gives $C_6H_5CH_2CO_2H$ and primary alcohol ($C_6H_5CH_2CH_2OH$) on oxidation gives the same compound.
Alcohol in option B is tertiary alcohol which is resistant to oxidation.
Alcohol in option C is secondary alcohol which on oxidation gives ketone.

24) Tartaric acid
Tartaric acid is a white crystalline diprotic organic acid. It does not contain benzene ring in its structure. Therefore, it is not an aromatic compound.

25) Increase in molecular mass
As the alkyl mass increases it weakens the hydrogen bond thus decreasing the solubility of carboxylic acids. Also, alkyl groups are hydrophobic.

26) Ear canal infection
Acetic acid is used to treat an outer ear infection (external otitis). It works by stopping the growth of bacteria and fungus. Treating the infection reduces pain and swelling in the ear.

27) Both a and b
Vinegar, that is acetic acid, is mostly used for curing of meats, fish and vegetables.

28) Aliphatic Monocarboxylic Acids
The aliphatic monocarboxylic acids are commonly called fatty acids because higher members of this series such as palmitic acid, stearic acid etc. are obtained by the hydrolysis of fats and oils. They contain suffix "oic acid". They are obtained from various sources e.g., Acetic acid from vinegar. They have high boiling point due to inter molecular hydrogen bonding.

29) Butyric Acid
$CH_3CH_2CH_2COOH$, butyric acid, first obtained from butter, was named after the Latin butyrum, meaning "butter."

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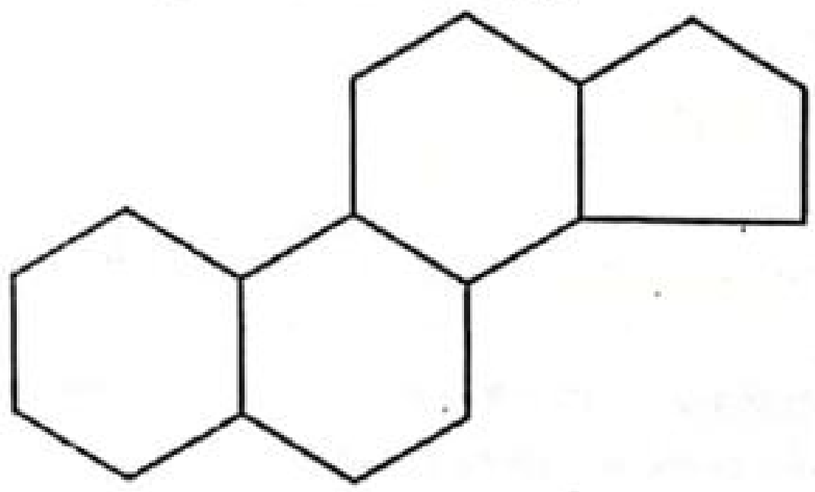
Chapter 14 - Macromolecules

1) Fe^{2+} is a cofactor of:
a) Chrome oxidase
b) Carbonic anhydrase
c) Glucose 6-phosphatase
d) Both a and b

2) Plastic cannot be recycled by
a) Depolymerization b) Transformation c) Deformation d) None of these

3) Adipic acid and Hexamethylene diamine combine to form?
a) Nylon-6,6 b) Epoxy Resin c) Polystyrene d) Polyvinyl chloride

4) Following is the structure of?



a) Glucose b) Lysine c) Steroid d) Androgens

5) Formula of fructose is:
a) $C_6H_{12}O_6$ b) $(C_6H_{12}O_6)n$ c) $C_5H_{10}O_5$ d) $C_5H_{10}O_6$

6) Three different polymers are polymerized to form
a) Copolymer b) Terpolymer c) Homopolymer d) None of these

7) Which of the following is not a disaccharide?
a) Sucrose b) Lactose c) Raffinose d) Dextrin

8) PVC is created from which halogen
a) Fl b) Br c) Cl d) I

9) Which of the following has less amount of protein
a) Potato b) Milk c) Egg d) Fruit

10) Teflon contains which of the following halide?
a) Chlorine b) Bromine c) Fluorine d) All of these

11) Polymer having a characteristics odour and mostly used as an adhesive material is
a) Polyvinyl chloride b) Poly styrene c) Ploride d) Polyvinyl acetate

12) Monomers of Nylon 6,6 is/are:
a) Caprolactam
b) Adipoyl chloride
c) Hexamethylene diamine
d) Both b and c

13) Which of the following can be used as a source of energy
a) Lipids b) Carbohydrates c) Both a and b d) None of these

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14) Which of the following is not a part of the human diet?
a) Glucose b) Sucrose c) Fructose d) Cellulose

15) Which of the following enzyme is used for conversion of Starch into Sugar?
a) Zymase b) Invertase c) Amylase d) Yeast

16) Proteins are present in
a) Hair b) Nails c) Skin d) All of these

17) Which of the following is a monosaccharide ?
a) Maltose b) Sucrose c) Lactose d) Fructose

18) Which of following is poison for catalyst:
a) Sulphur b) Arsenic c) Al2O3 d) Both a and b

19) Teflon is name of:
a) Polytetraflurorthylene b) Polyhexafluoroethylene
c) Polytetrachloroethylene d) Polyhydrafluoroethylene

20) A catalyst catalyzes reaction by:
a) Providing new path for reaction b) Increasing activation energy
c) Reacting with the reactants d) Producing free ions

21) Which of the following is the formula of Table Sugar?
a) $C_2H_4O_2$ b) $C_{12}H_{22}O_{11}$ c) $C_6H_{12}O_6$ d) $C_{12}H_{23}O_{12}$

22) Nylon 6 – 6 is obtained by heating adipic acid with:
a) Hexethylene Diamine b) Hexmethylene Diamine
c) hexmethylene amine d) hexdimethylene diamine

23) Starch is a polymer of:
a) α-d glucose b) β-d glucose c) Amino acids d) Amylose

Answers of Chapter 14 – Macromolecules

1) Chrome oxidase

2) Deformation

3) Nylon-6,6

4) Steroid

5) $C_6H_{12}O_6$

6) Terpolymer

7) Dextrin

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8) Cl

9) Fruit

10) Fluorine

11) Polyvinyl acetate

12) Both b and c

Nylon 6 is only made from one kind of monomer, a monomer called caprolactam. However, Nylon 6,6 is made from two monomers, adipoyl chloride and hexamethylene diamine.

13) Both a and b

14) Cellulose

Enzymes in the human body cannot break the B bond, present in cellulose.

15) Amylase

Amylase enzyme is found in our saliva. It breaks down starch into sugar (glucose). Starch digestion starts in the mouth.

16) All of these

Keratin is a type of fibrous structural protein which is found in various vertebrates in various parts of their body like hair, nails, skin, horns, claws etc.

17) Fructose

Examples of monosaccharides include glucose (dextrose), fructose (levulose), and galactose. Monosaccharides are the building blocks of disaccharides (such as sucrose and lactose) and polysaccharides (such as cellulose and starch).

18) Both a and b

Catalytic poisoning happens due to presence of trace amounts of foreign substances which render them ineffective. Such substances are called poisons. The poisoning of a catalyst may be temporary or permanent. In permanent poisoning, the poison reacts chemically with the catalyst. The compounds of sulfur and arsenic behave as poison to many metallic catalysts.

19) Polytetraflurorthylene

Teflon is a synthetic polymer containing carbon and fluorine commonly known as Polytetrafluoroethylene (PTFE).

20) Providing new path for reaction

A catalyst is a substance that can be added to a reaction to increase the reaction rate without getting consumed in the process. Catalysts typically speed up a reaction by reducing the activation energy or changing the reaction mechanism. Enzymes are proteins that act as catalysts in biochemical reactions. In general, chemical reactions occur faster in the presence of a catalyst because the catalyst provides an alternative reaction pathway - or mechanism - with a lower activation energy than the non-catalyzed mechanism. In catalyzed mechanisms, the catalyst usually reacts to form an intermediate, which then regenerates the original catalyst in a process.

21) $C_{12}H_{22}O_{11}$

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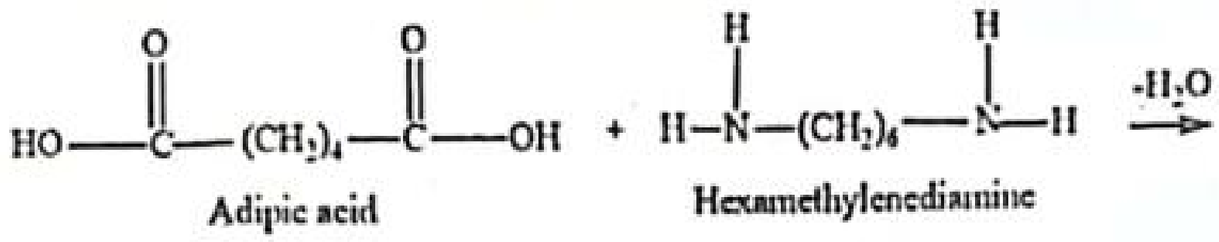
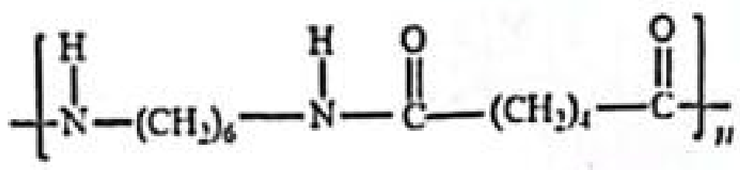
omposed of two monosaccharides, namely glucose and fructose. This non-reducing disaccharide has a chemical formula of $C_{12}H_{22}O_{11}$. Sucrose is commonly referred to as table sugar or cane sugar.

22) Hexmethylene Diamine

To prepare Nylon 6,6, adipic acid and hexamethylene diamine are heated to 553 K under pressure. Nylon 6,6 is obtained by condensation polymerization.





Nylon 66

23) α-d glucose

Starch is also known as amylum which occurs in all green plants. A molecule of starch (C6H10O5)n is built of many α-glucose rings joined through oxygen-atom.

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Chapter 15 – Common Chemical Industries in Pakistan

1) Percentage of nitrogen in urea is:
a) 92% b) 68% c) 46% d) 48%

2) The zone where moisture is removed and clay is broken down into Al_2O_3, SiO_2, Fe_2O_3 is
a) Burning zone b) Cooling zone c) Drying zone d) Decomposition zone

3) In Paper industry, sodium sulphite is buffered with
a) Sodium carbonate b) Sodium hydroxide c) Sodium acetate d) Both a and b

4) Which can be used as a liquid fertilizer?
a) Urea b) Ammonia
c) Potassium phosphate d) Diammonium phosphate

5) What is the nature of "hydrated tricalcium aluminate" (3 Ca. Al_2O_3. 6 H_2O) in the setting of cement?
a) Hardened mass b) Hardened Gel c) Colloidal Gel d) Liquid

6) Aluminium nitrate is not used for
a) Rice b) Corn c) Cotton d) Wheat

7) Which of the following is a Marco-nutrient
a) Boron b) Copper c) Iron d) Nitrogen

8) How many grams of micronutrients are needed by 1 acre of land?
a) 100-1000 b) 200-500 c) 6 to 200 d) 20 to 300

9) Ammonium nitrate contain _____ nitrogen
a) 82% b) 46% c) 20% d) 35%

10) Which in not woody raw material
a) Poplar b) Hard wood c) Fir d) Rag

11) What is used in cement manufacture?
a) Limestone b) Starch c) Potassium Oxide d) Clay
e) Both a and b

12) Which Organic acid is used in pulping of wood for paper?
a) Formic Acid b) Acetic Acid c) Propanoic Acid d) Stearic Acid

13) Which of the following is not a macronutrient?
a) Mn b) Mg c) N d) Ca

14) Identify the pair of micronutrients:
a) B, I b) N, Cu c) C, Cl d) Zn, H

15) 1500-degree Celsius furnace temperature is maintained at which zone?
a) Heating b) Burning c) Decomposition d) Both b and c

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16) Which of the following is the most widely used fertilizer in Pakistan?
a) Ammonium Nitrate b) Ammonia c) Calcium Nitrate d) Urea

17) The macronutrients for healthy plant growth are required in _____ per acre.
a) 5g – 200 g b) 5kg – 200 kg c) 5g – 2000kg d) None of these

18) The temperature zones in rotary kilns are:
a) 5 b) 4 c) 6 d) None of these

Answers of Chapter 15 – Common Chemical Industries in Pakistan

1) 46%

2) Drying zone

3) Both a and b
Sodium sulphite is buffered with NaOH or sodium carbonate to neutralize the organic acid liberated from the raw materials.

4) Ammonia

5) Colloidal Gel

6) Rice

7) Nitrogen

8) 6 to 200

9) 35%

10) Rag

11) Both a and b

12) Acetic Acid

13) Mn
Plants need nutrients from the soil for a healthy growth. The elements essential for plant growth can be classified as micro-nutrients and macro-nutrients.
The nutrients required in very small amount for the plan growth are termed as micro-nutrients. Common examples are: Boron, Copper, Iron, Manganese, Zinc, Molybdenum and Chlorine. These are generally required in quantities ranging from 6 grams to 200 grams.
The nutrients which are required in a larger amount for the plant growth are known as macro-nutrients. These include: Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sulphur, Carbon, Hydrogen and Oxygen.

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14) B, I

Plants need nutrients from the soil for a healthy growth. The elements essential for plant growth can be classified as micro-nutrients and macro-nutrients.

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The nutrients which are required in a larger amount for the plant growth are known as macro-nutrients. These include: Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sulphur, Carbon, Hydrogen and Oxygen.

Only the first option gives the micro-nutrients. In all other options, a micro-nutrient is paired with a macro-nutrient.

15) Burning

In manufacturing of cement, there are 4 temperature zones in Rotary Kiln:

1) Drying or Pre-heating zone with a temperature of 500 C
2) Decomposition zone with temperature up to 900 C
3) Burning zone with temperature up to 1500 C
4) Cooling zone with temperature cooled down to 150 – 200 C

16) Urea

Urea is a high-quality nitrogenous fertilizer. It contains about 46% nitrogen and is the most concentrated solid nitrogen fertilizer. It is most widely used nitrogen fertilizer in Pakistan.

17) 5kg – 200 kg

Micronutrients are required in quantities ranging from 6 grams to 200 grams per acre. Macronutrients are required in quantities ranging from 5kg to 200kg per acre for a healthy plant growth.

18) 4

There are four temperature zones in a rotary kiln:

1. Drying or preheating zone
2. Decomposition zone
3. Burning zone
4. Cooling zone

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Chapter 16 – Environmental Chemistry

1) Ozone absorbs
a) UV
b) IR
c) Radioactive radiations
d) All of these

2) Which one of these is toxic?
a) Nitrous oxide
b) Nitric oxide
c) Sulphur dioxide
d) Carbon dioxide

3) Function of ozone is?
a) To filter UV radiations
b) Act as a reducing agent
c) Act as an antibiotic
d) None of these

4) Treatment of water which is very effective in killing of pathogens is:
a) Aeration
b) Coagulation
c) Landfill
d) Chlorine usage

5) NO_2 in atmosphere absorbs moisture to form?
a) HNO_3
b) HNO_2
c) NO
d) Both a and b

6) Global scale SO_2 is produced by
a) Combustion
b) Fossil fuels
c) Volcano
d) None of these

7) Chloro-fluoro carbons cause
a) Radiations pollution
b) Water pollution
c) Air pollution
d) Soil pollution

8) The best yield of SO_2 can be obtained by which of the following:
a) Burning of coal
b) Excess of oxygen
c) Fertilization
d) Oxides of pyrites

9) Which of the following causes suffocation?
a) SO_2
b) CO_2
c) Fog
d) All of these

10) What is the major reason for SO_2 emissions?
a) Agriculture
b) Volcanic eruptions
c) Fuel combustion
d) All of the above

11) Which of the following gases has least concentration in air
a) O_2
b) H_2
c) He
d) CO_2

12) Which one is correct about incineration of industrial waste?
a) Ash buried in sea water.
b) Secondary chamber is maintained at temperature range 650 C to 1100 C
c) Smoke stacks emit oxides of nitrogen and carbon
d) Solids wastes are the significant sources of dioxins

13) Earth's crust is included in which sphere?
a) Lithosphere
b) Hydrosphere
c) Atmosphere
d) Aerosphere

14) Ozone is
a) O_2
b) O_3
c) O_4
d) O_5

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15) Which of the following is a secondary pollutant?
a) CO_2 b) O_3 c) Sulphur Oxide d) Nitrogen Oxide

16) Which one substance is used to remove both H_2S and carbon dioxide from biogas?
a) Sodium oxide b) Calcium oxide c) Both a and b d) None of the above

17) Which of the following is a water cleaning halogen?
a) Cl b) Br c) F d) I

18) Measuring 'Biochemical Oxygen Demand' (BOD) is a method used for:
a) Estimating the amount of organic matter in sewage water for determining quality.
b) Measuring the activity of Saccharomyces cerevisiae in producing curd on a commercial scale.
c) Working out the efficiency of RBCs, about their capacity to carry oxygen.
d) Working out the efficiency of oil driven automobile engines.

Answers of Chapter 16 – Environmental Chemistry

1) UV
It absorbs biologically harmful ultraviolet (UV) radiation coming from the sun.

2) Nitrous oxide

3) To filter UV radiations

4) Chlorine usage

5) Both a and b

6) Volcano

7) Air pollution

8) Burning of coal

9) All of these

10) Volcanic eruptions

11) CO_2

12) Solids wastes are the significant sources of dioxins
Option a is wrong because the ash residue is buried in land or landfills.
Option b is wrong because the temperature of secondary chamber is maintained at 950 C to 1300 C.
Option c is wrong because the smoke stacks emit oxides of nitrogen and sulfur.

13) Lithosphere
The crust and the upper mantle make up the lithosphere.
Environment consists of 4 components that are
1. Atmosphere 2. Hydrosphere 3.Lithosphere 4. Biosphere.

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Lithosphere includes crust and the uppermost mantle, which constitute the hard and rigid outer layer of the earth.

14) O_3

Ozone is the unstable triatomic form of oxygen O3. It is a powerful oxidant that is produced for various chemical and industrial uses.

15) O_3

Primary pollutants include ammonia, sulfur dioxide, nitrogen dioxide and carbon monoxide. Secondary pollutants include ground level ozone, acid rain and nutrient enrichment compounds.

16) Calcium oxide

The lime process is very old and familiar process to remove impurities like CO2 and H2S from biogas, but it is not used on large scales.

17) Cl

Chlorine is frequently used to disinfect water. Chlorine treatment is very effective in killing the pathogens that may cause serious waterborne diseases such as typhoid and cholera which have killed many thousands of people around the world. Most used disinfectant is Hypochlorous acid HOCl.

18) Estimating the amount of organic matter in sewage water for determining quality.

Biochemical oxygen demand (BOD) is the amount of oxygen that bacteria take from water when they oxidize the organic matter. Micro-organisms involved in biodegradation of organic matter in the receiving water body consume a lot of oxygen, and as a result there is a sharp decline in dissolved oxygen. BOD is measured over a 5-day period, by recording the concentration of oxygen in water at beginning and end of the 5 days period.

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Miscellaneous Questions

1) Vinyl bromide can be prepared from:
a) Hydroxyl bromide b) Ethylene dibromide c) Vicinal bromide d) All of these

2) Hydrolysis accompanied by bond cleavage is called
a) Hydrogenation b) Hydration c) Partial hydration d) Hydrogenolysis

3) $CH_3CN + HCl$ ----> A + B in presence of water in the above reaction A and B are
a) Acetic acid and acid amide b) Acetic acid and ammonia
c) Acetic acid and methyl chloride d) Acetic acid and ammonium chloride

4) AgCl is ___ in water.
a) Partially soluble b) Completely soluble c) Not soluble d) None of these

5) Bond energy of C-Cl in kJ/moles is:
a) More than that of C-F b) More than that of C-Br but less than C-I
c) Less than C-Br d) More than that of C-Br and C-I

6) The reaction between borohydride and carbonyl compounds is:
a) Nucleophilic substitution b) Electrophilic addition
c) Electrophilic substitution d) Both a and c

7) Formula of hydrogen peroxide
a) HO b) H_2O_2 c) HO_2 d) H_3O_2

8) Water in solution acts as?
a) Acid b) Base c) May be acid or base d) None of these

9). When was electron discovered?
a) 1897 b) 1909 c) 1896 d) None of these

10) Which carbohydrate is soluble in water?
a) Cellulose b) Starch c) Amylase d) Fructose

11) Which enzyme is used when sugar in molasses is converted to glucose and fructose?
a) Amylase b) Protease c) Sucrase d) None of these

12) The indicator is a colored _____ compound?
a) Organic b) Inorganic c) Acidic d) Basic

13) Which one of the following is used as an anesthetic?
a) Acetone b) Halothane c) Methyl alcohol d) Ethyl alcohol

14) Liquid whose thermodynamic property do not depend upon intermolecular forces is
a) Ethylene glycol b) Acetone c) Mercury d) None of these

15) Which of the following atoms would be diamagnetic?
a) O b) Al c) K d) Ne

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16) Hydration energy of sodium ion is:
a) 321 Kj/mol b) 406 Kj/mol c) 1032 kj/mil d) 940 Kj/mol

17) The correct order of decreasing solubility of AgCl in
A) Water B) 0.1 M NaCl C) 0.1 BaCl2 D) 0.1M NH3 is?
a) D > A > B > C b) D > C > B > A c) B > A > D > C d) A > D > B > C

Answers of Miscellaneous Questions

1) Ethylene dibromide

2) Hydrogenolysis

3) Acetic acid and ammonium chloride
$CH_3CN + 2H_2O + HCl \longrightarrow CH_3COOH + NH_4Cl$
This reaction is described as acidic hydrolyzes of nitrile.

4) Not soluble

5) More than that of C – Br and C – I.

6) Electrophilic addition

7) H_2O_2

8) May be acid or base
Water can act as both a " hydrogen ion donor" and a "hydrogen ion acceptor", depending on the acidic or basic properties of the dissolved substance

9) 1897
10) Amylase
11) Sucrase
12) Organic
13) Halothane
14) None of these
15) Ne
It's a noble gas and their outermost shell is complete (no unpaired electron) so they are not attracted by magnetic field.

16) 406 Kj/mol

17) D > A > B > C
With ammonia, AgCl forms a complex [Ag(NH3)2]Cl . Hence, AgCl is more soluble in ammonia than in water. When a common ion such as chloride ion is present, the solubility of AgCl decreases. Greater the concentration of chloride ion from strong electrolyte, lesser will be the solubility. The chloride ion concentration in 0.1M NaCl solution is 0.1. The chloride ion concentration in 0.1 M BaCl2 solution is 0.2α, where α is the degree of dissociation of BaCl2. Hence, the decreasing order of the solubility is:
D > A > B > C.

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Introduction to English Portion of NET Engineering

In NET Engineering out of 200 Multiple Choice Questions, 20 questions will be from the English portion. Like any other standardized test, the questions in English portion can be from any of the following topics:

1. Vocabulary: Synonyms and Antonyms
2. Spelling Correction
3. Comprehension
4. Analogies
5. Grammar

Introduction to Vocabulary Portion

Vocabulary comprises main part of the English Portion. Out of 20 questions of English you can expect around 6 - 9 vocabulary questions in your NET. To prepare for this portion you need to increase your vocabulary by learning more words. The best sources to prepare for vocabulary are: Word Lists of SAT, Word Lists of GRE, English books of FSC/A level and vocabulary words from Past NET Papers. Improved vocabulary will also be helpful in all the other portions i.e., in analogies, grammar portion, spelling corrections and comprehension.

Format of Vocabulary Questions in NET:

In vocabulary portion you are given a word with 4 choices and you have to choose the correct meaning or opposite of the given word. Pay close attention if the question is asking for the meaning of the word or its opposite.

Vocabulary Questions from Past NETs

The next few pages contain vocabulary questions from Past NET Papers with correct answers mentioned at the end. You will find several words from the above High Frequency List in questions of Past NET Papers. For better preparation both the High Frequency List and Words from Past NET Papers must be learned.

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Synonyms and Antonyms

1) Choose the word closest in meaning to "Accord"
a) Disunity b) Cord c) Concurrence d) Pack

2) Choose the word closest in meaning to "Mediation"
a) Annoyance b) Irritating c) Aggregate d) Intercession

3) Choose the word closest in meaning to "Anthology"
a) Analogy b) Compilation c) Collage d) Beast

4) Choose the word most opposite in meaning to "Fallacy"
a) Paradox b) Flaw c) Accuracy d) Prejudice

5) Choose the word most opposite in meaning to "Benign"
a) Amiable b) Malignant c) Kind d) Generous

6) Choose the word closest in meaning to "Fulminate"
a) Vilify b) Praise c) Laud d) Loud

7) Choose the word closest in meaning to "Heartfelt"
a) Cold b) False c) Cordial d) Shallow

8) Choose the word closest in meaning to "Hasty"
a) Kind b) Slow c) Wise d) Impulsive

9) Choose the word closest in meaning to "Juxtaposition"
a) Distance b) Remoteness c) Proximity d) Abroad

10) Choose the word closest in meaning to "Expedient"
a) Feasible b) Inappropriate c) Unattainable d) Explore

11) Choose the word closest in meaning to "Arable"
a) Tillable b) Infertile c) Immature d) Myth

12) Choose the word closest in meaning to "Negligible"
a) Seize b) Momentous c) Hefty d) Trivial

13) Choose the word closest in meaning to "Bona Vacantia"
a) Seen and Heard b) Captive c) Ownerless Goods d) Merciless King

14) Choose the word closest in meaning to "Morose"
a) Uplift b) Jovial c) Gloomy d) Heartening

15) Choose the word closest in meaning to "Welter"
a) Tumble b) Calm c) Order d) Peace

16) Choose the word closest in meaning to "Nadir"
a) Bottom b) Pinnacle c) Apex d) Root

17) Choose the word closest in meaning to "Amend"
a) Exacerbate b) Deteriorate c) Impair d) Improve

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18) Choose the word closest in meaning to "Amass"
a) Allot b) Gather c) Dispense d) Deliver

19) Choose the word closest in meaning to "Soggy"
a) Parched b) Dull c) Sodden d) Desiccated

20) Choose the word closest in meaning to "Eavesdrop"
a) Pry b) Ignore c) Ditch d) Ear clip

21) Choose the word most opposite in meaning to "Tireless"
a) Diligent b) Vigorous c) Weary d) Assiduous

22) Choose the word closest in meaning to "Robust"
a) Wealthy b) Stout c) Limp d) Shaky

23) Choose the word closest in meaning to "Acrimonious"
a) Congruent b) Pleasant c) Agreeable d) Hostile

24) Choose the word closest in meaning to "Cacophonous"
a) Melodious b) Tuneful c) Musical d) Jarring

25) Choose the word closest in meaning to "Headstrong"
a) Passionate b) Docile c) Obstinate d) Polite

26) Choose the word closest in meaning to "Knuckle Head"
a) Intolerable b) Inept person c) Musical d) Talented

27) Choose the word closest in meaning to "Axiom"
a) Paradox b) Absurdity c) Foolish d) Truism

28) Choose the word closest in meaning to "Industrious"
a) Indolent b) Active c) Slothful d) Idle

29) Choose the word closest in meaning to "Extravagant"
a) Profuse b) Reserve c) Calm d) Discreet

30) Choose the word most opposite in meaning to "Outset"
a) Origin b) Rise c) Source d) Conclusion

31) Choose the word closest in meaning to "Intrepid"
a) Craven b) Valiant c) Spine d) Gutless

32) Choose the word closest in meaning to "Destitute"
a) Needy b) Institute c) Indebt d) Solvent

33) Choose the word closest in meaning to "Beholden"
a) Debuted b) Ungrateful c) Bound d) Bonding

34) Choose the word closest in meaning to "Fad"
a) Calm b) Standard c) Tradition d) Vogue

35) Choose the word most opposite in meaning to "Indistinguishable"
a) Identical b) Indispensable c) Interchangeable d) Diverse

36) Choose the word closest in meaning to "Rapport"

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a) Misunderstand b) Disharmony c) Agony d) Affinity

37) Choose the word closest in meaning to "Effrontery"
a) Meekness b) Chutzpah c) Caution d) Mess

38) Choose the word closest in meaning to "Venial"
a) Major b) Juvenile c) Innocent d) Justifiable

39) Choose the word closest in meaning to "Knotty"
a) Simple b) Throw c) Tricky d) Regular

40) Choose the word most opposite in meaning to "Abandon"
a) Difficult b) Forsake c) Hold d) Dispose

41) Choose the word closest in meaning to "Hierarchical"
a) Bureaucracy b) Stratified c) Origin d) Grain

42) Choose the word closest in meaning to "Pursue"
a) Aid b) Quit c) Hunt d) Shun

43) Choose the word most opposite in meaning to "Fortunate"
a) Provident b) Adverse c) Happy d) Chance

44) Choose the word closest in meaning to "Trepidation"
a) Anxiety b) Composure c) Poise d) Equal

45) Choose the word closest in meaning to "Eschew"
a) Participate b) Join c) Roger d) Shun

46) Choose the word most opposite in meaning to "Incomparable"
a) Unique b) Rival c) Attire d) Routine

47) Choose the word most opposite in meaning to "Incomparable"
a) Bound b) Endless c) Vast d) Bottom

48) Choose the word closest in meaning to "Cardinal"
a) Derive b) Original c) Consequence d) Core

49) Choose the word closest in meaning to "Cardinal"
a) Prehistoric b) Prevailing c) Novel d) Contemporary

50) Choose the word most similar in meaning to "Abhor"
a) Adore b) Loveable c) Idolize d) Loathe

51) Choose the word closest in meaning to "Meek"
a) Firm b) Timid c) Push d) Force

52) Choose the word closest in meaning to "Passé"
a) Trendy b) Chic c) Obsolete d) In

53) Choose the word closest in meaning to "Mon Ami"
a) Momentary b) My Friend c) Fresh Air d) Coming Day

54) Which one is closest in meaning to "Autopsy"
a) Post-mortem b) A medicine c) A disease d) None of these

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55) Which of the following is most opposite in meaning to "Indolent"
a) Industrious b) Lazy c) Upright d) Jester

56) Which of the following is most opposite in meaning to "Opportunity"
a) Antonym b) Prospective c) Closure d) Root

57) Which one is closest in meaning to "Perturbed"
a) Relax b) Calm c) Anxious d) Cozy

58) Which one is closest in meaning to "Antecedent"
a) Past b) Present c) Future d) Current

59) Which one is closest in meaning to "Bleak"
a) Cheerful b) Hostile c) Congenial d) Desert

60) Which one is closest in meaning to "Flamboyant"
a) Calm b) Unflashy c) Dull d) Ornate

61) Which of the following is most opposite in meaning to "Validate"
a) Ratify b) Sanction c) Endorse d) Repudiate

62) Which one is closest in meaning to "Laborious"
a) Lackadaisical b) Painstaking c) Inappropriate d) Traditional

63) Which one is closest in meaning to "Audacious"
a) Daredevil b) Reserved c) Blonde d) Curly

64) Which one is closest in meaning to "Boisterous"
a) Vociferous b) Subdued c) Generous d) Accurate

65) Which one is closest in meaning to "Vivacious"
a) Dead b) Wealthy c) Spirited d) Delighted

66) Which one is closest in meaning to "Arduous"
a) Motivating b) Strenuous c) Clinging d) Steady

67) "Fortnight" means:
a) Eternity b) 2-weeks c) Bizarre d) Week

68) He is more wordly than his older cousins. "Wordly" means?
a) Temporal b) Inhumane c) Priest d) Thinking of after-life

69) Which one is closest in meaning to "Vacillate"
a) Opt b) Elect c) Choose d) Waver

70) Which one is closest in meaning to "Digress"
a) Disrespect b) Stride c) Ramble d) Stay

71) Which one is closest in meaning to "Prodigious"
a) Average b) Typical c) Ordinary d) Phenomenal

72) Which one is closest in meaning to "Assuage"
a) Mollify b) Dust c) Sage d) Gauge

73) Which one is closest in meaning to "Burgeon"

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a) Dwindle b) Shrink c) Flourish d) Fade

74) Which one is closest in meaning to "Sober"
a) Merry b) Giddy c) Idle d) Solemn

75) Which one is closest in meaning to "Intemperate"
a) Excessive b) Modest c) Temper d) Mean

76) Which one is closest in meaning to "Cajole"
a) Vilify b) Persuade c) Jinx d) Utter

77) Which one is closest in meaning to "Actuate"
a) Activate b) Retard c) Pause d) Impede

78) Choose the antonym of "Fervent"
a) Ardent b) Fanatic c) Zeal d) Apathetic

79) The most nearest meaning to the word "Categorical" is:
a) Assertive b) Indirect c) Conditional d) Unambiguous

80) The meaning of the word "Manacle" is:
a) Wave b) Statue c) Shackle d) Building

81) What is most similar in meaning to "Belligerent"
a) Engaged in war. b) State of serenity c) Very timid d) Strong

82) The meaning of the word "Arid" is:
a) Dry b) Slug c) Parched d) Wet

83) Choose the antonym of "Vivid":
a) Glowing b) Flamboyant c) Gaudy d) Fade

84) "Wurst" is related to:
a) Drinking b) Initiation c) Sausage d) Closure

85) Synonym of "Expedient" Is:
a) Inapt b) Indebt c) Tactless d) Opportune

86) Cosmopolitan is _____ person.
a) Popular b) Lousy c) Lazy d) Experienced

87) The most nearest meaning to the word "Listless" is:
a) Languid b) Awake c) Animated d) Enormous

88) The most nearest meaning to the word "Wane" Is:
a) Amplify b) Loss c) Lessen d) Win

89) The most nearest meaning to the word "Flout" Is:
a) Flatter b) Appreciate c) Mock d) Approve

90) The most nearest meaning to the word "Brood Over" Is:
a) Ruminate b) Destroy c) Fight till death d) Enhance

91) The most nearest meaning to the word "Bellicose" is:
a) Serene b) Quiescent c) Stoical d) Aggressive

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92) The most nearest meaning to the word "Loom" is:
a) Hover b) Deep c) Cry d) Light

93) The most nearest meaning to the word "Aberration" is:
a) Blessing b) Delusion c) Clarity d) Imposition

94) The most nearest meaning to the word "Laggard" is:
a) Lounger b) Upfront c) Hostile d) Shephard

95) Antonym of "Outrageous" is:
a) Barbarous b) Sensible c) Steep d) Crazy

96) The most nearest meaning to the word Avarice is:
a) Philanthropy b) Cage c) Bank d) Greed

97) The most nearest meaning to the word Oligarchy is:
a) Democracy b) Communism c) Capitalism d) Autocracy

98) Choose the antonym of Maim:
a) Castrate b) Hog-tie c) Maul d) Adorn

99) Choose the antonym of Conversant:
a) Versant b) Witting c) Ignorant d) Cognizant

100) The most nearest meaning to the word Infirm is:
a) Feeble b) Assure c) Robust d) Final

101) The most nearest meaning to the word Bonanza is:
a) Catapult b) Long Lasting c) Greenish land d) Windfall

102) The most nearest meaning to the word Footling is:
a) Enormous b) Persuasive c) Trivial d) Visible

103) The most nearest meaning to the word Timid is:
a) Shy b) Crazy c) Proud d) Resourceful

104) The most nearest meaning to the word Acrimonious is:
a) Crabby b) Pleasant c) Kindle d) Flatter

105) Choose the antonym of Angel:
a) Cherub b) Seraph c) Sprite d) Demon

106) The most nearest meaning to the word Expletive is:
a) Oath b) Excessive c) Broad d) Detailed

107) The most nearest meaning to the word Adorable is:
a) Coherent b) Despicable c) Ambrosial d) Detestable

108) The most nearest meaning to the word Venerable is:
a) Esteemed b) Senior c) Huge d) Dangerous

109) The most nearest meaning to the word Fiend is:

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a) Ogre b) Angel c) Captive d) Pal

110) The most nearest meaning to the word Putrefy is:
a) Clean b) Varnish c) Decay d) Improve

111) The most nearest meaning to the word Obscene is:
a) Immoral b) Formal c) Upright d) Carnival

112) The most nearest meaning to the word Foreboding is:
a) Providence b) Premonition c) Lucky d) Challenging

113) The most nearest meaning to the word Murky is:
a) Intangible b) Corporal c) Transparent d) Obscure

114) The most nearest meaning to the word Chivalry is:
a) Army b) Fear c) Rudeness d) Valor

115) The most nearest meaning to the word Behoove is:
a) Befit b) Opposite c) Concise d) Deduct

116) The most nearest meaning to the word Captious is:
a) Careful b) Finding Faults c) Imaginary d) Hardworking

117) The most nearest meaning to the word Baffle is:
a) Confuse b) Soothe c) Abet d) Alert

118) The most nearest meaning to the word Cohere is:
a) Dispute b) Loosen c) Cling d) Present

119) The most nearest meaning to the word Apathy is:
a) Coldness b) Concern c) Courage d) Calligraphy

120) The most nearest meaning to the word Agnostic is:
a) Believer b) Priest c) Skeptic d) Painful

121) The most nearest meaning to the word Acrostic is:
a) Away b) Idol c) Shun d) Cipher

122) The most nearest meaning to the word Bewilderment is:
a) Expectation b) Perplexity c) Courage d) Assumption

123) 'Oncology' is related to:
a) Study of tumors b) Study of blood
c) Study of brain d) Study of digestive system

124) The most nearest meaning to the word Dote is:
a) Denounce b) Propose c) Abuse d) Flatter

125) The most nearest meaning to the word Teetotaler is:
a) Abstainer b) Drinker c) Souse d) Criminal

126) The most nearest meaning to the word Decrepit is:

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a) Young b) Sturdy c) Crippled d) Strong

127) Choose the opposite of Exacerbate
a) Infuriate b) Vex c) Placate d) Deteriorate

128) Choose the opposite of Caustic
a) Mild b) Corrosive c) Acid d) Tart

129) The most nearest meaning to the word Unnerve is:
a) Uphold b) Bind c) Calm d) Dismay

130) The most nearest meaning to the word Zealot is:
a) Moderate b) Maniac c) Dumb d) Expert

131) The most nearest meaning to the word Conversant is:
a) Talkative b) Acquainted c) Lucky d) Cold

132) The most nearest meaning to the word Bedevil is:
a) Annoy b) Soothe c) Helping hand d) Destroy

133) The most nearest meaning to the word Courteous is:
a) Affable b) Heedless c) Law follower d) Dauntless

134) The most nearest meaning to the word Abiding is:
a) Compulsory b) Ephemeral c) Enduring d) Ending soon

135) The most nearest meaning to the word Strident is:
a) Subdued b) Genius c) Blatant d) Experienced

136) The most nearest meaning to the word Magnanimous is:
a) Selfless b) Selfish c) Petty d) Bounteous

137) Most nearest meaning to the word En Rapport is:
a) In a group b) In agreement with c) In Limits d) In Style

138) The most nearest meaning to the word Ambiguous is:
a) Lucid b) Enigmatic c) Certain d) Indispensable

139) The most nearest meaning to the word Meticulous is:
a) Detailed b) Puzzling c) Energetic d) Crowdie

140) The most nearest meaning to the word Surreptitious is:
a) Open b) Fearful c) Sneaky d) Apprehensive

141) The most nearest meaning to the word Trigger-Happy is:
a) Aggressive b) Peaceful c) Hunky-Dory d) Dandy

142) The most nearest meaning to the word Admonish is:
a) Fortify b) Applause c) Commend d) Rebuke

143) The most nearest meaning to the word Irreproachable is:
a) Exemplary b) Guilty c) Imperfect d) Hidden

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144) The most nearest meaning to the word Sulky is:
a) Cheerful b) Bulky c) Mean d) Trivial

145) The most nearest meaning to the word Quest is:
a) Retreat b) Leaning c) Investigate d) Crusade

146) The most nearest meaning to the word Blemish is:
a) Disfigure b) Mend c) Ornament d) Stained

147) The most nearest meaning to the word Immaculate is:
a) Exquisite b) Unsterile c) Homely d) Troglodytic

148) The most nearest meaning to the word Fetid is:
a) Squally b) Breezy c) Aromatic d) Rancid

149) The most nearest meaning to the word Diffident is:
a) Extrovert b) Gregarious c) Meek d) Cordial

150) The most nearest meaning to the word Dauntless is:
a) Gallant b) Fearful c) Fictitious d) Extravagant

151) The most nearest meaning to the word Pusillanimity is:
a) Acquisition b) Cold Feet c) Symphony d) Legible

152) The most nearest meaning to the word Thick Skull is:
a) Pointless b) Active c) Extraordinary d) Dull

153) The most nearest meaning to the word Spurious is:
a) Pseudo b) Genuine c) Dreamer d) Triumphant

154) The most nearest meaning to the word Baroque is:
a) Plain b) Unadorned c) Florid d) Natural

155) The most nearest meaning to the word Bona Fide is:
a) Active b) Genuine c) Existing d) Related

156) The most nearest meaning to the word Fait Accompli is:
a) Natural Existence b) Accomplished Fact c) Scientific Discovery d) Distorted Reality

157) The most nearest meaning to the word Prodigy is:
a) Whiz b) Imbecile c) Normality d) Informality

158) The most nearest meaning to the word Farce is:
a) Tragedy b) Sobriety c) Satire d) Solemnity

159) Choose the opposite of Calm
a) Unhappy b) Troubled c) Unlucky d) Smooth

160) Choose the opposite of Hallow
a) Curse b) Void c) Full d) Solid

161) Choose the opposite of Precariousness

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a) Mutability b) Pliancy c) Alteration d) Peace

162) Choose the opposite of Lugubrious
a) Joyful b) Pensive c) Gloomy d) Forlorn

163) Choose the opposite of "Foe"
a) Enemy b) Antagonist c) Friend d) Portent

164) Choose the opposite of Lofty
a) Humble b) Towering c) Acute d) Bonding

165) Choose the opposite of Impudent
a) Blatant b) Cheeky c) Retiring d) Sassy

166) Choose the opposite of Singular
a) Standard b) Rare c) Eminent d) Unwonted

167) Choose the opposite of Tranquil
a) Murmuring b) Inebriated c) Sedate d) Alert

168) Choose the opposite of Pit
a) Peak b) Plain c) Gulf d) Well

169) Choose the opposite of Erode
a) Preserve b) Consume c) Grind d) Pulsate

170) Choose the option closest in meaning to Obscure
a) Approval b) Hidden c) Excuse d) None of these

171) Choose the option closest in meaning to Obsolete
a) Voguish b) Dapper c) Antediluvian d) Contemporary

172) Choose the option closest in meaning to Arbitrary
a) Subjective b) Heedful c) Sage d) Shrewd

173) Choose the option closest in meaning to Knave
a) Villain b) Challenging c) Persuasive d) Lazy

174) Choose the option closest in meaning to Eager
a) Indifferent b) Thoughtful c) Keen d) Apathetic

175) Choose the option closest in meaning to Approbation
a) Fear b) Veto c) Consent d) Prediction

176) Choose the option closest in meaning to Fitful
a) Irregular b) Constant c) Trough d) Even

177) Choose the option closest in meaning to Baleful
a) Auspicious b) Evil c) Promising d) Well-Timed

178) Choose the option closest in meaning to Procrastination
a) Confidence b) Liberation c) Dispatch d) Setback

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179) Choose the option closest in meaning to Achromatic
a) Spectral b) Neutral c) Distortion d) Having no purpose

180) Choose the option closest in meaning to Lacuna
a) Misfortune b) Closure c) Cavity d) Species

181) Choose the option closest in meaning to Abscond
a) Retort b) Obscure c) Amassed d) Depart secretly

182) Choose the option closest in meaning to Adulterate
a) Purify b) Cleanse c) Get rid of d) Taint

183) Choose the option closest in meaning to Aggregate
a) Separate b) Isolate c) Discrete d) Amass

184) Choose the option closest in meaning to Aloof
a) Snooty b) Affable c) Lofty d) Snobbish

185) Choose the option closest in meaning to Analogous
a) Incomparable b) Different c) Consonant d) Alter

186) Choose the option closest in meaning to Apportion
a) Praise b) Admire c) Brief d) Administer

187) Choose the option closest in meaning to Arable
a) Uncultivable b) Airy c) Cultivable d) Pundit

188) Choose the option closest in meaning to Arbiter
a) Praise b) Mediator c) Immeasurable d) Judge

189) Choose the option closest in meaning to Arrogate
a) Assume b) Cede c) Surrender d) Abandon

190) Choose the option closest in meaning to Artful
a) Cane b) Articulate c) Adroit d) Detective

191) Choose the option closest in meaning to Ascribable
a) Untraceable b) Fond c) Undetectable d) Detectable

192) Choose the option closest in meaning to Astute
a) Incisive b) Senseless c) Rash d) Heedless

193) Choose the option closest in meaning to Barbaric
a) Tender b) Savage c) Temperate d) Placid

194) Choose the option closest in meaning to Bashful
a) Shy b) Accelerative c) Headlong d) Brazen

195) Choose the option closest in meaning to Beckon
a) Can b) Terminate c) Reject d) Motion

196) Choose the option closest in meaning to Bigot

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a) Tolerant b) Moderate c) Adequate d) Extremist

197) Choose the option closest in meaning to Evident
a) Obscure b) Unclear c) Patent d) Unmarked

198) Choose the option closest in meaning to Fascinating
a) Beguiling b) Repellent c) Hideous d) Repugnant

199) Choose the option closest in meaning to Fleece
a) Sincerity b) Flee c) Busy d) Defraud

200) Choose the option closest in meaning to Flippant
a) Stern b) Facetious c) Somber d) Humorless

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Answer Key (Synonyms and Antonyms)

1) Concurrence
2) Intercession
3) Compilation
4) Accuracy
5) Malignant
6) Vilify
7) Cordial
8) Impulsive
9) Proximity
10) Feasible
11) Tillable
12) Trivial
13) Ownerless Goods
14) Gloomy
15) Tumble
16) Bottom
17) Improve
18) Gather
19) Sodden
20) Pry
21) Weary
22) Stout
23) Hostile
24) Jarring
25) Obstinate
26) Inept person
27) Truism
28) Active
29) Profuse
30) Conclusion
31) Valiant
32) Needy
33) Bound
34) Vogue
35) Diverse
36) Affinity
37) Chutzpah
38) Justifiable
39) Tricky
40) Hold
41) Stratified
42) Hunt
43) Adverse
44) Anxiety
45) Shun
46) Routine
47) Bound
48) Core
49) Prehistoric
50) Loathe
51) Timid
52) Obsolete
53) My Friend
54) Post-mortem
55) Industrious
56) Closure
57) Anxious
58) Past
59) Desert
60) Ornate
61) Repudiate
62) Painstaking
63) Daredevil
64) Vociferous
65) Spirited
66) Strenuous
67) 2-weeks
68) Temporal
69) Waver
70) Ramble
71) Phenomenal
72) Mollify
73) Flourish
74) Solemn
75) Excessive
76) Persuade
77) Activate
78) Apathetic
79) Unambiguous
80) Shackle
81) Engaged in war
82) Parched
83) Fade
84) Sausage
85) Opportune
86) Experienced
87) Languid
88) Lessen
89) Mock
90) Ruminate
91) Aggressive
92) Hover
93) Delusion
94) Lounger
95) Sensible
96) Greed
97) Autocracy
98) Adorn
99) Ignorant
100) Feeble
101) Windfall
102) Trivial
103) Shy
104) Crabby
105) Demon
106) Oath
107) Ambrosial
108) Esteemed
109) Ogre
110) Decay
111) Immoral
112) Premonition
113) Obscure
114) Valor
115) Befit
116) Finding Faults
117) Confuse
118) Cling
119) Coldness
120) Skeptic
121) Cipher
122) Perplexity
123) Study of tumors
124) Flatter
125) Abstainer
126) Crippled
127) Placate
128) Mild
129) Dismay
130) Maniac
131) Acquainted
132) Annoy
133) Affable
134) Enduring
135) Blatant

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136) Selfless
137) In agreement with
138) Enigmatic
139) Detailed
140) Sneaky
141) Aggressive
142) Rebuke
143) Exemplary
144) Mean
145) Crusade
146) Disfigure
147) Exquisite
148) Rancid
149) Meek
150) Gallant
151) Cold Feet
152) Dull
153) Pseudo
154) Florid
155) Genuine
156) Accomplished Fact
157) Whiz
158) Satire
159) Troubled
160) Curse
161) Peace
162) Joyful
163) Friend
164) Humble
165) Retiring
166) Standard
167) Inebriated
168) Peak
169) Preserve
170) Hidden
171) Antediluvian
172) Subjective
173) Villain
174) Keen
175) Consent
176) Irregular
177) Evil
178) Setback
179) Neutral
180) Cavity
181) Depart secretly
182) Taint
183) Amass
184) Snobbish
185) Consonant
186) Administer
187) Cultivable
188) Judge
189) Assume
190) Adroit
191) Detectable
192) Incisive
193) Savage
194) Shy
195) Motion
196) Extremist
197) Patent
198) Beguiling
199) Defraud
200) Facetious

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Introduction to Spelling Corrections

In this portion you are given 4 options and you have to choose which one of them gives the correct spellings of the word. The words that are commonly misspelled are added in this portion. When preparing for vocabulary portion focus on the spellings of the words as well. To check if you are prepared for this portion write down the spellings of the words you remember and then check if you are writing them correct or not. Below is the list of words which can be helpful for this portion. These words appeared for spelling correction in **Past NET Papers.**

To prepare more words, search for commonly misspelled words on the internet, you will find several such lists.

1. Exasperating
2. Satellite
3. Righteous
4. Posthumous
5. Boundary
6. Tongue
7. Emoticon
8. Phenomenal
9. Profession
10. Liquor
11. Accidently
12. Presumably
13. Inundation
14. Comparable
15. Fictitious
16. Excessive
17. Perseverance
18. Essential
19. Extravagant
20. Harassment
21. Censure
22. Hilarious
23. Pursuit
24. Alliance
25. Fluoride
26. Pigeon
27. Succeed
28. Hierarchical
29. Philanthropist
30. Mechanism
31. Acquire
32. Allegiance
33. Environment
34. Procedure
35. Separate
36. Endeavour
37. Heinous
38. Incredible
39. Disciple
40. Arguably
41. Filament
42. Decipher
43. Mathematics
44. Grievances
45. Commemorate
46. Severely
47. Relevance
48. Evidently
49. Fictitious
50. Emissaries
51. Nomenclature
52. Persuade
53. Antagonist
54. Infectious
55. Prejudice
56. Environment
57. Perseverance
58. Divergent
59. Proprietary
60. Real Admiral
61. Siege
62. Portuguese
63. Contiguous
64. Panorama
65. Opportunity
66. Collateral
67. Metallurgy
68. Acceleration
69. Apprehension
70. Hungry
71. Converse
72. Lubrication
73. Ideology
74. Allegiance
75. Psychic
76. Definition
77. Paraphernalia
78. Sovereignty

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Introduction to Analogies

"Genius is the capacity to see 10 things where the ordinary man sees one."

–Erza Pound

In NET Business Studies and Social Sciences, out of 80 questions of English Portion, you will find around 10 – 15 questions of Analogy.

Analogy basically means "resemblance of one object to another in certain aspects." The aim of analogy is to test the candidate's ability to discover the relationship between the question pair and then to find the required pair of words which is most similar to that relationship.

Format of Analogy Questions In NET:

A pair of words will be given in the question, you have to identify the relation between the given pair of words and then chose a pair from given 4 options which also exhibit the same relation.

For example, consider this pair "Polite : Rude"
These two words are antonyms or opposite of each other. Therefore, from the given options you will have to find such a pair which contain two words that are antonyms.

The following pages contain practice questions of Analogies. Some of these questions appeared in past NETs and others are from books and internet. Going through these questions and understanding the solutions will make you capable enough to solve any type of analogy questions in your test, as the difficulty level of questions in your actual paper will almost be the same.

Tip : Do not cram any answer or explanation, rather understand how the relation is established in the given pair of words. The relation between the words in your test will be of similar nature.

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Analogy Questions

Directions: From the given options choose the pair which best matches with the given question pair.

1) Defunct : Life
a) Stagnant : Motion b) Orderly : Pattern c) Arid : Desert d) Obese : Weight

2) Knife : Chopper
a) Walking : Fitness b) Swim : Float c) Scissors : Cloth d) Quilt : Blanket

3) Surgeon : Scalpel
a) Musician : Instrument b) Carpenter : Cabinet
c) Sculptor : Chisel d) Baker : Oven

4) Yawn : Boredom
a) Anger : Madness b) Dream : Sleep
c) Smile : Amusement d) Impatience: Rebellion

5) Cells : Cytology
a) Worms : Ornithology b) Insects : Entomology
c) Diseases : Physiology d) Tissues : Morphology

6) Elevated : Exalted
a) Dirty : Filthy b) Disorderly : Unfaithful
c) Raise : Commensurate d) Promoted : Excellence

7) Birds : Aves
a) Fish : Water b) Whale : Fish c) Lizard : Insect d) Man : Homosapiens

8) Badminton : Court
a) Hockey : Stick b) Cricket : Bat c) Skating : Rink d) Football : Goal

9) Dusk : Night
a) Afternoon : Evening b) Infant : Child c) Walk : Run d) Day : Light

10) Teeth : Chew
a) Mind : Think b) Sweater : Heat c) Food : Taste d) Eyes : Flicker

11) Cat : Mouse
a) Horse : Stable b) Trap : Cheese c) Bird : Worm d) Lion : Cage

12) Balance : Weigh
a) Airplane : Height b) Radar : Detection
c) Satellite : Revolution d) Television : Picture

13) Shield : Soldier

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a) Law : Court
b) Stethoscope : Doctor
c) Helmet : Rider
d) Book : Rider

14) Fish : Shoal
a) Shark : School
b) Whale : Herd
c) Elephant : Flock
d) Audience : Theatre

15) Canvas : Painter
a) Leather : Shoe
b) Chisel : Wood
c) Marble : Sculptor
d) Hammer : Carpenter

16) Pesticide : Plant
a) Injection : Disease
b) Vaccination : Body
c) Medicine : Cure
d) Teacher : Student

17) Fox : Cunning
a) Cat : Playful
b) Horse : Runner
c) Vixen : Cute
d) Ant : Industrious

18) Traffic : Road
a) Airplane : Aerodrome
b) Roots : Tree
c) Blood : Veins
d) Car : Garage

19) Cattle : Drove
a) Soldier : Crew
b) Grain : Bundle
c) Chicken : Brood
d) Bees : Heap

20) Embarrass : Humiliate
a) Enquire : Ask
b) Embezzle : Peculate
c) Gamble : Investment
d) Annoy : Exasperate

21) House : Ceiling
a) Hut : Roof
b) Building : Floor
c) Bed : Bedsheet
d) Grapes : Wine

22) Fish : Aquarium
a) Teacher : Hostel
b) Bee : Apiary
c) Bird : Nest
d) Child : School

23) Dog : Kennel
a) Horse : Carriage
b) Sheep : Flock
c) Cow : Barn
d) Sports : Stadium

24) Practice : Perfection
a) Perseverance : Achievement
b) Run : Jump
c) Examination : Qualification
d) Medicine : Treatment

25) Platform : Train
a) Airplane : Aerodrome
b) Hotel : Tourist
c) Quay : Ship
d) Footpath : Traveler

26) Paper : Ream
a) Eggs : Dozen
b) Books : Pile
c) Twigs : Bush
d) Food : Packet

27) Sonnet : Poem
a) Ballad : Stanza
b) Murder : Crime
c) Chapter : Book
d) Lie : Falsehood

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28) Explosion : Destruction
a) Talk : Exaggeration
b) Girl : Woman
c) Success : Failure
d) Engagement : Marriage

29) Pen : Nib
a) Book : Knowledge
b) Sword : Blade
c) Radio : Transistor
d) Nut : Bolt

30) Necessity : Invention
a) Curiosity : Knowledge
b) Nation : Citizens
c) Price : Commodity
d) Language : Conversation

31) Weight : Kilogram
a) Seconds : Hours
b) Distance : Kilometer
c) Bushel : Corn
d) Mile : Length

32) Sigh : Relief
a) Tear : Joy
b) Trembling : Fear
c) Carelessness : Accident
d) Sweat : Hot

33) Ecstasy : Pleasure
a) Hatred : Affection
b) Joy : Grief
c) Rage : Anger
d) Mumble : Speak

34) Branch : Tree
a) Crest : Wave
b) Bulb : Filament
c) Clothes : Cupboard
d) Water : Tap

35) Friendly : Inimical
a) Lithosphere : Hydrosphere
b) Condemnation : Approval
c) Abstain : Refrain
d) Disappointment : Embarrassment

36) Implicate : Incriminate
a) Involvement : Malpractice
b) Exonerate : Acquit
c) Embezzlement : Charge
d) Perjury : Fraud

37) Range : Mountain
a) Point : Line
b) Bouquet : Flower
c) School : Class
d) String : Bead

38) Chair : Carpenter
a) Grass : Gardener
b) Medicine : Doctor
c) Bridge : Engineer
d) Radio : Radiologist

39) Revolver : Holster
a) Book : Bag
b) Eye : Eyelid
c) Juice : Glass
d) Nostril : Nose

40) Spring : Summer
a) Adolescence : Youth
b) Fight : Battle
c) Stagger : Walk
d) Read : Learn

41) Teeth : Dentist
a) Legs : Philanthropist
b) Eyes : Oculist
c) Operation : Surgeon
d) Sight : Spectator

42) Textile : Mill

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a) Eggs : Hen b) Coal : Mine c) Food : Agriculture d) Brick : Kiln

43) Modesty : Arrogance
a) Passion : Emotion b) Practice : Perfection c) Cause : Purpose d) Debility : Strength

44) Shoes : Cobbler
a) Spectacles : Optician b) Education : Teacher c) Oxygen : Plant d) Food : Kitchen

45) Cool : Cold
a) Length : Width b) Gold : Bourne c) Plant : Tree d) Pretty : Beautiful

46) Wrestler : Arena
a) Cricket : Pitch b) Ring : Finger c) Farmer : Field d) Assistant : Clerk

47) Symphony : Music
a) Mural : Painting b) Ode : Prose c) Preface : Book d) Editorial : Journal

48) Traitor : Disloyalty
a) Executioner : Reliability b) Rebel : Defiance
c) Manager : Administration d) Hope : Pessimism

49) Arrows : Quiver
a) Fear : Tremble b) Money : Bank c) Sound : Music d) Coin : Mint

50) Sound : Muffled
a) Moisture : Humid b) Color : Faded c) Despair : Anger d) Odor : Pungent

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Analogy Answers

1) Stagnant : Motion

Analogy Used: The words in each pair are antonyms.

Further Explanation: Defunct means no longer existing or functioning, so life is its opposite(antonym). Similarly, stagnant is antonym of motion. The other given pairs are synonymous. Orderly and pattern means arranged. Arid and desert means dry. Obese and weight means heavy. Therefore, stagnant: motion is the correct analogous pair.

2) Quilt : Blanket

Analogy Used: Both knife and chopper are used for the same purpose i.e. cutting. Similarly, both quilt and blanket are used same purpose i.e. for protection from cold.

Further Explanation: Knife and choppers are the tools which are used for the same purpose which is to cut something. A quilt and blanket both are piece of cloths used as a sheet for protection from cold. Fitness is a state achieved by walking and other exercises. Swim and float are activities, and this pair does not indicate any purpose. Scissors and cloth show relationship of a tool and an object on which that tool acts. Therefore, quilt : blanket is the correct analogous pair.

3) Sculptor : Chisel

Analogy Used: Second word in the pair is the tool used by the first.

Further Explanation: A surgeon uses a scalpel to perform operation. A scalpel is a small and extremely sharp bladed instrument used for surgery. Similarly, a sculptor uses a chisel to carve out statue. A chisel is a tool with a characteristically shaped cutting edge of blade on its end, for carving or cutting a hard material such as wood, stone, or metal. Both pairs show worker-tool relationship. Both are using a tool or an object having blades to perform a delicate task of cutting or craving.

A baker uses oven to bake food. A musician uses various instruments to create sounds. A carpenter makes a cabinet. By considering all the above pairs, according to worker-tool relation and use of sharp blade, sculptor: chisel is the best choice

4) Smile : Amusement

Analogy Used: Yawn indicates boredom. Similarly, smile indicates amusement.

Further Explanation: Establish the relationship between yawn and boredom. Roughly, the relationship between two words is 'a yawn indicates boredom'. The correct answer is c because smile indicates amusement.

A dream is a state achieved during deep sleep. Rest of the two options seem close enough to fit the relationship established, so we restate it more precisely. A yawn is a physical movement of facial muscles indicating boredom and so is the smile indicating amusement. Now, rest two options indicate emotional states instead of physical movement. Therefore, smile : amusement is the best option.

5) Insects : Entomology

Analogy Used: The study of cells is called cytology. Likewise, the study of Insects is called entomology.

Further Explanation: Ornithology is the study of birds. Physiology is the science that deals with the normal activities and functions of living organisms. Morphology is the study of form or structures. Tissues are one of the basic components that form any part of a living organism.

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Therefore, the correct relation as depicted by the given pair is Insects : Entomology

6) Dirty : Filthy

Analogy Used: Second word in the pair is of higher intensity than the first one

Further Explanation: The given pair shows degrees of characteristics analogies. One degree higher than elevated can be exalted. Similarly, higher level of dirty is termed as filthy.

Excellence is the reason someone is promoted. So, this pair does not fit the given relation.

7) Man : Homosapiens

Analogy Used: Second word in the pair denotes the class to which the first belongs.

Further Explanation: Birds belong to the class of aves. Humans belong to class homosapiens. A fish has a water/aqueous habitat. Whale eats fish and a lizard eats insect. Therefore, man : homosapien relationship best suits the give pair.

8) Skating : Rink

Analogy Used: Badminton is played in a court. Similarly, skating is done in a rink.

Further Explanation: A goal is scored in football. Hockey is played with a stick. Cricket is played with a bat. Therefore, according to relationship between a game and area where it is played, skating : rink is the correct analogous pair.

9) Infant : Child

Analogy Used: First word in the given pair is the initial stage of the second word.

Further Explanation: Dusk is the initial stage of night i.e. when night starts to fall. Similarly, Infant is the initial stage of a child i.e. infant is a very young child. Walk and run pair do not go well with the concerned relationship. Morning and Evening are different parts of the day and do not match with the given relationship. Similarly, Day : Light also do not depict the correct analogy. Therefore, infant : child is the correct analogous pair.

10) Mind : Think

Analogy Used: Second word in the given pair is the function of the first.

Further Explanation: The function of teeth is to chew. Similarly, function of mind is to think. Function of sweater is to protect from the cold. Food : Taste and Eyes : Flicker aren't related to the given pair in any way. So, mind : think is the correct analogous pair.

11) Bird : Worm

Analogy Used: First one in the pair feeds on the second.

Further Explanation: A cat feeds on a mouse. Similarly, a bird feeds on a worm. This expresses an animal and its feed relationship. Other pairs do not express such relationship. So, bird : worm is the correct analogous pair.

12) Radar : Detection

Analogy Used: Second word in the pair denotes the purpose for which the first is used.

Further Explanation: A balance is used for weighing(measuring weights). Similarly, a radar is used for detection. Both pairs are expressing object-purpose relationship. Airplane : height and satellite :

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revolution shows object-position relationship. Television : picture also does not show object-purpose relationship. Therefore, radar: detection is the correct analogous pair.

13) Helmet : Rider

Analogy Used: First word in the pair is used by the second for protection.

Further Explanation: Shield is used by a soldier for protection against attacks. Similarly, helmet is used by a rider for protection from accidents while travelling. Stethoscope is used by a doctor but not for protection. It is used for diagnostic purpose. So, the best option expressing the same relationship is helmet : rider.

14) Shark : School

Analogy Used: Second word in the pair is a collective group of the first.

Further Explanation: A shoal is large number of fish swimming together. Similarly, a group of sharks is collectively called school. A group of whales is commonly called a pod, a school or a gam. A group of elephants is called a herd or parade. Audience is the passive participants of the theatre. So, the correct option is shark : school, expressing correct relationship of animal and its collective noun.

15) Marble : Sculptor

Analogy Used: Second word in the pair works on the first.

Further Explanation: A painter works(paints) on the canvas. Similarly, a sculptor works on the marble. Shoes are made from the leather. A woodworker uses chisel to work on the wood. And a carpenter uses a hammer as one of its tools to work on something. So, the correct analogous pair describing the relation of the object and the person working on it is marble : sculptor.

16) Vaccination : Body

Analogy Used: First word in the pair is meant to protect the second from diseases.

Further Explanation: A pesticide's purpose is to protect plants from harmful organisms. Similarly, vaccination protects our body from micro-organism's attacks. An injection is a medicine which prevents or cures diseases. A medicine provides care to its user. A teacher teaches its student. So, correct option is vaccination : body, as it expresses the same relation as that of pesticide : plant, i.e. of protection from micro-organisms.

17) Ant : Industrious

Analogy Used: Fox is considered to be cunning. Similarly, ant is considered to be an industrious creature.

Further Explanation: This question uses the concept of similes. The definition of simile is: "a figure of speech involving the comparison of one thing with another thing of a different kind, used to make a description more emphatic or vivid (e.g. as brave as a lion)"

The given simile is "as Cunning as a fox". The correct corresponding simile will be "as industrious as an ant". Option "a" is wrong as the correct version is "As playful as a kitten". Option b is also wrong as the correct simile is "as hungry as a horse". Similarly, option c is also wrong. Therefore, the option ant : industrious shows the correct relationship as in fox : cunning i.e. these both are similes commonly used.

18) Blood : Veins

Analogy Used: Traffic moves on road. Similarly, blood travels through veins.

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Further Explanation: Both, the traffic and blood are showing relationship with their paths i.e. a road and a vein through which they move. Aerodrome is a location from where aircraft flight operations take place. So is the garage, a place where cars are parked. Roots are the parts of tree which help it stand tall and strong. Therefore, the most relative option is blood : veins which express same relationship as in traffic : road.

19) Chicken : Brood

Analogy Used: This expresses relationship of nouns and their groups. Drove is a group of cattle. Similarly, brood is a group of chickens.

Further Explanation: The collective noun for a group of bees is called a colony, not heap. Collective noun for grain is sheaf and that of soldiers is a troop. So, the option with correct analogous pair is chicken : brood.

20) Annoy : Exasperate

Analogy Used: The words in each pair are synonyms.

Further Explanation: Embarrass and humiliate are similar in meaning but latter(Humiliate) is stronger in degree. The same relation exists between annoy and exasperate. Exasperate means annoy intensely. Other pairs are also synonymous of each other but the second word in those pairs is not an intense form of the first.

21) Hut : Roof

Analogy Used: Second is the top part of the first.

Further Explanation: Ceiling is the top part of a house. Likewise, roof is the top part of a hut. Floor is the bottom part of a building. Wine is the product of grapes and bedsheet is sheet that is spread over the bed. Therefore, the pair hut : roof expresses the same analogous relationship.

22) Bee : Apiary

Analogy Used: Fish are kept and reared in an aquarium. Similarly, bees are reared in an apiary.

Further Explanation: Both pairs show relationship of organisms and containers where they are reared. The nests are made by birds themselves for shelter and incubation of eggs. A hostel is a place where teacher lives. A school is place where a child is given admission. So according to the given relationship, bee and apiary is the correct analogous pair.

23) Cow : Barn

Analogy Used: Second word in the pair is the living place of the first.

Further Explanation: A dog lives in a kennel. Likewise, a cow lives in a barn. A horse is used to pull carriages. Sports are played in stadiums. A group of sheep is called flock. So correct option is cow and barn because it shows the same analogous relationship of animal and its habitat.

24) Perseverance : Achievement

Analogy Used: Second word in the pair is the result of the first.

Further Explanation: Practice leads to perfection. Likewise, Perseverance leads to achievement. Examination may lead to either qualification or disqualification. Medicine may lead to either treatment or

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prevention. Running may not necessarily ends up with jumping. Therefore, the correct analogous pair is Perseverance : Achievement

25) Quay : Ship

Analogy Used: Second word in the pair is the place designed for the stoppage of the first.

Further Explanation: Platform is a section of pathway, alongside rail tracks at a railway station, metro station or tram stop, at which passengers may board or alight from trains or trams. Likewise, quay is a stone or metal platform lying alongside or projecting into water for loading and unloading ships. Aerodrome is a location from which aircraft flight operations take place. It is not a station or stop like a platform or a quay. Hotel is a temporary place where tourists live. Footpath is a track for travelers. Therefore, quay : ship is the correct analogous pair.

26) Eggs : Dozen

Analogy Used: Papers are bought in reams. Similarly, eggs are bought in dozens.

Further Explanation: Food is wrapped in a packet. A twig is a thin branch of a tree or bush. Pile is large quantity of books lying on each other. Therefore, the correct analogous pair is Eggs : Dozen.

27) Murder : Crime

Analogy Used: First word in the pair is a type of the second.

Further Explanation: Sonnet is a type of poem. Similarly, murder is a type of crime. Chapter is a part of book. Lie is synonym of falsehood. Stanza is a part of ballad. So, the correct analogous pair murder : crime.

28) Engagement : Marriage

Analogy Used: First word in the pair is followed by the second.

Further Explanation: Explosion leads to destruction. Similarly, engagement leads to marriage. Other options do not fit well with the given relation. So, the correct analogous pair is engagement : marriage.

29) Sword : Blade

Analogy Used: Second word in the pair is the topmost part of the first.

Further Explanation: Nib is the topmost part of a pen. Similarly, blade is the topmost part of a sword. Bool contains knowledge. Radio contains a transistor. Therefore, the correct analogous pair is sword : blade.

30) Curiosity : Knowledge

Analogy Used: First is essentially required for the second.

Further Explanation: Necessity is essentially required for invention, or necessity leads to invention. Similarly, curiosity is essentially required for knowledge or curiosity leads to knowledge. Both ar expressing a need or strong keen to gain the other one. Language itself makes the conversation. Nation i made of citizens. Prices are given to the commodities. So, correct analogous pair is curiosity : knowledge

31) Distance : Kilometer

Analogy Used: Second word in the pair is a unit to measure the first.

Further Explanation: Weight is measured in kilograms. Similarly, distance is measured in kilometers. Bot kilogram and kilometer are metric system units. Second and Hour are both units of time.

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Bushel is an imperial or US customary unit system for corn. Mile is a unit of length. If you observe, in the given pair(Weight : Kilogram) second word is the unit of the first one but in choices c and d, it's the opposite, first word is the unit of second word. Therefore, these two options are incorrect. So, the most appropriate analogous pair is distance : kilometer.

32) Trembling : Fear

Analogy Used: Sigh is a sign of relief. Likewise, trembling is a sign of fear.

Further Explanation: Both trembling and sigh are exact expressions given in feared and relieved conditions. A tear may indicate joy or sorrow. Carelessness causes accident. Sweat indicates hot weather. Therefore, the correct analogous pair is trembling : fear.

33) Rage : Anger

Analogy Used: First word in the pair is a more intense form of the second.

Further Explanation: Ecstasy is an intense pleasure. Likewise, rage is an intense anger. Hatred is antonym of affection. Joy is antonym of grief. Mumble is to speak indistinctly or quietly. Therefore, the correct analogous pair is rage : anger.

34) Crest : Wave

Analogy Used: First word in the pair is a part of the second.

Further Explanation: A branch is a part of a tree. Similarly, crest is the maximum or highest point of a wave. Notice that first word of the pair is part of the second one.

A filament is a part of the bulb, but in this pair the second word is the part of other first. For a correct analogous pair, the position of words must match as well. So, the correct analogous pair is Crest : Wave.

35) Condemnation : Approval

Analogy Used: The words in each pair are antonyms of each other.

Further Explanation: Friendly and inimical are antonyms are each other. Similarly, condemnation and approval are antonyms of each other. Lithosphere and hydrosphere are terms used for all the land and water on the surface of earth, respectively, hence, not opposites of each other. Abstain and refrain are synonyms. While disappointment may cause embarrassment, they are not antonyms of each other. Therefore, the correct analogous pair is condemnation : approval.

36) Exonerate : Acquit

Analogy Used: The words in each pair are synonyms.

Further Explanation: Implicate and incriminate are synonyms of each other. Similarly, exonerate and acquit are synonyms. Involvement may lead to malpractice, embezzlement leads to charge, perjury leads to fraud, but none of these pairs are synonyms. Therefore, the correct analogous pair is Exonerate : Acquit.

37) String : Bead

Analogy Used: The first word in the pair is name given to a continuous chain of the second.

Further Explanation: Range is the name given to a continuous chain of the mountain. Similarly, the string is a name given to a continuous chain of the bead.

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Two or more points form a line. Some of you may argue that a line is a continuous chain of points. But notice that in given pair (Range : Mountain), the first word is the name given to the continuous chain, but in this pair (point : line), second word is the name of continuous chain. So, this option cannot be correct. Bouquet is collective noun for flowers. A school contain classes, but they don't necessarily form a continuous chain. Therefore, the correct analogous pair is string : bead.

38) Bridge : Engineer
Analogy Used: First word in the pair is designed by the second.
Further Explanation: A chair is made by a carpenter. Similarly, a bridge is made by an engineer. Grass is grown by a gardener, not made or designed. Medicines are given or prescribed by a doctor. Radio waves are studied and used by a radiologist. Therefore, the correct analogous pair is bridge : engineer.

39) Book : Bag
Analogy Used: First word in the pair is kept inside the second.
Further Explanation: A revolver is kept in a holster. Similarly, a book is kept inside a bag. Eyelid is a part of eye. Juice is served in a glass, not kept. Nostril is a part of nose. Therefore, the correct analogous pair is book : bag.

40) Adolescence : Youth
Analogy Used: First word in the pair occurs after the second.
Further Explanation: Spring comes after summers. Similarly, adolescence comes after youth. Fight is done during a battle. Staggering does not lead to walking. One may stagger after walking for hours. Reading leads to learning. So, none of these 3 pairs satisfy the given relation. Therefore, the correct analogous pair is Adolescence : Youth.

41) Eyes : Oculist
Analogy Used: Second word in the pair examines the first.
Further Explanation: Teeth are examined by a dentist. Likewise, eyes are examined by an oculist. A surgeon performs an operation, he does not examine the operation.
Another relation can be: A dentist is a specialized person in treatment of teeth, likewise an oculist is a specialized person in treatment of eye. Therefore, the correct analogous pair is eyes : oculist.

42) Brick : Kiln
Analogy Used: Second is the place where the first is manufactured.
Further Explanation: Textile is processed in mills. Similarly, bricks are processed in a kiln. Eggs are produced by hen. Coal is extracted from a mine. Food is obtained from agriculture. Therefore, the correct analogous pair is Brick : Kiln.

43) Debility : Strength
Analogy Used: The words in both pairs are antonyms of each other.
Further Explanation: Modesty means humility and arrogance means egotism, so both are antonyms. Debility means weakness, so strength is its antonym. Other options are synonyms of each other.

44) Spectacles : Optician
Answer: a) Spectacles : Optician

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Analogy Used: First word in the pair is designed by the second.
Further Explanation: A cobbler makes or designs shoes. Likewise, an optician makes spectacles. Education is given by teacher. Oxygen is produced by trees. Food is made in the kitchen. Therefore, the correct analogous pair is Spectacles : Optician.

45) Pretty : Beautiful
Analogy Used: Second word in the pair is of higher intensity than the first.
Further Explanation: One degree higher than cool is cold. Likewise, one degree higher than pretty is beautiful. No other pair fit in this relation. Therefore, the correct analogous pair is Pretty : Beautiful.

46) Cricket : Pitch
Analogy Used: Second word in the pair is the place where the first activity/support is played.
Further Explanation: Wrestling is played in an arena. Likewise, cricket is played on pitch. Ring is worn on finger. Framer works on a field. Assistant works with a clerk. Therefore, the correct analogous pair is cricket : pitch.

47) Mural : Painting
Analogy Used: First word in the pair is a type of the second.
Further explanation: A symphony is a type of music. Similarly, a mural is a type of painting which is done directly on a wall.
Ode is a type of poem and prose is a writing without ant rhyming or structure. Preface occurs at the start of a book as an introduction. Editorial is an article in newspaper and journal is a newspaper/magazine with a particular subject. Therefore, the correct option is mural : painting.

48) Rebel : Defiance
Analogy Used: Second word in the pair is the defining characteristic of the first.
Further Explanation: A traitor possesses characteristic of disloyalty. Similarly, a rebel possesses characteristic of defiance. So, the correct option is rebel : defiance.

49) Money : Bank
Analogy Used: First word in the pair is kept in the second.
Further Explanation: Arrows are kept in a quiver. Similarly, money is kept in a bank. Coins are manufactured in mint, not kept. Therefore, the correct option is money : bank.

50) Color : Faded
Analogy Used: Second is the process of gradual disappearance of the first.
Further explanation: Sound when gradually disappears is muffled. Similarly, when color disappears gradually it is faded. Odor means a distinctive smell especially an unpleasant one and pungent means a sharp smell. Despair means loss/absence of hope. Therefore, the correct analogous pair would be Color : Faded.

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Introduction to Reading Comprehension

In NET Engineering and Computer Science, out of 20 questions of English Portion, you will find around 4 – 6 questions of Comprehension.

Format of Comprehension Passages in NET:

A short passage will be given which will usually span on less than 10 lines. After the passage a question will be presented, and you will have to answer the question based on the information provided in the given passage. Only 1 question per passage will be asked in NET.

The questions will be of varying difficulty level. Some of the passages and their question will be really easy and some of the passages will be hard. Students usually face difficulty in comprehension passages because they are not aware of the meaning of the words. So, improving your English Vocabulary will prove helpful for this section as well.

Practice questions are presented in the following pages. The questions in your NET will be mostly similar.

Tip: Before reading the given passage, read the question. Read only the question not the given options. Then, read the passage. This way when you are reading the passage, the given question is in your mind. So, as soon as you reach the line which answers the question directly or indirectly, you can focus more on that line. Don't just stop when you reach at this line. Continue reading till the end of the passage. After finishing the passage read the question with options and then select the best possible answer based on your reading.

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Questions of Reading Comprehension

Passage 1 - Opera

Opera refers to a dramatic art form, originating in Europe, in which the emotional content is conveyed to the audience as much through music, both vocal and instrumental, as it is through the lyrics. By contrast, in musical theater an actor's dramatic performance is primary, and the music plays a lesser role. The drama in opera is presented using the primary elements of theater such as scenery, costumes, and acting. However, the words of the opera, or libretto, are sung rather than spoken. The singers are accompanied by a musical ensemble ranging from a small instrumental ensemble to a full symphonic orchestra.

It is stated in the reading that ___

a) Acting and costumes are secondary to music in musical theater
b) Many people find musical theater more captivating than opera
c) Music in musical theater is not as important as it is in opera
d) An opera requires a huge orchestra as well as a large choir

Passage 2 – Dolphins

Dolphins are regarded as the friendliest creatures in the sea and stories of them helping drowning sailors have been common since Roman times. The more we learn about dolphins, the more we realize that their society is more complex than people previously imagined. They look after other dolphins when they are ill, care for pregnant mothers and protect the weakest in the community, as we do. Some scientists have suggested that dolphins have a language, but it is much more probable that they communicate with each other without needing words.

It is clear from the passage that dolphins ___.

a) Don't want to be with us as much as we want to be with them
b) Are proven to be less intelligent than once thought
c) Have a reputation for being friendly to humans
d) Are the most powerful creatures that live in the oceans

Passage 3 - Unsinkable Ship

Naval architects never claim that a ship is unsinkable, but the sinking of the passenger-and-car ferry Estonia in the Baltic surely should never have happened. It was well designed and carefully maintained. It carried the proper number of lifeboats. It had been thoroughly inspected the day of its fatal voyage. Yet hours later, the Estonia rolled over and sank in a cold, stormy night. It went down so quickly that most of those on board, caught in their dark, flooding cabins, had no chance to save themselves. Of those who managed to scramble overboard, only 139 survived. The rest died of hypothermia before the rescuers could pluck them from the cold sea. The final death toll amounted to 912 souls.

One can understand from the reading that ___.

a) The lifesaving equipment did not work well and lifeboats could not be lowered
b) 139 people managed to leave the vessel but died in freezing water
c) Naval architects claimed that the Estonia was unsinkable
d) Most victims were trapped inside the boat as they were in their cabins

Passage 4 - Erosion in America

Erosion of America's farmland by wind and water has been a problem since settlers first put the prairies and grasslands under the plow in the nineteenth century. By the 1930s, more than 282 million acres of

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farmland were damaged by erosion. After 40 years of conservation efforts, soil erosion has accelerated due to new demands placed on the land by heavy crop production. In the years ahead, soil erosion and the pollution problems it causes, are likely to replace petroleum scarcity as the nation's most critical natural resource problem.

It is pointed out in the reading that in America

a) Petroleum is causing heavy soil erosion and pollution problems

b) Heavy crop production is necessary to meet the demands and to prevent a disaster

c) Soil erosion has been hastened due to the overuse of farming lands

d) Water is undoubtedly the largest cause of erosion

Passage 5

One of my favorite vacation places is Mexico. I really like the weather there because it never gets cold. The people are very nice too. They never laugh at my bad Spanish. The food is really good. Mexico City is a very interesting place to visit. It has some great museums and lots of fascinating old buildings. The hotels are too expensive to stay but there are more affordable options. For example, you can stay at one of the beach resorts like Acapulco. If you are planning to visit Mexico, you should definitely see the Mayan temples near Merida.

What can you conclude from the paragraph?

a) Hotels are very cheap in Mexico

b) The hotels aren't comfortable there

c) Hotels are all poor in Mexico

d) The hotels in Mexico are pretty expensive

Passage 6

Last summer, we decided to spend our vacation at the beach because the weather was very hot in the mountains. The travel agent said that traveling by bus was the cheapest way, but we went by plane because it was faster. We wanted to have more time to spend at the beach. The weather was beautiful, and we had a great time.

We decided to go to the beach because ___

a) It was cheaper than going to the mountains

b) The travel agent said that it was the cheapest

c) The weather was hot in mountains

d) we wanted to spend time at the beach

Passage 7

Dear Melissa, I hope you are well. Guess what! I am having a big party next week at my house and I am inviting all my close friends. The theme of the party is going to be Harry Potter, so all must dress accordingly. You would make a great witch! I need to let everyone know by Wednesday since I am throwing the party next Saturday. Sam is going to decorate the house and my mother is going to bake a cake and making lots of food. There is going to be music and dancing as well. John is going to be the DJ. You can stay over at my house. It's going to be great! I hope to see you then.

What kind of an organization is it?

a) It is a slumber party

b) It is a costume party

c) It is about making cake

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d) It is a dance party

Passage 8

Often mistaken for insects, spiders actually belong to a different classification of creatures, called arachnids. They're insects' worst enemies. Although a few species, such as the black widow and the brown recluse, are dangerous, the majority are harmless to humans. Moreover, they can be helpful. Pest control, for example is just one of the many ways spiders can help us. They kill far more pests than commercial insecticides do. In the future, perhaps if farmers employ armies of spiders to protect their fields, our grocery bills will be lower and our soil and water and food will have fewer pesticide remains.

Unlike many people think, ___.

a) Spiders can be used in insecticide industry

b) The black widow is a dangerous species of the spider

c) Spiders are the worst enemy of insects

d) A spider is not a kind of insect at all

Passage 9

Dear Marcos, Hi, my name is Rebecca and I am your new pen pal. I'm ten years old, and I live in Barcelona, Spain. I go to the 4th grade in Saint Michael Elementary School. On weekdays, I get up at 6 o'clock. The school starts at 7:30 in the morning. I have my lunch at the school cafeteria and I usually leave around 3:30 in the afternoon. I am good at math, I also like history and geography, but my favorite subject is science. I like playing basketball and soccer. I also play tennis, and I like swimming. On the weekends, I go to the movie theater with my friends. We like action movies. I usually go to church with my parents on Sundays.

Which statement is correct?

a) Rebecca usually practices the drums on weekdays.

b) Rebecca is interested in Science.

c) Rebecca has got a music group at school.

d) Rebecca and his friends like watching thrillers.

Passage 10

Hi, my name's Andriy. I love football, I am a great fan of AC Milan. I have also been interested in cars since I was a child. I'm crazy about driving and I also enjoy fixing cars. When I was ten, I had many toy cars. I would play with them, repair the ones my friends broke. I also used to help my dad fix his car. So, eventually I decided to become a mechanic and open up my own shop. My parents are happy with my choice, too. They think it's important that I pursue a carrier that I like. I have a bright career now and I really enjoy it. I'm planning to get married soon. My girlfriend is also interested in cars. Who knows, maybe we can run the car shop together with our kids in the future.

Andriy has been interested in cars since ___.

a) 2007

b) He was born

c) His started driving

d) Very young age

Passage 11

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Diana, Princess of Wales, became famous when she decided to marry Prince Charles. She became the most photographed person in the world. Everywhere she went, there were photographers taking pictures of her and people were very interested in her clothes, where she went on holiday and who she was with. They were also interested in the problems between her and her husband. When they divorced she remained very popular. In addition to her image as a 'star', Princess Diana used her influence to attract attention to some charities. She was very sympathetic to all people who were ill and unhappy and dedicated time to helping them and drawing public attention to their problems. She used to visit homeless people regularly and did a lot of work for the National AIDS Trust; she visited people suffering from AIDS.
It is implied in the passage that before her marriage to Prince Charles, Diana was ___.

a) Widowed by another Prince of Wales
b) An unknown figure to public
c) Followed by an army of photographers
d) Was one of the victims of the epidemic AIDS

Passage 12

Every summer Nichole goes to the countryside for a month. She stays at her uncle's farm and helps him. She works very hard, but she likes it because she loves to spend time with her cousin Macy. Every morning she wakes up at six o'clock, first she collects the eggs and feeds the chickens, then she has breakfast at 6:30 and after breakfast, she helps her aunt with the house chores for an hour. She can't wait to spend time with her cousin Macy. They always have a great time together. They climb trees, pick fruits and flowers. They love being outdoors. They come back home before dark and get ready for dinner. After dinner, they go out and feed the animals. Before they go to bed, they watch TV for a little bit or read books. They are always very tired at the end of the day and usually fall asleep watching TV or reading.
Where does Nichole go in summer?

a) She goes to a big city.
b) She goes to her uncle's farm.
c) She goes to her cousin's hotel.
d) She goes camping

Passage 13 - Our Toy Shop

Hi, my name is Amy. I am twelve years old. We have a small toy shop in our neighborhood. My father says Fridays are the busiest day in our toy shop. So, after the school, my mom takes me there to help my dad. That's another reason why I like Fridays. We allow kids to play with the toys when they are in the store. My father says I am responsible for the toys and that I need to watch and make sure nothing breaks. Many kids from my school and neighborhood also come to the shop to look at our new toys. It is always noisy here. Because it's full of babies and small children. Little girls tend to go for dolls, boys go for cars. Some just want to play with the toys, some actually want to buy them. It's a bit tiring for me, but I like going to the shop and helping my father.
Which of the following questions you cannot answer?

a) Where is the toy shop located?
b) When is the busiest day at the toy shop?
c) Why is the toy shop so noisy?
d) What's the name of the toy shop?

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Passage 14

When schools opened in Texas this fall, some favorites were missing from the cafeteria menus. Sodas and candy bars had been banned for grade schoolers, chips and cookies were mini-size. And that perennial favorite, the French fry, was given just one more year before it too will be banned. Howls of protest could be heard everywhere. Principals complained about being forced to act as "nutrition police." Parents and kids traded schoolyard rumors about twinkies being confiscated from lunch boxes. Nearly everyone, addicted to the revenues that vending machines bring in, yelled that there wouldn't be enough money for activities like band camp and choir trips. Angry e-mails poured in to the woman who had imposed the new rules - Texas agriculture commissioner Susan Combs.

It is stated in the passage that both the students and the principals of the schools in Texas ___.

a) Have the most qualified teaching staff

b) Are to commute between the campus and downtown

c) Intend to devise new methods of dieting

d) Seem to be displeased with the current food policy

Passage 15

Hi, my name is Joshua. I am a financial adviser. Yesterday I had a very busy day. I woke up at half past six. Waking up was so hard that I needed to wash my face with cold water to open my eyes. Then I went to the kitchen and had a cup of coffee and toast for breakfast. I brushed my teeth, took the trash out, ironed my clothes and finally I got dressed up and left home around seven o'clock. I got on the bus at half past seven to downtown. I arrived at work at ten to eight. I needed to finish up six reports before noon. At twelve o'clock I had half an hour lunch with my colleagues. After lunch we had a meeting until two o'clock. Then I visited one of my clients at three o'clock to talk about his financial plans. I came back to work at around four o'clock and prepared three more reports. Finally, at six I was able to leave my office and I was exhausted by the time I got home.

Which of the following questions you cannot answer?

a) Why was Joshua so sleepy?

b) How many reports did he finish?

c) What time did he have his lunch?

d) Why did he visit his client?

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Answers of Reading Comprehension

Passage 1 - Opera

c) Music in musical theater is not as important as it is in opera

Explanation: The answer to this question lies in the 3rd line of the passage: "By contrast, in musical theater an actor's dramatic performance is primary, and the music plays a lesser role".

Since the contrast is made to the opera, therefore, we can conclude that music plays a lesser role in musical theaters than in opera. OR, in musical theater is not as important as it is in opera.

Passage 2 - Dolphins

c) Have a reputation for being friendly to humans

Explanation: The answer to this question lies in the 1st line of the passage: "Dolphins are regarded as the friendliest creatures in the sea and stories of them helping drowning sailors have been common since Roman times".

Passage 3 - Unsinkable Ship

d) Most victims were trapped inside the boat as they were in their cabins

Explanation: The answer lies in the 4th line: "It went down so quickly that most of those on board, caught in their dark, flooding cabins, had no chance to save themselves".

Passage 4 - Erosion in America

c) Soil erosion has been hastened due to the overuse of farming lands

Explanation: The answer lies in the 3rd line: "After 40 years of conservation efforts, soil erosion has accelerated due to new demands placed on the land by heavy crop production".

Passage 5

d) The hotels in Mexico are pretty expensive

Explanation: The answer lies in the 4th line: "The hotels are too expensive to stay".

Passage 6

c) The weather was hot in mountains

Explanation: The answer lies in the 1st line: "Last summer, we decided to spend our vacation at the beach because the weather was very hot in the mountains".

Passage 7

b) It is a costume party

Explanation: The answer lies in the 2nd line: "The theme of the party is going to be Harry Potter, so all need dress accordingly". Since the theme is harry potter, this shows every participant has to wear a customer accordingly.

Passage 8

d) A spider is not a kind of insect at all

Explanation: The answer lies in the 1st line of the passage: "Often mistaken for insects, spiders actually belong to a different classification of creatures, called arachnids'

Passage 9

b) Rebecca is interested in Science.

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Explanation: The answer lies in the following line: "my favorite subject is science".

Passage 10

d) Very young age

Explanation: The answer can be found in the 1st line of the passage: "I have also been interested in cars since I was a child".

Passage 11

b) An unknown figure to public

Explanation: The 1st line: "Diana, Princess of Wales, became famous when she decided to marry Prince Charles", implies that Diana was not famous before her marriage.

Passage 12

b) She goes to her uncle's farm.

Explanation: The answer lies in the first line: "Every summer Nichole goes to the countryside for a month. She stays at her uncle's farm and helps him".

Passage 13 - Our Toy Shop

d) What's the name of the toy shop?

Explanation: The question in choice a can be answered from the first line: "We have a small toy shop in our neighborhood". So, the toy shop is located in the neighborhood.

The question in choice b can be answered from the second line: "My father says Fridays are the busiest day in our toy shop".

The question in choice can be answered based on the line that "It is always noisy here. Because it's full of babies and small children".

This leaves us with choice d. There has been no description of the name of the toy shop.

Passage 14

d) Seem to be displeased with the current food policy

Explanation: The answer lies in the following line: "Howls of protest could be heard everywhere. Principals complained about being forced to act as "nutrition police."

This shows both students and principles were not happy with the current food policy.

Passage 15

a) Why was Joshua so sleepy?

Explanation: There is no mention of why Joshua was so sleepy. The questions in rest of the choices can be answered from the passage.

He finished 9 reports in total, did lunch at 12 pm and visited the client to discuss about his financial plans.

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Grammar Portion

In NET Engineering and Computer Science, out of 20 questions of English Portion, you will find around 4 – 6 questions of Grammar.

Format of Grammar Questions in NET:

Most of the Grammar questions in NET are on the format of complete the sentence. You have to choose the most suitable word from the given choices that will complete the given sentence. Some questions might also require you to spot an error in the given sentence. The key to performing better in Grammar is to learn and revise the tenses and rules of Grammar.

Practice questions are presented in the following pages. The questions in your NET will be similar to these.

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Practice Questions for Grammar

Directions: Pick out the most effective word(s) from the given words to fill in the blank to make the sentence meaningfully complete.

1) Fate smiles _____ those who untiringly grapple with stark realities of life.
a) At b) Over c) On d) Upon

2) The miser gazed _____ at the pile of gold coins in front of him.
a) Avidly b) Admiringly c) Thoughtfully d) Earnestly

3) Catching the earlier train will give us the _____ to do some shopping.
a) Chance b) Luck c) Possibility d) Occasion

4) I saw a _____ of cows in the field.
a) Group b) Herd c) Swarm d) Flock

5) The grapes are now _____ enough to be picked.
a) Ready b) Mature c) Ripe d) Advanced

6) Success in this examination depends _____ hard work alone.
a) At b) Over c) For d) On

7) My uncle decided to take _____ and my sister to the market.
a) I b) Mine c) Me d) Myself

8) If you smuggle goods into the country, they may be _____ by the customs authority.
a) Possessed b) Punished c) Confiscated d) Fined

9) Man does not live by _____ alone.
a) Food b) Bread c) Meals d) Diet

10) Ahmed behaves strangely at times and, therefore, nobody gets _____ to him.
a) About b) Through c) Along d) Up

11) Rida and Ramsha are twin sisters, but they do not look _____
a) Unique b) Different c) Likely d) Alike

12) To err is _____ to forgive divine.
a) Beastly b) Human c) Inhuman d) Natural

13) The ruling party will have to put its own house _____ order.
a) In b) On c) To d) Into

14) _____ of old paintings is a job for experts.
a) Resurrection b) Retrieval c) Restoration d) Resumption

15) During Eid festivals the shops are _____ of people.
a) Busy b) Full c) Crowded d) Bubbling

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16) The paths of glory lead _____ to the grave.
a) Straight b) But c) In d) Directly

17) The telephone _____ several times before I answered it.
a) Was Ringing b) Has Rung c) Had Rung d) Would Ring

18) He passed the examination in the first class because he _____
a) Was Hard Working For It b) Worked Hardly For It
c) Had Worked Hard For It d) Was Working Hard For It

19) Quaid e Azam spent his last days _____ Ziarat residency.
a) At b) In c) On d) Across

20) If negotiations are to prove fruitful, there must not only be sincerity on each side, but there must also be _____ in the sincerity of the other side.
a) Faith b) Belief c) Substance d) Certainty

21) I hate sitting _____ him as he always smells of garlic.
a) Besides b) Along c) At d) Beside

22) Some regions of our country still remain _____ to the average man.
a) Inaccessible b) Impossible c) Impermeable d) Impenetrable

23) It _____ that Miraal will not be selected for the post
a) Feels b) Looks c) Believes d) Seems

24) Teachers are up _____ some major problems these days.
a) For b) Into c) Against d) To

25) I have not seen you _____ a week.
a) Within b) Since c) For d) From

26) I listened, but I had no idea what he was _____ about.
a) Saying b) Talking c) Telling d) Discussing

27) The car in which the minister was traveling _____ with an accident.
a) Hit b) Drove c) Crashed d) Met

28) The non-cooperative attitude of the members can only _____ the image of the society.
a) Spoil b) Improve c) Degrade d) Defame

29) Sania is quite intelligent but rather _____
a) Idealistic b) Generous c) Lazy d) Optimistic

30) In a little-publicized deal, Pepsi, Cola has _____ the entire soft drink market in Afghanistan.
a) Occupied b) Conquered c) Swallowed d) Captured

31) He _____ in wearing the old-fashioned coat in spite of his wife's disapproval.
a) Insists b) Persists c) Desists d) Resists

32) She _____ a brief appearance at the end of party.

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a) Put On b) Put In c) Put Across d) Put Up

33) Life is to death as pleasure is to _____
a) Poverty b) Suffering c) Anguish d) Pain

34) This, partly, explains how the Nawaz family has been able to _____ its lavish lifestyle in recent times, despite the fact that all its assets have been _____
a) Keep, Removed b) Afford, Attached c) Develop, Liquidated d) Keep Up, Destroyed

35) The machine is difficult to build _____ easy to maintain.
a) But b) And c) For d) If

36) If you work beyond your capacity, you will naturally feel _____
a) Drowsy b) Tired c) Confident d) Giddy

37) If you persist in telling lies to me, I shall sue you _____ slander.
a) To b) On c) For d) With

38) His father-in-law _____ him up in business.
a) Put b) Made c) Set d) Built

39) _____ works of reference are valuable as Encyclopedia, Britannica.
a) A Few b) Few c) The Few d) Fewer

40) This book is quite similar _____
a) With The "Treasure Island" b) Of That Film We Saw At School
c) To The One I Read Last Week d) Than A Story Told By Our Teacher

41) If our friends are not able to take us in their car, we must make _____ arrangements to go to the airport.
a) Alternative b) Another c) Alternate d) Possible

42) A crescendo of metallic thuds arose from the market, where the ironsmiths were _____ the pieces of metals.
a) Flattening b) Striking c) Hammering d) Thrashing

43) I haven't eaten an apple _____ a long while.
a) From b) Since c) For d) Until

44) The parliament invested the new organization _____ judicial authority.
a) By b) With c) From d) Through

45) Owing to the power cut in the area, factories are being forced to _____ men
a) Throw Away b) Send Off c) Put Off d) Lay Off

46) Man must _____ to stop pollution.
a) Act b) Perform c) Operate d) Behave

47) He was sent to the prison for his _____
a) Sin b) Vice c) Crime d) Guilt

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48) The answer was written _____ blue ink.
a) With b) By c) In d) On

49) Many _____ decisions were taken at the meeting.
a) Hectic b) Historic c) Historical d) Histrionic

50) Those who persist in the endeavor at long last triumph _____ the odds of life.
a) Over b) On c) Upon d) About

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Answers for Grammar Portion

1) On

The correct preposition for this sentence would be "On". We usually "smile at" someone, but this usage changes when it comes to phrases/idioms. For words like Fate the correct usage is "smile on" you. It is an old-fashioned idiom meaning "May you enjoy good luck".
An even more old-fashioned version is: May Fortune smile upon you.

2) Avidly

Avid usually means very eager or enthusiastic. If you are an avid reader, it means you read as much as you can, whenever you can. But this adjective can also mean wanting something so much that you can be thought of as greedy. For example, a person can be avid for success or power.

3) Chance

Chance means the possibility of something happening. Here, the possibility of being able to do shopping is mentioned in case of catching the train earlier. Therefore, the correct option is chance.

4) Herd

We will use a collective noun here. A collective noun is a word used for a group of specific items, animals, or people. For example, a group of ships is called a fleet, a group of cows is called a herd, a group of flying insects is called swarm, flock is a group of birds or sheep.

5) Ripe

A Ripe fruit is a fully grown and developed fruit, which is ready to be pulled away from the plant.

6) On

We use preposition "on" or "upon" with depend. The difference is that upon is more formal than on and is generally used in phrases, but both mean the same thing.

7) Me

8) Confiscated

To confiscate means to take away temporarily for security or legal reasons. It implies an act by an authority upon one of less power.

9) Bread

The phrase "man shall not live by bread alone" is today a common expression meaning that people need more than material things to truly live. However, it is also sometimes used in almost the opposite sense to justify materials luxuries beyond simple things like bread.

10) Through

If you get through to someone, you succeed in making them understand something that you are trying to tell them.

11) Alike

Twins are expected to look similar, so suitable word here is Alike.

12) Human

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It is a commonly used phrase meaning, it is human's nature to make mistakes, but it is divine to forgive people for mistakes.

13) In
If you put or keep something in order, you make sure that it is neat or well organized.

14) Restoration
Restoration of paintings denote that the repair or renovation of artworks that have already sustained injury or decay and the attempted restoration of such objects to something approaching their original undamaged appearance.

15) Full
Full of people is the best choice. For crowded we use the preposition "with" for a similar usage.

16) But
This is famous quotation from a poem: "The paths of glory lead but to the grave." Meaning mortality is the ultimate, inevitable truth that no circumstances can change.

17) Had Rung
This is an example of past perfect tense. Subject + had + past participle = past perfect tense. Example: She had met him before the party.

18) Had Worked Hard For It
This is an example of past perfect tense. Subject + had + past participle = past perfect tense.

19) At
"At" is used when you are at the top, bottom or end of something; at a specific address; at a general location; and at a point. "In" is used in a space, small vehicle, water, neighborhood, city, and country.

20) Faith

21) Beside
Beside is a preposition that means next to or at the side of. The preposition beside physically places two nouns side by side. Next to and beside have similar usage.

22) Inaccessible
Inaccessible means out of reach or remote. In context of the given sentence, Inaccessible is the most suitable choice.

23) Seems
Seems that is the best choice here. The correct preposition with Feels is like, i.e., "Feels like".

24) Against
If you are up against something, you have a very difficult situation or problem to deal with.

25) For
Since and From are used to refer to a specific point in time. For is used when specifying the amount of time (how long). For example, I have had this watch for more than 40 years.

26) Talking

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27) Met
"Met with" is the correct usage of the preposition.

28) Spoil

29) Lazy
"But rather" indicates that something opposing to the earlier is being said. So, intelligent (positive) and lazy(negative) are opposing ideas.

30) Captured
Captured is the most suitable choice, as for brands we use the words "capture the market".

31) Persists
Persist means continue in an opinion or course of action in spite of difficulty or opposition.

32) Put In
"Put in" an appearance means to go to an event, gathering, etc., usually for a short period of time. For example, I won't be able to stay at the party long, but I'll at least try to put in an appearance.

33) Pain
Life is the opposite of death, similarly pleasure is opposite of pain.

34) Keep Up, Destroyed
Keep up means to move or progress at the same rate as someone or something else.

35) But
Since the two halves of the sentence are showing opposites, the best word to connect them will be "but".

36) Tired
When you work too hard, you eventually feel tired for losing too much energy.

37) For
Sue someone for something means to file a lawsuit against someone in order to get something. For example, I will sue you for damages if you do anything else to my car.

38) Set
Set up means to start something such as a business, organization, or institution.

39) Few
'Few' means very less in number. Whereas 'a few' means hardly any or none at all. Therefore, the best possible choice is "Few"

40) To The One I Read Last Week
We use preposition "to" with "similar".

41) Alternative
Alternate is a verb. Example usage: Days alternate with night.
Alternative is a noun/adjective. Example usage: Alternative medicine, alternative route.
Based on this we can conclude that Alternative is the best possible answer.

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42) Hammering
Metallic thuds are the heavy sounds due to hammering of metal pieces.

43) For
Since and From are used to refer to a specific point in time. For is used when specifying the amount of time (how long). For example: I have had this watch for more than 40 years.

44) With
Invest with means to give something or someone a particular quality; give someone power, influence, or authority.

45) Lay Off
Lay off means to discharge a worker temporarily or permanently because of a shortage of work.

46) Act

47) Crime
Criminals are sent to the prison for their crimes. The word "Sin" is used in religious contexts.

48) In
Correct preposition used here will be "In". We say, I write with a pen. Now, if you wish to specify that the medium you use is ink, then you need to use a different preposition. In this situation, that preposition is "In." So, you should say: I write in ink.

49 Historic

50) Over
Triumphs over means To defeat someone or something, especially in a noteworthy contest. For example, by the end of the movie, good triumphs over evil and everybody is happy.

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Introduction to Intelligence Portion of NET Engineering

In NET Engineering out of 200 Multiple Choice Questions, 10 questions will be from the Intelligence portion. Like any other standardized test, the questions in Intelligence portion can be from any of the following topics:

1. Odd one out
2. Sequences and Series
3. Coding – Decoding
4. Direction Sense Test
5. Number Reasoning

This portion is generally the easiest one compared to the other subjects in NET Engineering. They key to performing well in this portion is understanding the logic and the method used in the following pages to solve the questions. On average there will be 2 questions from each of the following 5 topics:

1) Odd One Out:
A list of 4 words (options) is given and you have to tell which of them is different from the rest three options.

2) Sequences and Series:
A pattern of numbers is given, you have to identify that pattern and find the next or missing term in the pattern.

3) Coding – Decoding:
A word and its code is given. You have to identify the logic used to make that code and apply that logic to the new given word to find a code for that word.

4) Direction Sense Test:
A set of directions is given, you have to follow those directions and find the final position or distance of the body with respect to the starting point.

5) Number Reasoning
This category can be considered an extension of "Sequences and Series". A figure or a set of figures is given, and the numbers mentioned in these figures follow some logic/pattern. Students have to identify the pattern and find the missing number.

The following pages contain practice questions of all these portions from Past Papers of NUST (2013 and onwards).

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Practice Questions from Odd one Out from Past NET Papers

1) Pick the odd one out
a) X-ray b) Telephone c) Radio d) Television

2) Pick the odd one out
a) March b) July c) September d) October

3) Pick the odd one out
a) Trunk b) Tree c) Leaf d) Flower

4) Pick the odd one out
a) Rule b) Office c) Law d) Regulation

5) Pick the odd one out
a) Maize b) Bajra c) Wheat d) Rice

6) Pick the odd one out
a) Semicircle b) Seminar c) Semicolon d) Semifinal

7) Pick the odd one out
a) House b) Village c) Town d) Metropolis

8) Pick out the odd one
a) Learn b) Read c) Knowledge d) Write

9) Choose the odd one out
a) Cockroach b) Spider c) Butterfly d) Housefly

10) Pick the odd one out
a) Brinjal b) Potato c) Tomato d) Cucumber

11) Which of the following is the odd one?
a) Apple b) Orange c) Guava d) Pear

12) Pick the odd one out
a) Mongoose b) Tortoise c) Snake d) Crocodile

13) Pick the odd one out
a) Natural gas b) Gasoline c) Coal d) Biogas

14) Pick the odd one out

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a) Sindhi b) Urdu c) Balochi d) Punjabi

15) Choose the odd one out
a) Hammer b) Pin c) Nail d) Screw

16) Pick the odd one out
a) Stern b) Mast c) Quay d) Deck

17) Pick the odd one out
a) QUXNGHI b) IHGUNXQ c) XGHIQUN d) QHXNIGV

18) Pick the odd one out
a) Mercury b) Acetone c) Petrol d) Kerosene

19) Pick the odd one out
a) Saw b) Axe c) Shovel d) Sword

20) Choose the odd one out
a) Chocolate b) Bread c) Cake d) Biscuits

21) Pick the odd one out
a) Cot b) Sheet c) Blanket d) Pillow

22) Pick the odd one out
a) Green b) Violet c) White d) Yellow

23) Which one is odd?
a) Chess b) Running c) Walking d) Jogging

24) Choose the odd one out
a) Magazine b) Dictionary c) Novel d) Thesis

25) Pick the odd one out
a) Average b) Medium c) Moderate d) Terminal

26) Pick the odd one out
a) Fragrance b) Stench c) Aroma d) Incense

27) Which of the following is the odd one out?
a) Microfilm b) Microscope c) Microbe d) Microchip

28) Choose the odd one out
a) Data b) Media c) Radio d) Internet

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29) Choose the odd one out
a) Tin b) Iron c) Gold d) Silver

30) Choose the odd one out
a) Elated b) Happy c) Delighted d) Worried

31) Choose the odd one out
a) Transistor b) Post c) Tape Recorder d) Telegram

32) Pick the odd one out
a) Industrial b) Industrious c) Diligent d) Assiduous

33) Find the odd one out
a) Lion : Roar b) Snake : Hiss c) Frog : Bleat d) Bees : Hum

34) Pick the odd one out
a) Mustard b) Olive c) Onion d) Corn

35) Pick the odd one out
a) Mountain b) Mound c) Peak d) Valley

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Answers of Odd One Out

1) Answer: **X-ray**
Except X-ray, all other choices show the name of some device. X-ray is one of the types of Electromagnetic waves. So, X-ray is the odd one out.

2) Answer: **September**
All the given months, except September, have 31 days, while September has 30 days. So, September is the odd one out.

3) Answer: **Tree**
Tree is a complete structure while the other options i.e., trunk, leaf and flower are the parts of a tree. So, here "Tree" is different from the rest of the options.

4) Answer: **Office**
Except the word "office", other 3 words are synonyms of each other. So here the odd one is Office.

5) Answer: **Wheat**
Wheat is a Rabi crop and other given crops are Kharif Crops.
The kharif cropping season is from July –October during the south-west monsoon and the Rabi cropping season is from October-March (winter). Pakistan and Bangladesh are two other countries that are using the term 'kharif' and 'rabi' to describe about their cropping patterns. The terms 'kharif' and 'rabi' originate from Arabic language where Kharif means autumn and Rabi means spring.
The kharif crops include rice, maize, sorghum, pearl millet/bajra, finger millet/ragi (cereals), arhar (pulses), soyabean, groundnut (oilseeds), cotton etc. The rabi crops include wheat, barley, oats (cereals), chickpea/gram (pulses), linseed, mustard (oilseeds) etc.

6) Answer: **Seminar**
In all the given options except Seminar, semi indicates half. For example, Semicircle means a half circle. While seminar is a complete word on its own which means a conference or a meeting. So here the odd one out is seminar.

7) Answer: **House**
House is a place where people live while other options i.e., Village, Town and Metropolis have several houses in them. So here the odd one is House.

8) Answer: **Knowledge**
Knowledge is noun while other given options are verbs i.e., learn, read, and write show an action. So, the odd one out here is Knowledge.

9) Answer: **Spider**
All the given insects except Spider, are flying insects. So, the odd one out is spider.

10) Answer: **Potato**
Potato is the only vegetable in the group which grows underground, other given vegetables grow upright. So, Potato is the odd one in this case.

11) Answer: **Orange**

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Orange is the only citrus fruit in the group. So, it is the odd one out.
Citrus fruits are a group of plants that produce juicy fruits with a slightly sour taste: Oranges, lemons, limes, and grapefruit are types of citrus fruit.

12) Answer: **Snake**
Snake is the only poisonous animal in the group while other given animals are not poisonous. So, Snake is the odd one out here.

13) Answer: **Biogas**
Natural gas, gasoline and coal are obtained directly from earth. These occur naturally. Biogas is produced by fermentation of organic matter usually the waste materials i.e., waste food and animal wastes. Biogas is mostly man made. So, the odd one out is biogas.

14) Answer: **Urdu**
Sindhi, Balochi and Punjabi are the languages spoken in provinces of Pakistan called provincial languages. Urdu is the national language widely spoken all over Pakistan. So, Urdu is the odd one out here.

15) Answer: **Hammer**
All the given tools, except Hammer, have a pointed end due to which they can stick in the wall or things like wood. While hammer is a handheld tool used to strike another object. So, Hammer is the odd one here.

16) Answer: **Quay**
All except Quay are parts of a ship.
A mast is a tall upright post, spar, or other structure on a ship or boat, in sailing vessels generally carrying a sail or sails. A deck is a permanent covering over a compartment or a hull of a ship. The stern is the back or aft-most part of a ship or boat, technically defined as the area built up over the sternpost, extending upwards from the counter rail to the taffrail. The stern lies opposite of the bow, the foremost part of a ship. Quay is a stone or metal platform lying alongside or projecting into water for loading and unloading ships. Quay is the odd one out, because all except quay are the parts of ship.

17) Answer: **QHXNIGV**
Observe the alphabets in the given choices. The first three options have the same alphabets but in a different pattern. However, the word given in option "d" has the alphabet V instead of U which makes it different from the rest of the given options. So, option "d" is the odd one out here.

18) Answer: **Mercury**
Except mercury all the other options list a compound while Mercury is an element. A compound is a mixture of different elements. Therefore, Mercury is the odd one out here.

19) Answer: **Sword**
Saw, Axe and Shovel are tools while sword is a weapon. So, Sword is the odd one out.

20) Answer: **Chocolate**
Bread, cakes, and biscuits are baked in an oven, while chocolate is obtained from cocoa plant and then prepared or is subjected to different synthetic industrial processes. So, chocolate is the odd one out.

21) Answer: **Cot**

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Sheets, blanket, and pillow are the bedding accessories used, while a cot is small folding bed used mostly for children. So, cot is the odd one out here because all other options are bedspreads.

22) Answer: **White**
All the given colors are rainbow colors except white. Rainbow colors are violet, indigo, blue, green, yellow, orange and red, i.e., VIBGYOR. Therefore, the odd one out is White.

23) Answer: **Chess**
Chess requires two players to play and is an indoor game. Running, Walking and Jogging can be done alone and are usually an outdoor activity. So, chess is the odd one out.

24) Answer: **Thesis**
Except thesis, all other options are commonly read by everyone. However, thesis has a specific academic use and is not used by everyone. So, thesis is the odd one out here.

25) Answer: **Terminal**
Average, medium and moderate are synonyms of each other, while terminal is a totally different word. Terminal means situated at the end of something while Average, Medium and Moderate are related to the center/middle. So, terminal is the odd one out.

26) Answer: **Stench**
All, except Stench, are pleasant odors. Stench means an unpleasant smell and hence, it is the odd one out.

27) Answer: **Microbe**
In all other options, except Microbe, Micro has been added as a prefix. Therefore, Microbe is the odd one out.

28) Answer: **Data**
Media, Radio, and Internet are all means of communicating data. Data is any piece of information. Media, Radio, and Internet are the source of data communication with others. So, data is the odd one.

29) Answer: **Tin**
Tin occurs naturally mostly as a compound i.e., in combination with other substances. While the other substances usually occur naturally as elements i.e., without combination with other substances.

30) Answer: **Worried**
All, except worried, are synonyms. Elated, happy and delighted are cheering words, therefore, worried is the odd one out here

31) Answer: **Transistor**
All, except Transistor, are means of communication. A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. So, transistor is the odd one out here.

32) Answer: **Industrial**
All options, except industrial, are synonyms of hardworking. While industrial means something related to the industry. So, industrial is the odd one out.

33) Answer: **Frog : Bleat**

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Option C is the odd one out as the sound of a frog is croak and not bleat. Bleat is the sound of goat. In the other options, individual and their sound relationships are correct.

34) Answer: **Onion**
Mustard, Olive and Corn are all passed through processes of extraction to obtain oils, while Onion does not have this property of oil formation. So, Onion is the odd one.

35) Answer: **Valley**
Mountain, Mound and Peak are all elevated features, while valley is a lower area between hills and mountains usually with a river running through it. So, valley is the odd one.

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Practice Questions from Sequences and Series from Past NET Papers

1) Find the next number in the following sequence:
15, 25, 30, 50, 60, 100 ...
a) 200 b) 120 c) 180 d) 300

2) Find the missing number in the pattern given below:
12 (60) 18
23 (88) 21
15 (?) 26
a) 116 b) 82 c) 96 d) 108

3) Find next two terms in the sequence given below:
3, 5, 6, 8, 9 ...
a) 11, 12 b) 10, 12 c) 14, 16 d) 16, 18

4) Find the missing number in the pattern given below:
If
93 – 1 = 89
41 – 2 = 38
33 – 6 = 24
Then
59 – 2 = ?
a) 54 b) 48 c) 55 d) 34

5) Find the next number in the following sequence:
8, 36, 90, 135 ...
a) 196 b) 135 c) 215 d) 245

6) Find the next number in the following sequence:
1, 2, 3, 5, 7, 10, 13 ...
a) 17 b) 16 c) 15 d) 19

7) Use the pattern given below to find the missing number:

21	22	23
20	24	24
?	26	25

a) 31 b) 19 c) 25 d) 26

8) What comes next in the following sequence:
2, 10, 30, 68 ...
a) 112 b) 130 c) 145 d) 176

9) Find the missing number in the pattern given below:
If
2 x 3 = 812

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4 x 5 = 1620
Then
6 x 7 = ?
a) 2428 b) 42 c) 420 d) 3200

10) Find the missing number in the pattern given below:
If
4 × 6 = 1624
3 × 4 = 912
then
5 × 6 = ?
a) 2530 b) 30 c) 5060 d) 2024

11) Find the next number in the following sequence:
8, 32, 72, 128 ...
a) 325 b) 165 c) 200 d) 256

12) Find the next number in the following sequence:
1, 2, 3, 7, 22 ...
a) 89 b) 44 c) 112 d) 155

13) Find the next number in the following sequence:
12, 48, 108, 192 ...
a) 272 b) 240 c) 384 d) 300

14) Find the next number in the following sequence:
3, 4, 6, 15, 9, 48, 12 ...
a) 147 b) 96 c) 120 d) 175

15) Use the pattern given below to find the missing number

15	14	13
16	16	12
17	18	?

a) 14 b) 10 c) 23 d) 19

16) Find the next number in the following sequence:
29, 41, 47, 50 ...
a) 50.5 b) 51.5 c) 52 d) 52.5

17) Find the next number in the following sequence:
2160, 360, 72, 18 ...
a) 9 b) 6 c) 3 d) 1

18) Find the next number in the following sequence:
1, 9, 25, 49...
a) 100 b) 81 c) 72 d) 98

19) Find the next number in the following sequence:

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7, 16, 25, 52, 97 ...

a) 194 b) 148 c) 196 d) 174

20) Find the next two numbers in the following sequence:

1, 6, 16, 31, 51 ...

a) 71, 91 b) 61, 86 c) 46, 21 d) 76, 106

21) Find the missing number in the pattern given below:

22	(12)	26
57	(21)	27
39	(?)	53

a) 92 b) 54 c) 30 d) 23

22) Find the missing number in the pattern given below:

4	9	2
8	5	14
10	8	?

a) 6 b) 8 c) 10 d) 9

23) Find the missing number in the pattern given below:

21	18	21
22	20	20
24	21	?

a) 20 b) 19 c) 18 d) 17

24) Find the next number in the following sequence:

3, 4, 7, 14, 11, 44, 15 ...

a) 19 b) 77 c) 48 d) 134

25) Find the missing number in the pattern given below:

14	18	13
15	17	12
16	16	?

a) 11 b) 16 c) 10 d) 15

26) Find the missing number in the pattern given below:

12	6	15	6
9	13	?	12
3	7	2	18

a) 12 b) 13 c) 14 d) 16

27) Find the missing number in the pattern given below:

If

7 ÷ 5 = 4925

5 ÷ 4= 2516

then

3 ÷ 2 = ?

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a) 1.5 b) 9004 c) 94 d) 76

28) Find the next number in the following sequence:
4, 20, 54, 114 ...
a) 146 b) 210 c) 170 d) 108

29) Find the missing number in the following sequence:
9, 21, 39, 81, ___, 321
a) 159 b) 165 c) 202 d) 191

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Answers of Sequences and Series

1) Answer: 120

Two sequences are embedded in this one given sequence. 1st sequence is formed by the numbers at odd places i.e., 1st number, 3rd number, 5th number and so on. This sequence is:

15, 30, 60 ...

In this sequence the numbers are being multiplied by 2 to get the next number in the sequence.

And the 2nd sequence is formed by the numbers at even places i.e., 2nd number, 4th number, 6th number and so on. This sequence is:

25, 50, 100...

In this sequence the numbers are being multiplied by 2 to get the next number in the sequence.

We are to find the next term of the given sequence which is the 7th term (odd term) so it will belong to the 1st sequence. So, the next number in the sequence will be

2 x 60 = 120

Therefore, the answer to this question is 120.

2) Answer: 82

The numbers outside the brackets are added and the result is doubled to get the number inside the brackets. For example, for the first relation:

12 (60) 18

The numbers outside the brackets are 12 and 18. The sum of these numbers is 30 and twice of 30 is 60 which is written inside the brackets. Same logic is used in the second relation.

Likewise, for the third relation, the numbers outside the brackets are 15 and 26. The sum of these numbers is 41 and twice of 41 is 82. So, 82 must be within the brackets.

Therefore, the answer to this question is 82.

3) Answer: 11, 12

Two sequences are embedded in this one given sequence. 1st sequence is formed by the numbers at odd places i.e., 1st number, 3rd number, 5th number and so on. This sequence is:

3, 6, 9 ...

In this sequence the numbers are being increased by 3 to get the next number in the sequence.

And the 2nd sequence is formed by the numbers at even places i.e., 2nd number, 4th number and so on. This sequence is:

5, 8 ...

In this sequence the numbers are being increased by 3 to get the next number in the sequence.

We are to find the next 2 terms of the sequence. The number after 9 is 6th number so it will belong to the 2nd sequence i.e., 5, 8 ...

Next number in this sequence will be 8 + 3 = 11

The number after 11 will be the 7th number so it will belong to the 1st sequence i.e., 3, 6, 9 ...

Next number in this sequence will be 9 + 3 = 12

So, the next two numbers in the sequence will be 11 and 12. The sequence with these two numbers will be: 3, 5, 6, 8, 9, 11, 12 ...

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Therefore, the answer to this question is 11, 12

4) Answer: **48**
The following logic is used in this problem:
93 – 1 – 3 (i.e., the second digit of the number) = 89
41 – 2 – 1 = 38
33 – 6 – 3 = 24
Based on this logic, the next number will be:
59 – 2 – 9 = 48
Therefore, the answer to this question is 48

5) Answer: **135**
Following logic is used in this problem:

$$(8 \times 4) + \frac{8}{2} = 36$$

$$(36 \times 2) + \frac{36}{2} = 90$$

$$(90 \times 1) + \frac{90}{2} = 135$$

Based on this logic, the next number in the sequence will be

$$(135 \times 0.5) + \frac{135}{2} = 135$$

Therefore, the next number in the sequence will be 135.

6) Answer: **17**
Following logic is being used in this problem:
1 + 1 = 2
2 + 1 = 3
3 + 2 = 5
5 + 2 = 7
7 + 3 = 10
10 + 3 = 13
So, the next number in the sequence must be:
13 + 4 = 17

7) Answer: **31**
Sum of numbers of 2nd column is 22 + 24 + 26 = 72
Sum of numbers of 3rd column is 23 + 24 + 25 = 72
Therefore, the sum of 1st column must also be 72.
21 + 20 + ? = 72
41 + ? = 72
? = 72 – 41
? = 31
Therefore, the missing number in the 1st column is 31.

8) Answer: **130**

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The following logic is being used in this problem:

$1^3 + 1 = 2$
$2^3 + 2 = 10$
$3^3 + 3 = 30$
$4^3 + 4 = 68$

Based on this logic, the next number in the sequence will be:

$5^3 + 5 = 130$

9) Answer: **2428**
Each digit on the left-hand side is being multiplied by 4 to get the number on the right-hand side of the equation.
Consider the first relation:
2 x 3 = 812
2 multiplied by 4 is 8 and 3 multiplied by 4 is **12.** These answers are written on the right-hand side as 812.
Same logic is used for 4 x 5 = 1620. Based on this logic the, we can write:
6 x 7 = 2428
Therefore, the answer to this question is 2428

10) Answer: **2530**
Consider the first relation:
4 x 6 = 1624
4 is multiplied to itself to get **16.** 6 is multiplied to 4 to get **24.**
Similarly, in 3 x 4 = 912
3 is multiplied to itself to get **9.** 4 is multiplied to 3 to get **12.**
Based on this logic,
5 multiplied to itself is **25** and 6 multiplied to 5 is **30.** So
5 x 6 = 2530
Therefore, the answer to this question is 2530.

11) Answer: **200**
Following logic is used in this problem:
$8 \times 1 = 8 \times 1^2 = 8$
$8 \times 4 = 8 \times 2^2 = 32$
$8 \times 9 = = 8 \times 3^2 = 72$
$8 \times 16 = = 8 \times 4^2 = 128$
So, Based on this logic the next number in the sequence must be:
$8 \times 25 = 8 \times 5^2 = 200$

12) Answer: **155**
The number is being multiplied to its previous number and 1 is being added to the result to get the next umber as shown below:
(2 x 1) + 1 = 3
(3 x 2) + 1 = 7
(7 x 3) + 1 = 22
Based on this logic, the next number in the sequence must be:
(22 x 7) + 1 = 155

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Therefore, the answer to this question is 155.

13) Answer: 300
Following logic is being used in this problem:
$12 \times 1 = 12 \times 1^2 = 12$
$12 \times 4 = 12 \times 2^2 = 48$
$12 \times 9 = 12 \times 3^2 = 108$
$12 \times 16 = 12 \times 4^2 = 192$
So, based on this logic, the next number in the sequence must be:
$12 \times 25 = 12 \times 5^2 = 300$
Therefore, the answer to this question is 300.

14) Answer: 147
Two sequences are embedded in this one given sequence. 1st sequence is formed by the numbers at odd places i.e., 1st number, 3rd number, 5th number and so on. This sequence is:
3, 6, 9, 12 ...
3 is being added to each number to get the next term of the sequence.

And the 2nd sequence is formed by the numbers at even places i.e., 2nd number, 4th number and so on. This sequence is:
4, 15, 48 ...
The logic used in this sequence is:
$(4 \times 3) + 3 = 15$
$(15 \times 3) + 3 = 48$

The next term in the sequence will be the 8th term so it will belong to the 2nd sequence. So based on the above logic, the next number in the sequence will be:
$(48 \times 3) + 3 = 147$
Therefore, the answer to this question is 147

15) Answer: 23
The sum of 1st column is: $15 + 16 + 17 = 48$
The sum of 2nd column is: $14 + 16 + 18 = 48$
So, the sum of 3rd column must also be 48.
$13 + 12 + ? = 48$
$25 + ? = 48$
$? = 48 - 25$
$? = 23$
Therefore, the missing number in the 3rd column is 23.

16) Answer: 51.5
Following logic is used in this problem:
$29 + 12 = 41$
$41 + 6 = 47$
$47 + 3 = 50$
Based on this logic, the next number in the sequence should be:
$50 + 1.5 = 51.5$

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First, 12 is added to 29 to get the next number. Then half of 12 which is 6 is added to 41 to get 47. Then half of 6 which is 3, is added to 47 to get 50. So, finally half of 3 which is 1.5 should be added to 50 to get 51.5

Thus, the answer to this question is 51.5

17) Answer: 6

Following logic is used in this problem:

$2160 \div 6 = 360$

$360 \div 5 = 72$

$72 \div 4 = 18$

Based on this logic the next number in the sequence must be:

$18 \div 3 = 6$

So, the answer to this question will be 6.

18) Answer: 81

The sequence lists the squares of odd numbers.

$1^2 = 1$

$3^2 = 9$

$5^2 = 25$

$7^2 = 49$

So based on this logic, the next number in the sequence must be square of 9

$9^2 = 81$

Therefore, the answer to this question is 81.

19) Answer: 196

Following logic is used in this sequence:

$(7 \times 2) + 2 = 16$

$(16 \times 2) - 7 = 25$

$(25 \times 2) + 2 = 52$

$(52 \times 2) - 7 = 97$

Based on this logic, the next number in the sequence will be:

$(97 \times 2) + 2 = 196$

20) Answer: 76, 106

Following logic is being used in this sequence:

$1 + 5 = 6$

$6 + 10 = 16$

$16 + 15 = 31$

$31 + 20 = 51$

Based on this logic, the next 2 numbers in the sequence must be:

$51 + 25 = 76$

$76 + 30 = 106$

21) Answer: 23

The sum of numbers outside the brackets is divided by 4 to get the number inside the bracket.

For example for the first row we have:

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(22 + 26) ÷ 4 = 12
Similarly, for the second row we have:
(57 + 27) ÷ 4 = 21
Based on this logic, the missing number in the third row will be:
(39 + 53) ÷ 4 = 23
So, the answer to this question is 23.

22) Answer: **6**
The sum of first column is: 4 + 8 + 10 = 22
The sum of second column is: 9 + 5 + 8 = 22
So, sum of the third column must also be 22.
2 + 14 + ? = 22
16 + ? = 22
? = 22 – 16
? = 6
Therefore, the missing number in the third column is 6.

23) Answer: **19**
Sum of first row is: 21 + 18 + 21 = 60
Sum of second row is: 22 + 20 + 20 = 62
Based on this logic the sum of third row must be 64.
24 + 21 + ? = 64
45 + ? = 64
? = 64 – 45
? = 19
Therefore, the missing number is 19.

24) Answer: **134**
Two sequences are embedded in this one given sequence. 1st sequence is formed by the numbers at odd places i.e., 1st number, 3rd number, 5th number and so on. This sequence is:
3, 7, 11, 15 ...
In this sequence the numbers are being increased by 4 to get the next number in the sequence.

And the 2nd sequence is formed by the numbers at even places i.e., 2nd number, 4th number and so on. This sequence is:
4, 14, 44 ...
The logic used in this sequence is:
(4 x 3) + 2 = 14
(14 x 3) + 2 = 44

The next term in the given sequence is the 8th term so it will belong to the 2nd sequence. Using the logic given above, the next number in the sequence will be:
(44 x 3) + 2 = 134
Therefore, the answer to this question is 134.

25) Answer: **11**

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The first column has numbers 14, 15 and 16 i.e., three consecutive numbers.
The second column also has three consecutive numbers 16, 17 and 18.
So based on this logic, the third column must also have three consecutive numbers. Therefore, the answer to this question will be 11.

26) Answer: **13**
In each of the given column, the sum of smaller two numbers is equal to the largest number in that column. For example, for first column sum of 9 and 3 is 12. For the second column, sum of 6 and 7 is 13. For the fourth column, the sum of 6 and 12 is 18. So, we have to choose such a number from the given options so that the same logic can be applied on third column.
Number 13 satisfies this condition as sum of 13 and 2 is 15.
Therefore, the answer to this question is 13.

27) Answer: **94**
The result contains the squares of numbers on the left-hand side of the equation. For example, for the first relation:
7 ÷ 5 = 4925
Square of 7 is 49 and Square of 5 is 25.
Similarly, for the second relation,
5 ÷ 4= 2516
Square of 5 is 25 and square of 4 is 16
Using the same logic on third relation we can write:
3 ÷ 2 = 94
Therefore, the answer to this question is 94.

28) Answer: **108**
Following logic is used in this problem:
(4 x 4) + 6 = 20
(20 x 3) – 6 = 54
(54 x 2) + 6 = 114
Based on this logic, the next number in the sequence must be:
(114 x 1) – 6 = 108
Therefore, the answer to this question is 108.

29) Answer: **159**
Following logic is used in this problem:
(9 x 2) + 3 = 21
(21 x 2) – 3 = 39
(39 x 2) + 3 = 81
So, based on this logic the next number in the sequence must be:
(81 x 2) – 3 = 159
The next given number in the sequence (321) must also result from the above logic.
(159 x 2) + 3 = 321
Which is correct. So, the answer to this question is 159.

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Practice Questions from Coding – Decoding from Past NET Papers

1) If FASHION stands for ECUKMQP then DISEASE stands for:
a) CKUHEUG b) EMUBMTC c) EIQHFQG d) CMUEMTC

2) If BEYOND is coded as AFXPME, then code FALCON using same sequence.
a) EBKNMO b) EBKDNO c) EZKOMD d) EZKOND

3) If RTTHHX encodes for Purify, then code for Blanch will be:
a) DKDSHG b) AOCGTY c) DKCMEG d) EMGCKD

4) If SHELNXR stands for TEDIOUS, in the same way how would GLAMOUR be coded?
a) FODPNUQ b) FOBPNXS c) FOBPNXQ d) FODPNUS

5) If 1,2,3,4,5,6,7,8,9,10,11,12 be coded as BAHAWALNAGAR then how can you code NAGAR?
a) 6, 8, 1, 3, 4 b) 8, 9, 10, 11, 12, 10
c) 8, 9, 10, 11, 12 d) 8, 2, 10, 4, 12

6) If ANNJ is for BOOK, then what will be the code for LOOK?
a) KNNJ b) CNNJ c) LNNJ d) None of these

7) If LCMHN represents MANGO, then how will BOUTS be represented?
a) AWPAK b) AQTUR c) AQVRU d) AZSHD

8) If CBKPDG stands for BALOCH what stands for ORDERS?
a) PSCFSR b) NRBFRS c) PTDFTS d) OSEDFG

9) The coding for READING is 1234567, find the coding for RING
a) 1567 b) 1479 c) 1917 d) 1947

10) If PXWR is coded for RAIN then using this logic, how should PAIN be coded?
a) OXWR b) OXWS c) NXWR d) NXWS

11) If 74312 represents word SWEAT then 712 represents:
a) SIG b) SAT c) SIN d) SET

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Answers of Coding – Decoding

1) Answer: CKUHEUG

First convert the given word (FASHION) to numbers i.e., 1 for A, 2 for B, 3 for C and so on till 26 for Z, as shown below:

F	A	S	H	I	O	N
6	1	19	8	9	15	14

Now convert the given code of FASHION (ECUKMQP) to numbers as shown below:

E	C	U	K	M	Q	P
5	3	21	11	13	17	16

Now find the difference between 2nd and 1st list of numbers. The difference is:

-1	2	2	3	4	2	2

Convert the new word (DISEASE) to numbers as shown below:

D	I	S	E	A	S	E
4	9	19	5	1	19	5

Add the differences, in the above numbers to get the numbers for the new coded word:

3	11	21	8	5	21	7

Convert the above digits to alphabets to find the code:

C	K	U	H	E	U	G

Therefore, the code for DISEASE is CKUHEUG

2) Answer: EBKDNO

First convert the given word (BEYOND) to numbers i.e. 1 for A, 2 for B, 3 for C and so on till 26 for Z, as shown below:

B	E	Y	O	N	D
2	5	25	15	14	4

Now convert the given code of BEYOND (AFXPME) to numbers as shown below:

A	F	X	P	M	E
1	6	24	16	13	5

Now find the difference between 2nd and 1st list of numbers. The difference is:

-1	1	-1	1	-1	1

Convert the new word (FALCON) to numbers as shown below:

F	A	L	C	O	N
6	1	12	3	15	14

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Add the differences, in the above numbers to get the numbers for the new coded word:

5	2	11	4	14	15

Convert the above digits to alphabets to find the code:

E	B	K	D	N	O

Therefore, the code for FALCON is EBKDNO

3) Answer: **DKCMEG**

First convert the given word (PURIFY) to numbers i.e. 1 for A, 2 for B, 3 for C and so on till 26 for Z, as shown below:

P	U	R	I	F	Y
16	21	18	9	6	25

Now convert the given code of PURIFY (RTTHHX) to numbers as shown below:

R	T	T	H	H	X
18	20	20	8	8	24

Now find the difference between 2nd and 1st list of numbers. The difference is:

2	-1	2	-1	2	-1

Convert the new word (BLANCH) to numbers as shown below:

B	L	A	N	C	H
2	12	1	14	3	8

Add the differences, in the above numbers to get the numbers for the new coded word:

4	11	3	13	5	7

Convert the above digits to alphabets to find the code:

D	K	C	M	E	G

Therefore, the code for BLANCH is DKCMEG

4) Answer: **FOBPNXQ**

First convert the given word (TEDIOUS) to numbers i.e. 1 for A, 2 for B, 3 for C and so on till 26 for Z, as shown below:

T	E	D	I	O	U	S
20	5	4	9	15	21	19

Now convert the given code of TEDIOUS (SHELNXR) to numbers as shown below:

S	H	E	L	N	X	R
19	8	5	12	14	24	18

Now find the difference between 2nd and 1st list of numbers. The difference is:

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-1	3	1	3	-1	3	-1

Convert the new word (GLAMOUR) to numbers as shown below:

G	L	A	M	O	U	R
7	12	1	13	15	21	18

Add the differences, in the above numbers to get the numbers for the new coded word:

6	15	2	16	14	24	17

Convert the above digits to alphabets to find the code:

F	O	B	P	N	X	Q

Therefore, the code for GLAMOUR is FOBPNXQ

5) Answer: **8, 9, 10, 11, 12**

Observe the given two words. The word NAGAR is present in the word BHAWALNAGAR. So, the code of NAGAR can be directly taken from the code of BHAWALNAGAR.

B	A	H	A	W	A	L	N	A	G	A	R
1	2	3	4	5	6	7	8	9	10	11	12

Therefore, the code for NAGAR will be:

N	A	G	A	R
8	9	10	11	12

6) Answer: **KNNJ**

First convert the given word (BOOK) to numbers i.e., 1 for A, 2 for B, 3 for C and so on till 26 for Z, as shown below:

B	O	O	K
2	15	15	11

Now convert the given code of BOOK (ANNJ) to numbers as shown below:

A	N	N	J
1	14	14	10

Now find the difference between 2nd and 1st list of numbers. The difference is:

-1	-1	-1	-1

Convert the new word (LOOK) to numbers as shown below:

L	O	O	K
12	15	15	11

Add the differences, in the above numbers to get the numbers for the new coded word:

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11	14	14	10

Convert the above digits to alphabets to find the code:

K	N	N	J

Therefore, the code for LOOK is KNNJ.

7) Answer: **AQTUR**

First convert the given word (MANGO) to numbers i.e. 1 for A, 2 for B, 3 for C and so on till 26 for Z, as shown below:

M	A	N	G	O
13	1	14	7	15

Now convert the given code of MANGO (LCMHN) to numbers as shown below:

L	C	M	H	N
12	3	13	8	14

Now find the difference between 2nd and 1st list of numbers. The difference is:

-1	2	-1	1	-1

Convert the new word (BOUTS) to numbers as shown below:

B	O	U	T	S
2	15	21	20	19

Add the differences, in the above numbers to get the numbers for the new coded word:

1	17	20	21	18

Convert the above digits to alphabets to find the code:

A	Q	T	U	R

Therefore, the code for BOUTS is AQTUR.

8) Answer: **PSCFSR**

First convert the given word (BALOCH) to numbers i.e. 1 for A, 2 for B, 3 for C and so on till 26 for Z, as shown below:

B	A	L	O	C	H
2	1	12	15	3	8

Now convert the given code of BALOCH (CBKPDG) to numbers as shown below:

C	B	K	P	D	G
3	2	11	16	4	7

Now find the difference between 2nd and 1st list of numbers. The difference is:

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1	1	-1	1	1	-1

Convert the new word (ORDERS) to numbers as shown below:

O	R	D	E	R	S
15	18	4	5	18	19

Add the differences, in the above numbers to get the numbers for the new coded word

16	19	3	6	19	18

Convert the above digits to alphabets to find the code:

P	S	C	F	S	R

Therefore, the code for ORDERS is PSCFSR

9) Answer: **1567**

The word RING can be made from the alphabets of the word READING. So, we can get the coding for RING directly from the coding of READING.

R	E	A	D	I	N	G
1	2	3	4	5	6	7

Therefore, the code for the word RING will be:

R	I	N	G
1	5	6	7

10) Answer: **NXWR**

First convert the given word (RAIN) to numbers i.e., 1 for A, 2 for B, 3 for C and so on till 26 for Z, as shown below:

R	A	I	N
18	1	9	14

Now convert the given code of RAIN (PXWR) to numbers as shown below:

P	X	W	R
16	24	23	18

Now find the difference between 2nd and 1st list of numbers. The difference is:

-2	23	14	4

Convert the new word (PAIN) to numbers as shown below:

P	A	I	N
16	1	9	14

Add the differences, in the above numbers to get the numbers for the new coded word:

14	24	23	18

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Convert the above digits to alphabets to find the code:

N	X	W	R

Therefore, the code for PAIN is NXWR

11) Answer: **SAT**

Note that 712 is a part of 74312. So, we can get the resulting word for 712 from the word of 74312.

S	W	E	A	T
7	4	3	1	2

7	1	2
S	A	T

Therefore, 712 represents SAT

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Direction Sense Test

The key to scoring more in this portion is to draw the direction axis and follow the given directions one by one. The first 2 questions are explained by mentioning all the steps. Use the same strategy for all the questions in your NET.

The questions in your NET will be similar. Only the values, directions and names would be different. So, pay attention to the method of solving. The following pages contain 10 main type of questions from Past NET Papers (2013 and onwards)

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Questions of Direction Sense Test from Past NET Papers

1) Sultan traveled 320m south, took a U-turn and traveled 520m north then he turned right and traveled 200m distance , again turned right and traveled 200m what is his position with respect to his starting position?
a) North b) East c) South d) West

2) Absar, Kamran, Imran, Hameed and Sami all are facing north. Imran is 75 km at the right of Absar while Imran is to the North of Hameed. Sami is to the East of Hameed. Kamran is 50 km to the North of Imran, then who is at the position of Northwest of Hameed?
a) Kamran b) Absar c) Sami d) Imran

3) A, B, C, D, E are all facing north. If A is in front of B, B is west to C, D is south of C and E is on left of D. Which letter is northeast to the letter left to D. ?
a) A b) B c) C d) E

4) A man is facing north. He turns 45 degree in the clockwise direction and then another 180 degree in the same direction and then 45 degree in the anticlockwise direction. Find which direction he is facing now?
a) North b) South c) East d) West

5) One morning Umer and Waqas were talking to each other face to face at a field. If Waqas's shadow was exactly to the left of Umer, which direction was Umer facing?
a) North b) East c) West d) South

6) In morning, Ali and Farhan are standing in front of each other. Ali's shadow is to the right of Farhan. In which direction is Farhan standing?
a) East b) North c) West d) South

7) A man went 15 km to the west of his house, then turned left and walked 20 km. He then turned east and walked 25 km and finally turning left covered 20 km. How far was he from his house?
a) 5 km b) 10 km c) 40 km d) 80 km

8) If north is northwest, west is southwest then what is south?
a) South-east b) North-east c) South-west d) None of these

9) If Sarah and Habiba are talking face to face at the time of sunset and shadow of Sarah is towards the left of Sarah then face of Habiba is in which direction?
a) North b) South c) East d) West

10) Farhan starting from his house, goes 4 km in the East, then he turns to his right and goes 3 km. What minimum distance will be covered by him to come back to his house?
a) 4 b) 24 c) 5 d) 25

11) A person is facing South-West direction. He turns 225 degrees in clockwise direction and then turns by 135 degrees in anticlockwise direction. Which direction is the person facing now?
a) North-East b) North-West c) South-East d) South-West

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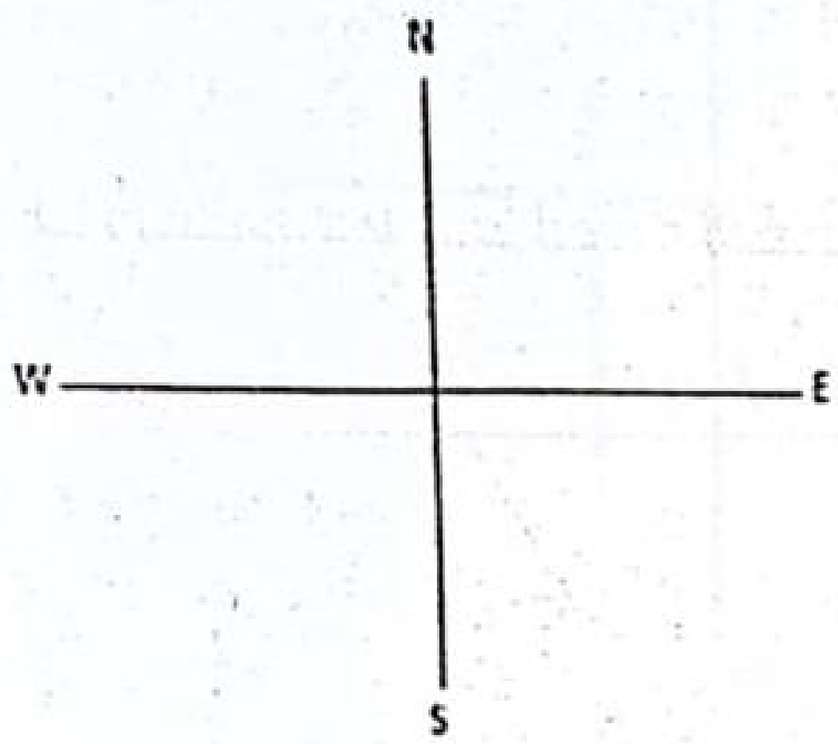
Answers for Direction Sense Test

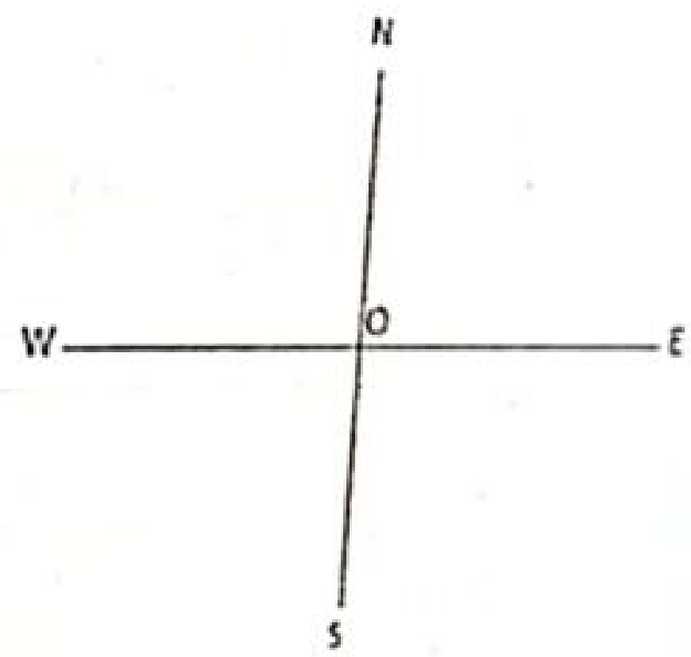
1) East

Explanation: From the final image we can see that at the end of the journey Sultan was on east side with respect to his starting position.

Step 1: Draw the direction axis

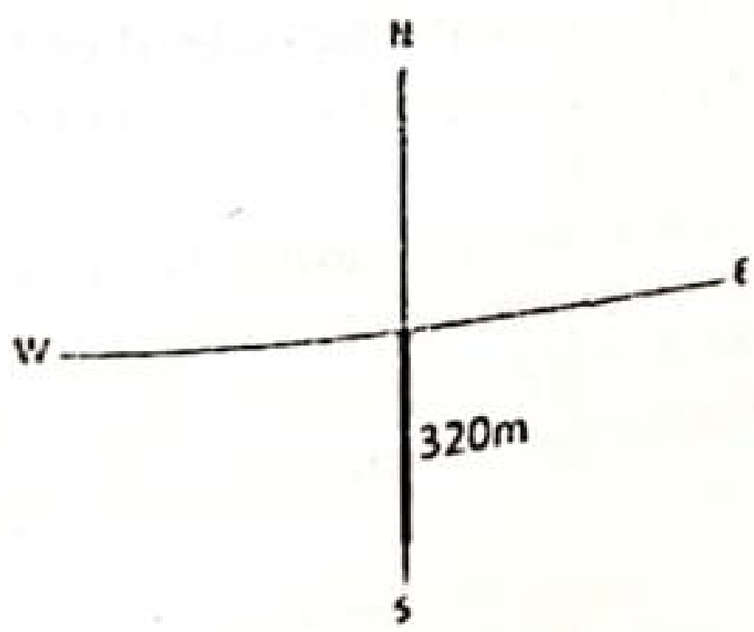


Step 2: Set origin as the starting point

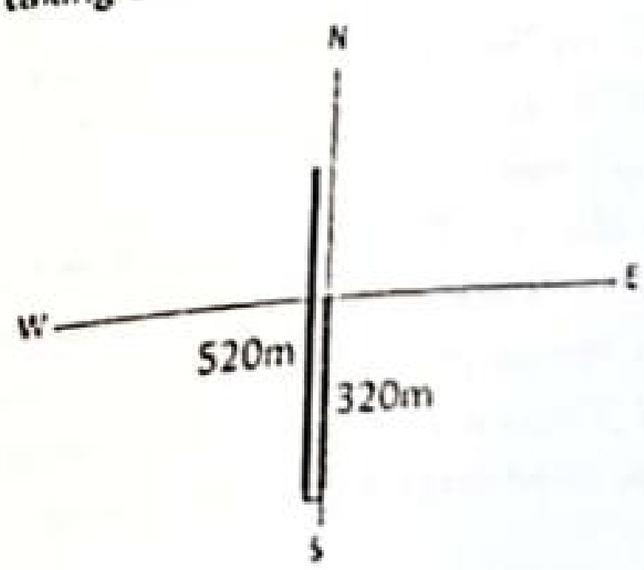


***Note:** Origin is the point where both the axis meet. Represented by O in the graph*

Step 3: Indicate the first movement of 320 towards south from starting point



Step 4: Indicate the next movement of taking a U-turn and travelling 500m



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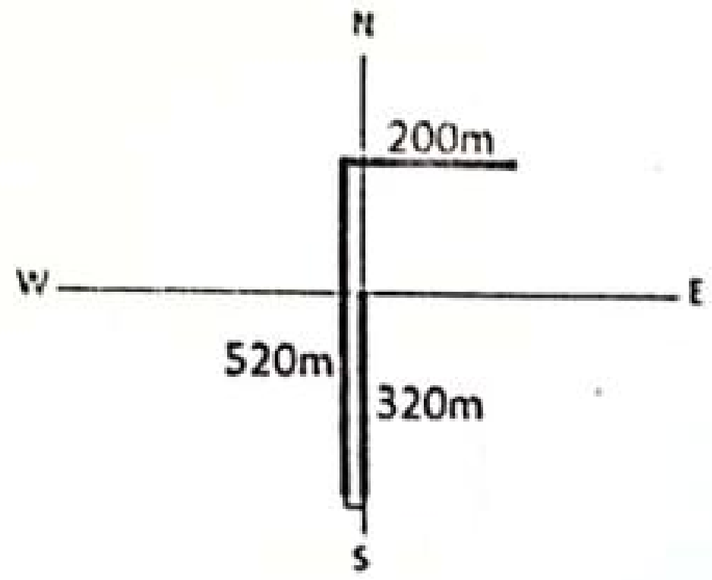
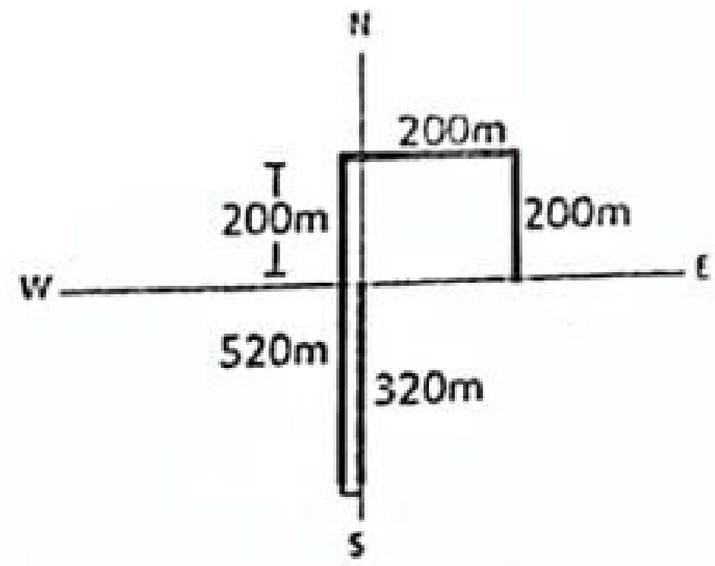
Step 5: Indicate a movement towards right of 200 m



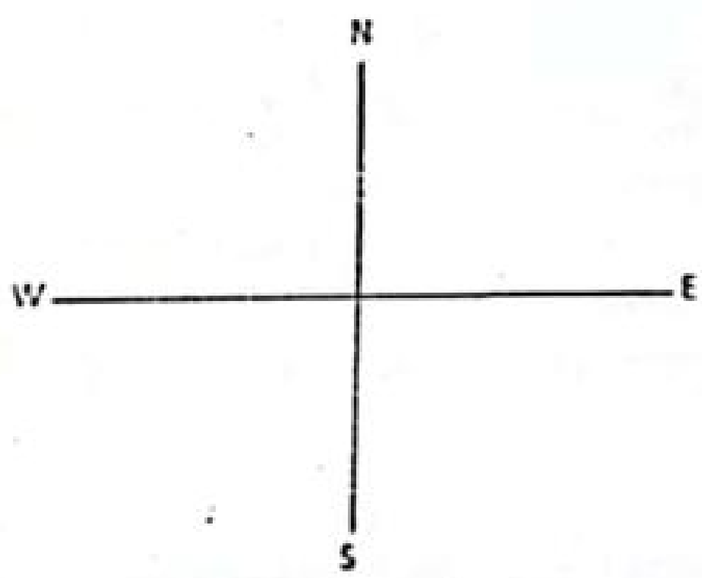
Step 6: Indicate the final right movement of 200m



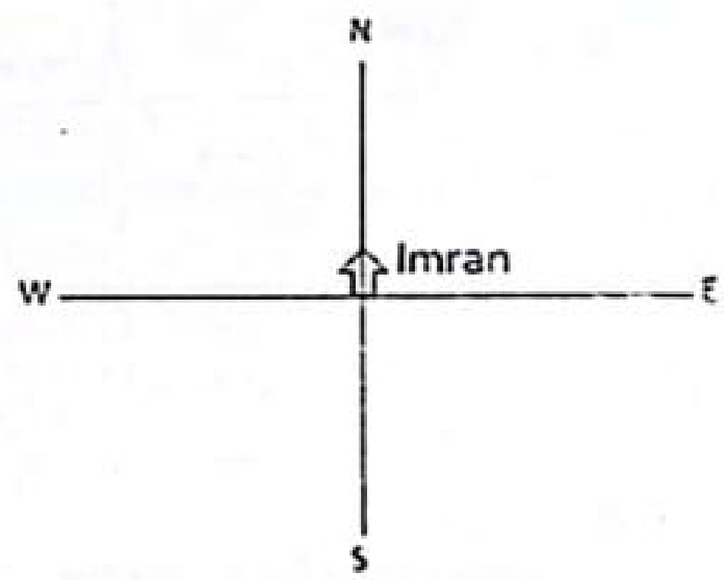
2) Absar

Explanation: The northwest position with respect to Hameed is indicated by an arrow in the final image. Northwest direction means in between North and West. Therefore, the person at northwest position of Hameed is Absar.

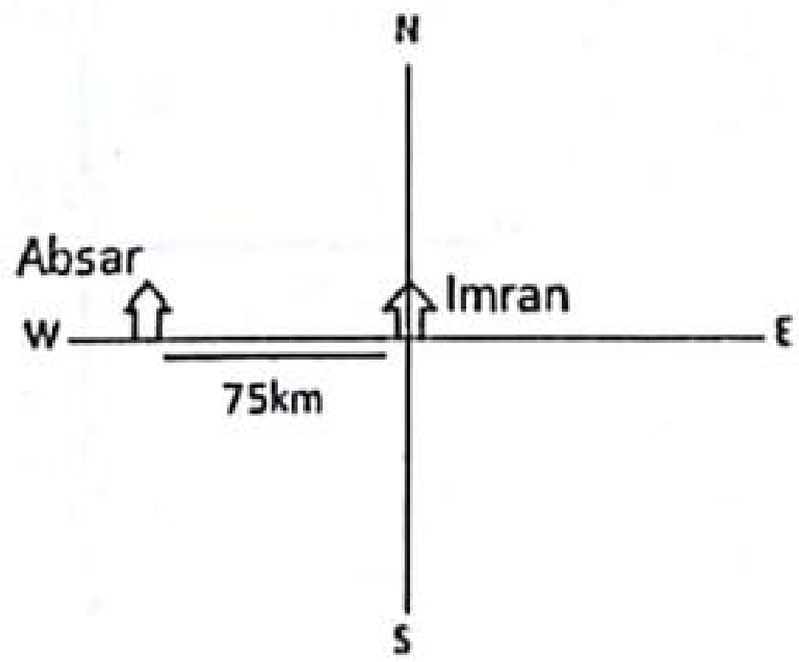
Step 1: Draw the direction axis.



Step 2: Assign Origin as the position of any of the given 5 names. Let the location of Imran be origin



Step 3: Since Imran is on Right of Absar, when they are facing North, Absar will be on west side, as shown in the figure.



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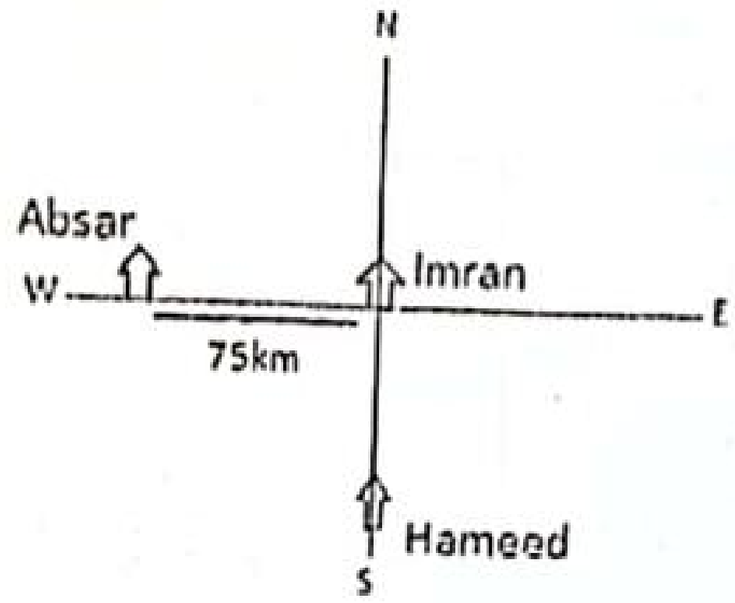
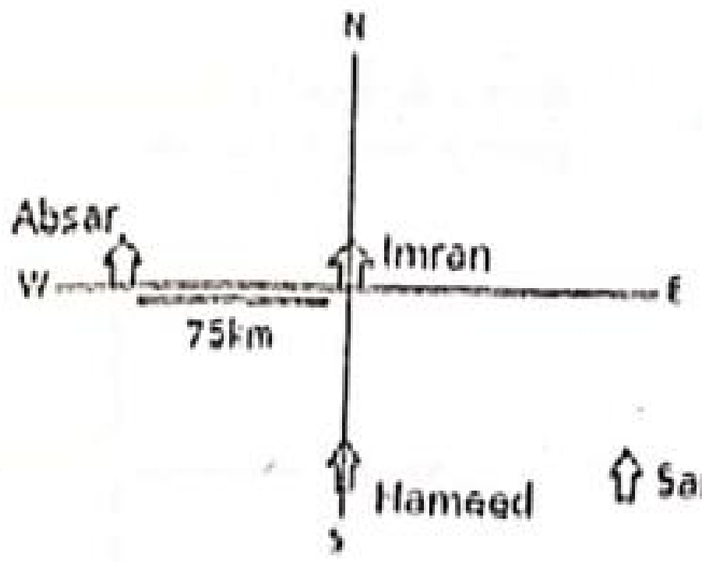
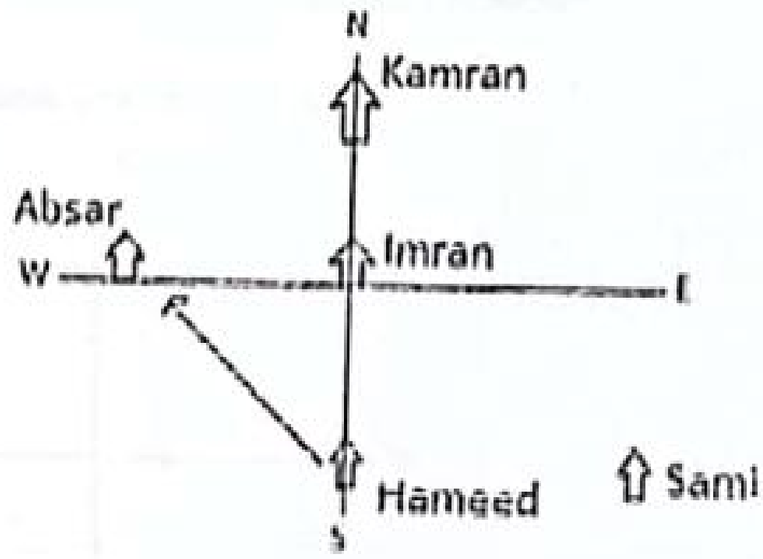
Step 4: Imran is on North of Hameed. This means position of hameed will be on south side as shown in figure.



Step 5: Saml is to the east of Hameed

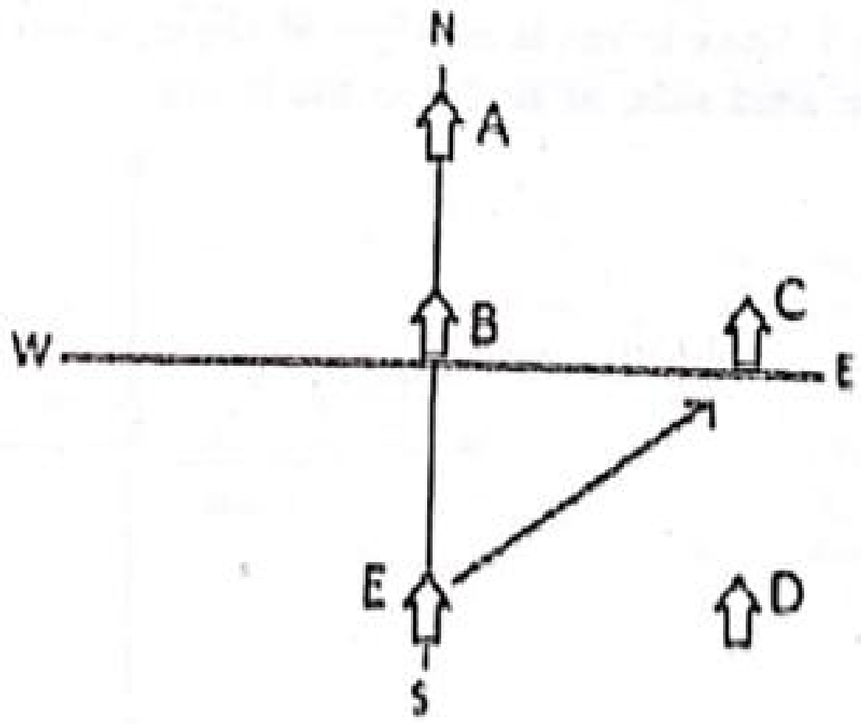


Step 6: Kamran Is 50km to the North of Imran



3) C

Explanation: After following the given directions we get the figure shown below. The letter to the left of D is E and the letter to northeast of E is C.



4) South

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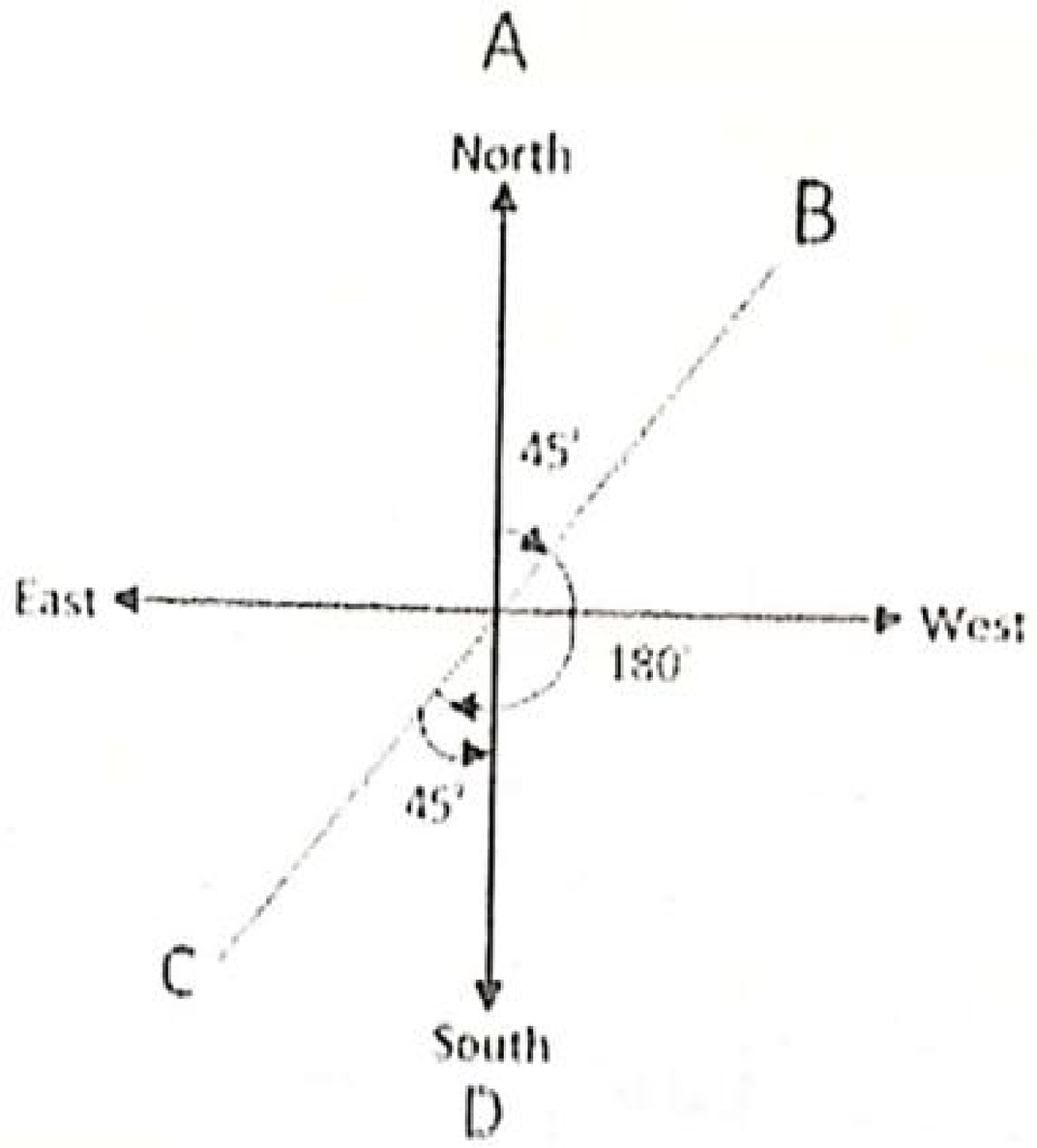
Explanation: The initial direction is shown by A i.e. towards North, after 45 degrees clockwise rotation the direction is in direction of B. After 180 degrees rotation in clockwise, the direction is towards C. After final 45 degrees anticlockwise rotation, the direction is towards D i.e. towards South..



5) North

Explanation: When two persons are facing each other, then the left side of one will be the right side of the other. So, the left of Umer will be Right of Waqas. Therefore, the shadow of Waqas needs to be on his Right side.

In Morning, if a person is facing North, then his shadow will be towards his right. Therefore, if Waqas is facing South his shadow will be towards his right as shown in the figure below.

As Waqas and Umer are facing each other, the right of Waqas is left for Umer. So, for Umer the shadow of Waqas is towards the left. This setting satisfies the condition mentioned in the question. So, we can conclude that Umer is facing North.

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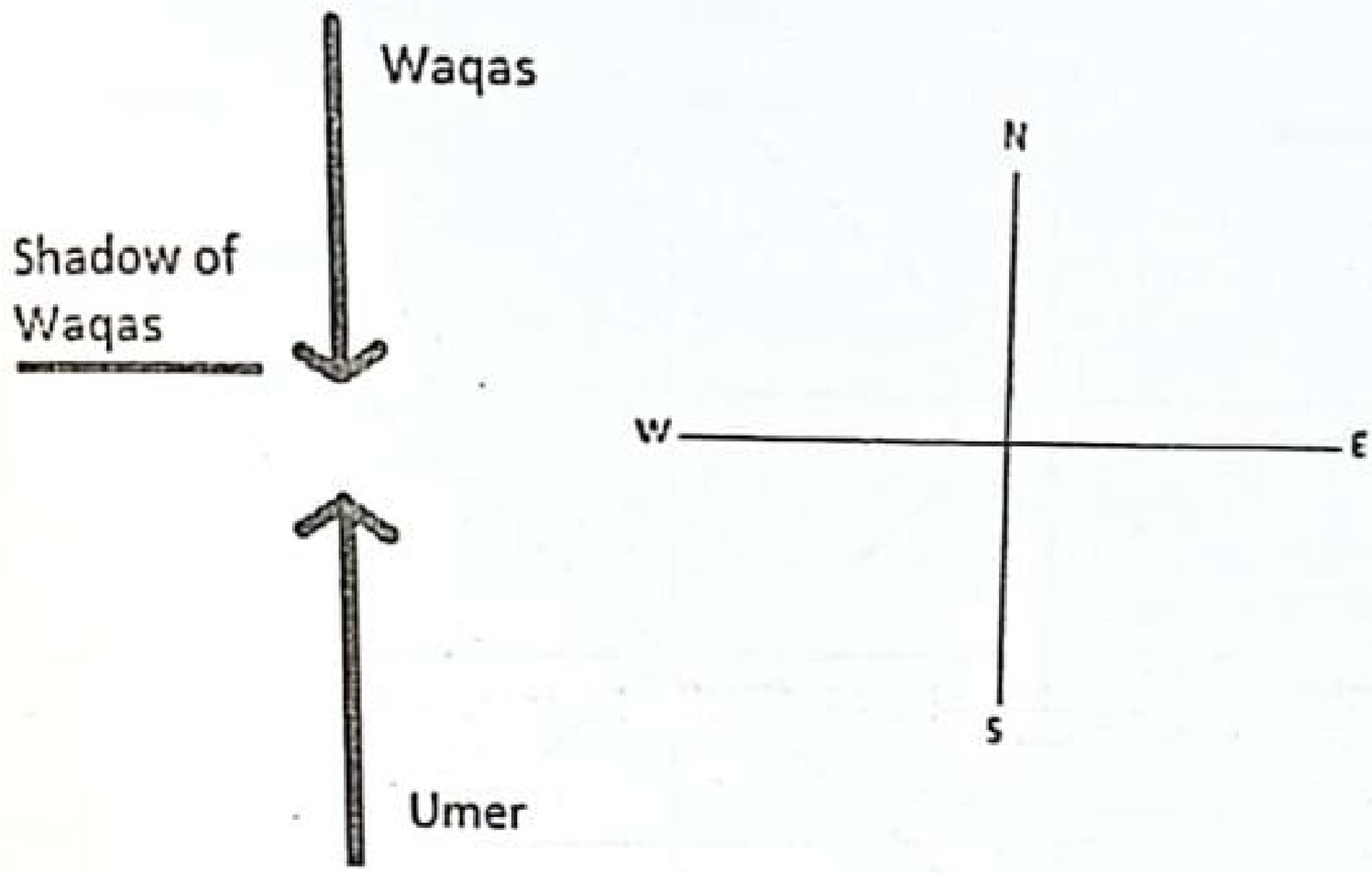
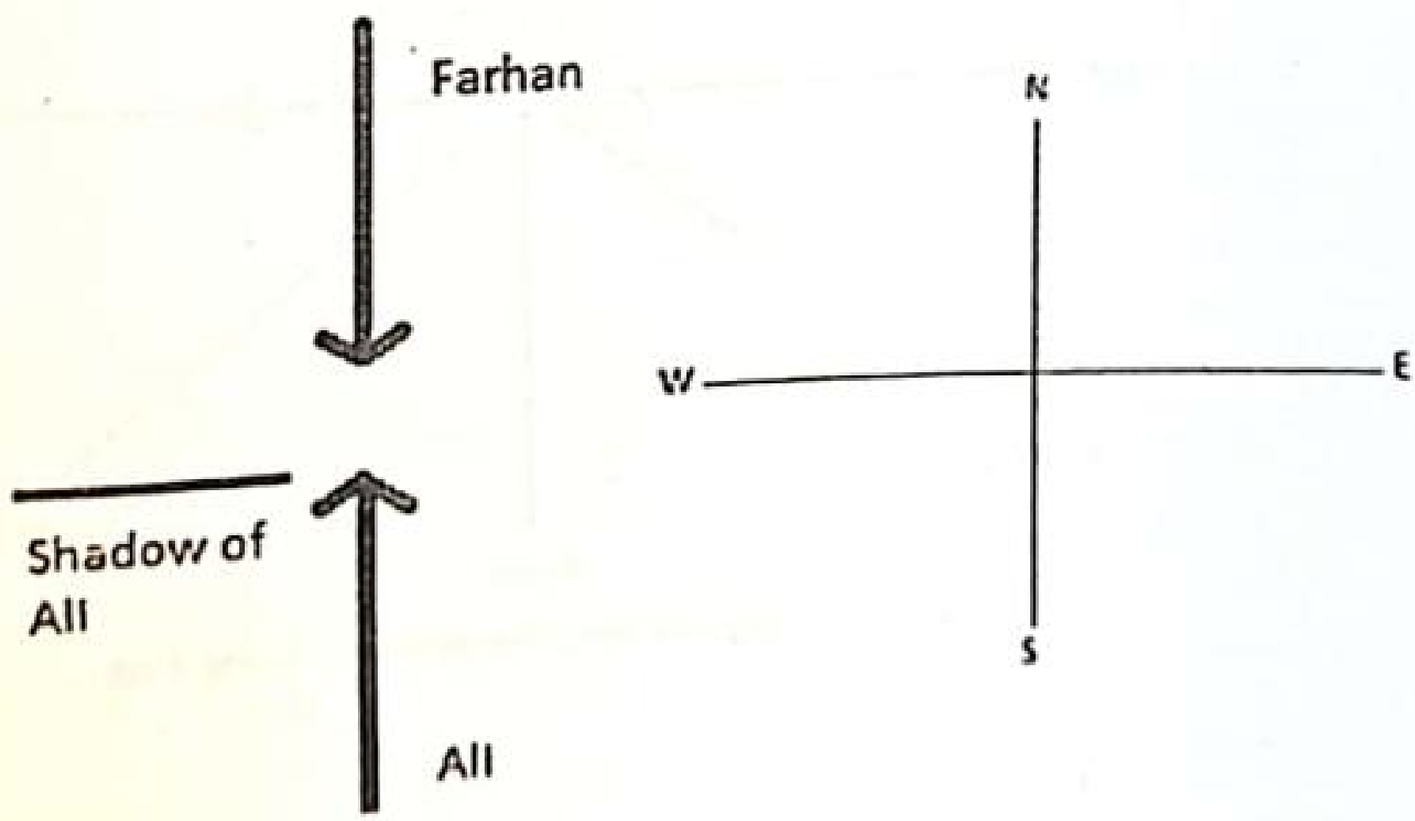


6) South

Explanation: Ali and Farhan are facing each other. So, right of Farhan means left for Ali.
Ali's shadow is to right of Farhan. This means, shadow of Ali is towards his left. During the morning time if a person is facing towards North, his shadow will be towards his left.
If Ali is facing North, Umer must be facing South as they are facing each other.



7) 10 km

Explanation: The movements of the man are shown in the figure below. We have to find out how far is his final position from his initial position.

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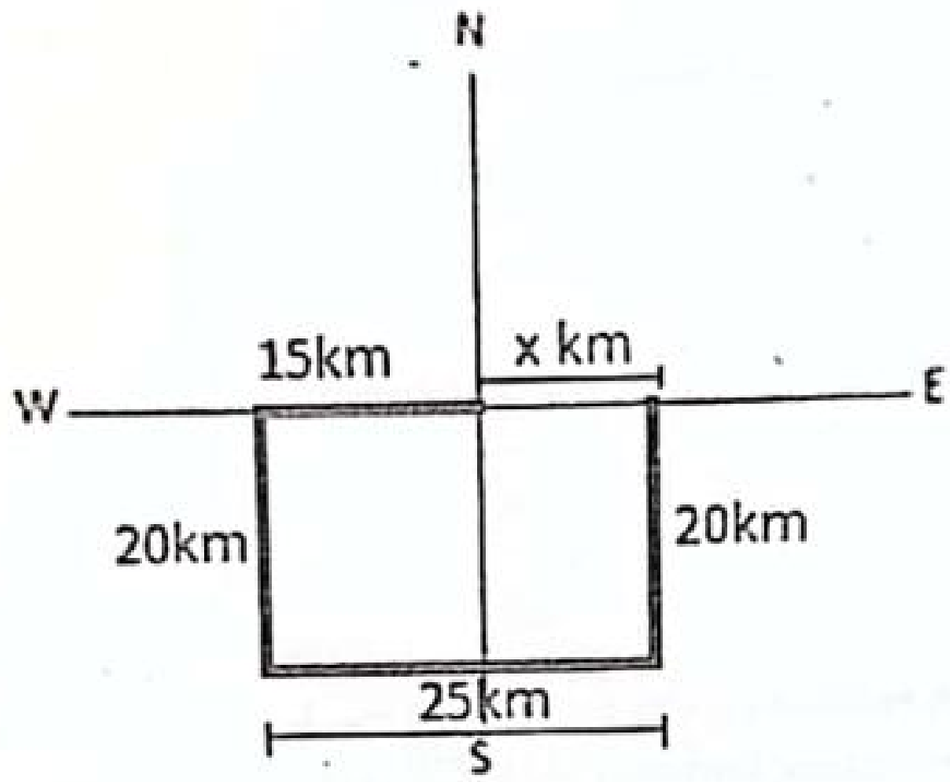
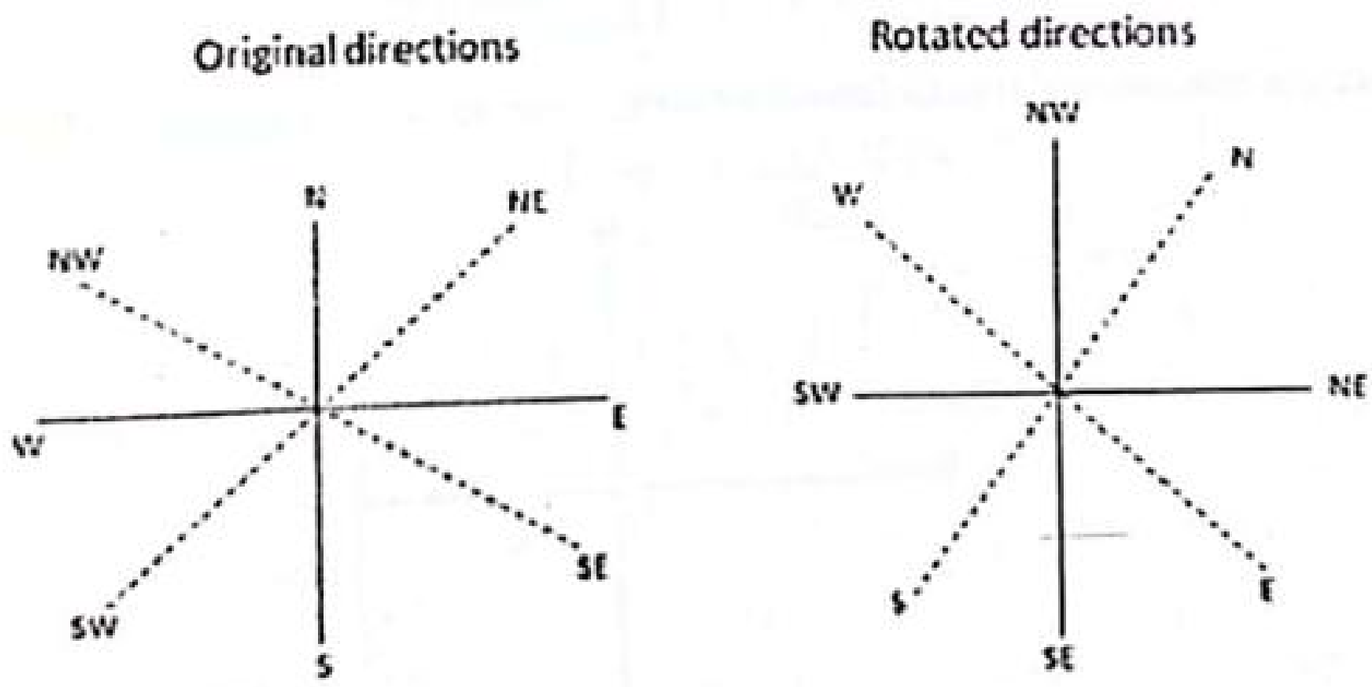
From the figure we can see that the distance between his initial and final position is represented by x km.
Also, from the figure we can see than 15 + x = 25 km.
This means, the distance between the initial and final position of the man is 10km towards east.



8) South-east
Explanation: To change North to North-west, we need to rotate the original direction axis by 45 degrees in clockwise direction. This will give us the new direction axis shown in the figure on the right side. In this new direction axis, the position of South will be taken by South-East.



9) North
Explanation: Sarah and Habiba are standing face to face. This means, left of Sarah is Right for Habiba. Shadow of Sarah is towards her left. At time of sunset, if a person is facing South, his shadow is towards his left. This means, Sarah is facing South and, hence, Habiba is facing North.

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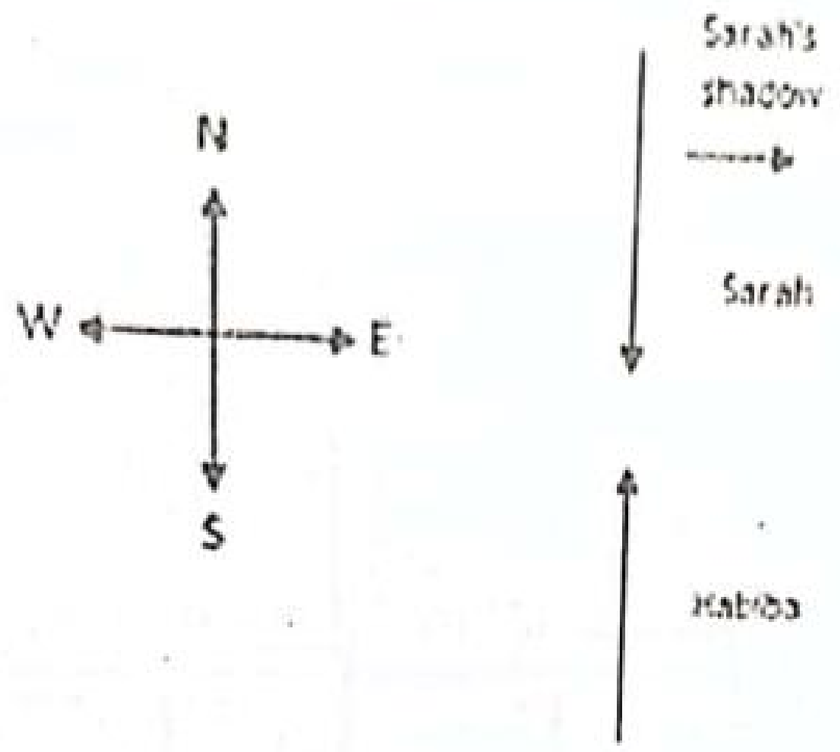


10) 5

Explanation: Point A represents the location of the house of Farhan and point C represents his ending point. The minimum distance between his house and final position is represented by the line AC.
From the figure we can see that triangle ABC is a Right-Angled Triangle with side AC being its hypotenuse.
Using the Pythagorean Theorem, we can find the length of hypotenuse of the triangle using the formula:

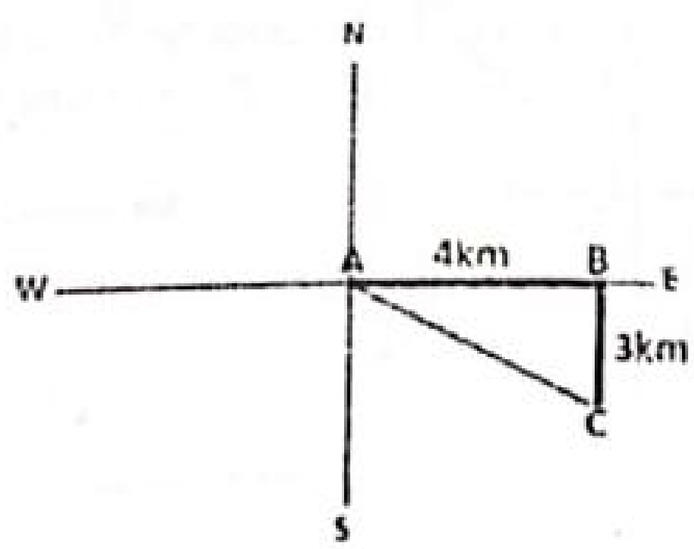
$$(AC)^2 = (AB)^2 + (BC)^2$$

$$(AC)^2 = 4^2 + 3^2$$

$$(AC)^2 = 25$$

$$AC = 5$$

This means the minimum distance from Farhan's house to his final position is 5km.



11) North-West

Explanation: Following the steps mentioned in the question, the final direction of the person is North-West.

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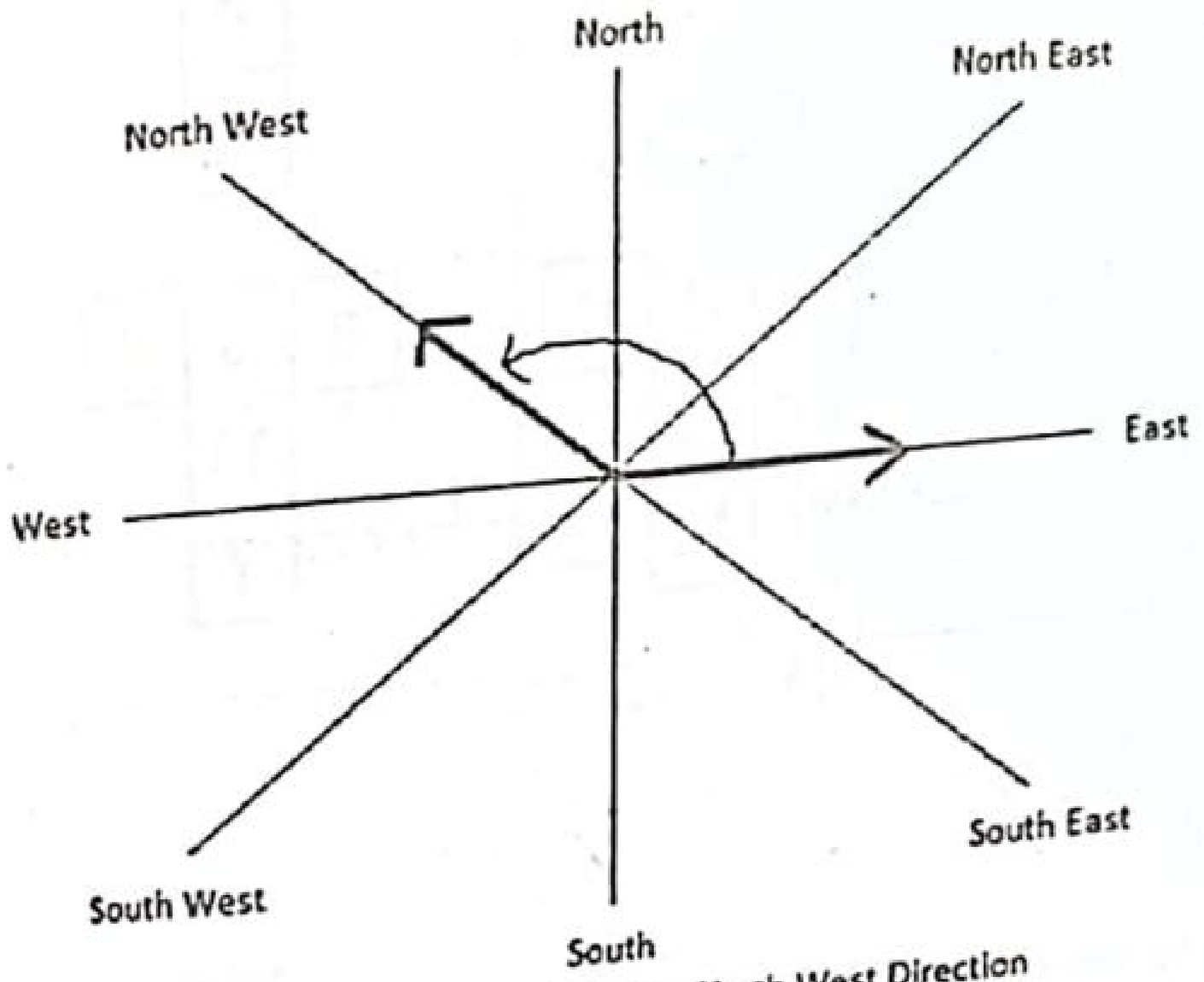
Step 4: Start from east and turn 135 degrees in anticlockwise direction



Thus, the person is facing North West Direction

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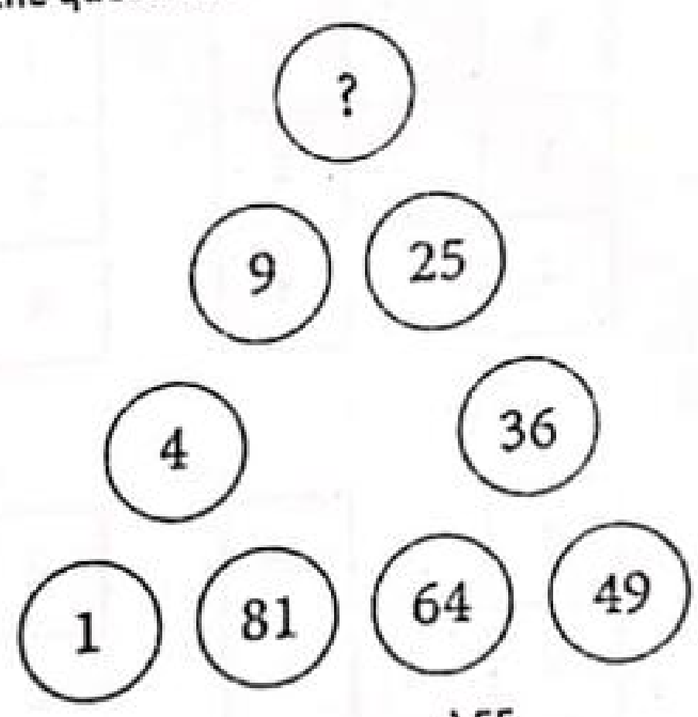
Practice Questions from Number Reasoning

1) Which number should replace the question mark?

a) 33 b) 35 c) 37 d) 39

2) Which number replaces the question mark?



a) 16 b) 37 c) 55 d) 2

3) Find the missing number:

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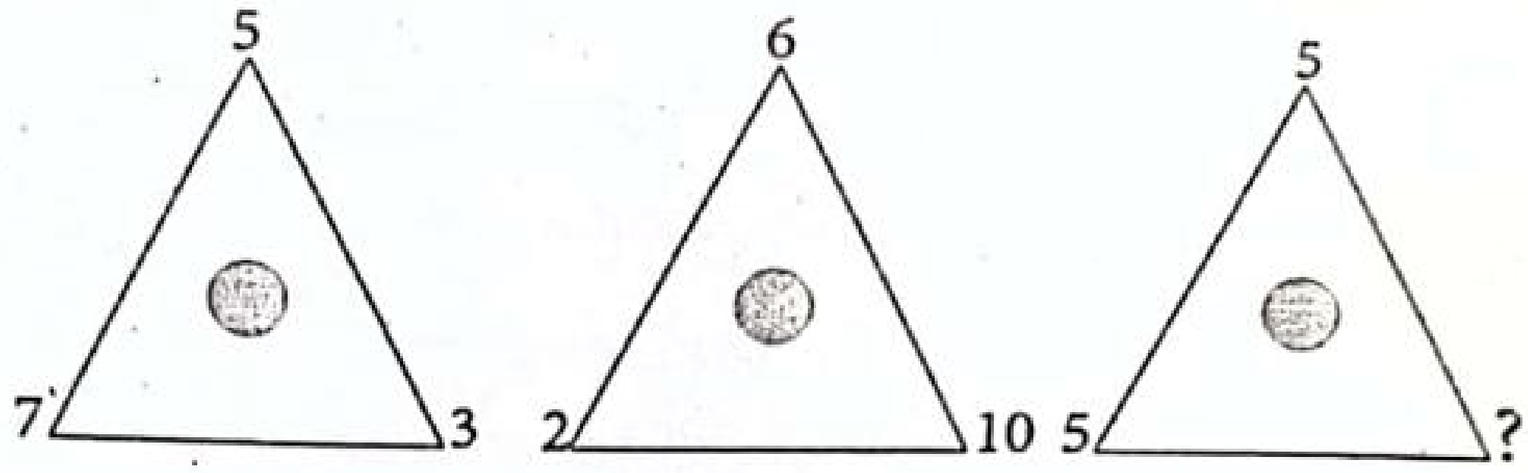
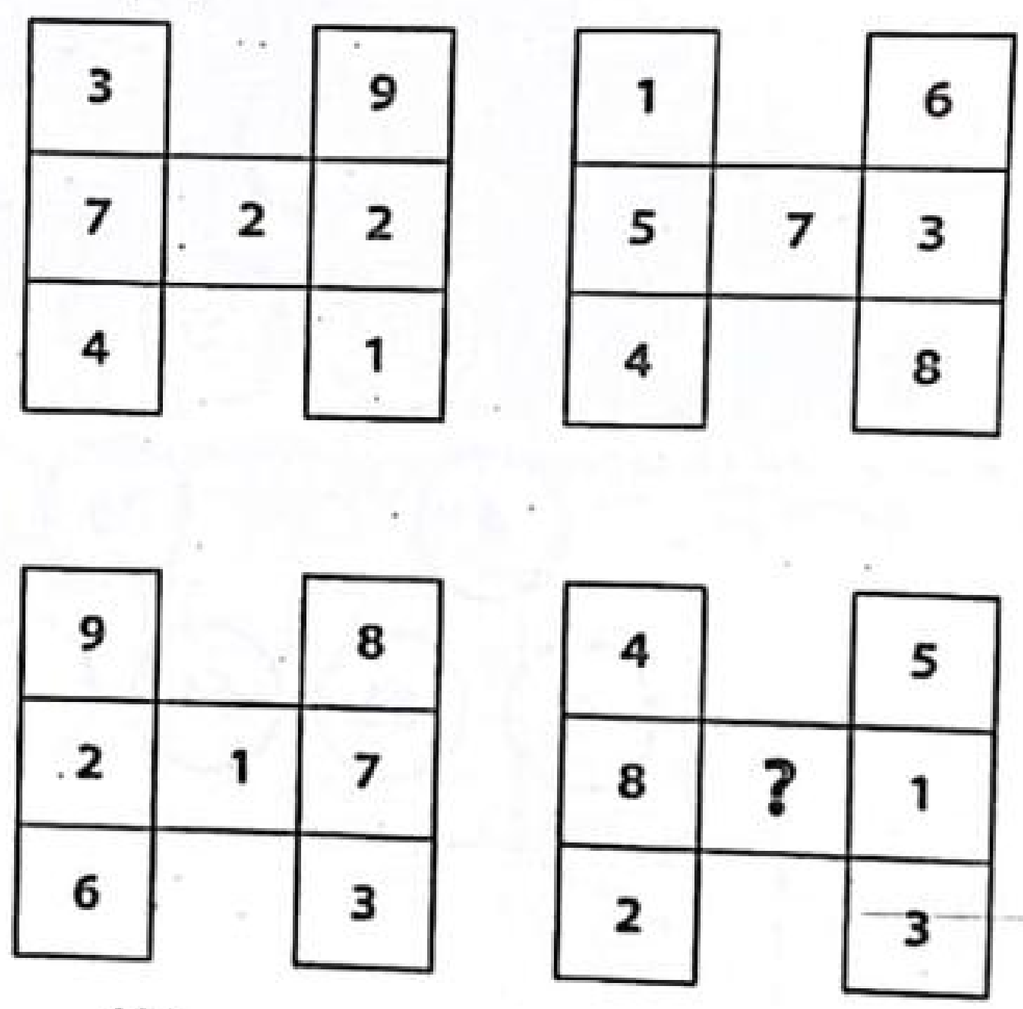
a) 5 b) 4 c) 3 d) 1

4) Find the missing number:



a) 8 b) 9 c) 11 d) 5

5) Find the missing number:



a) 3 b) 4 c) 5 d) 6

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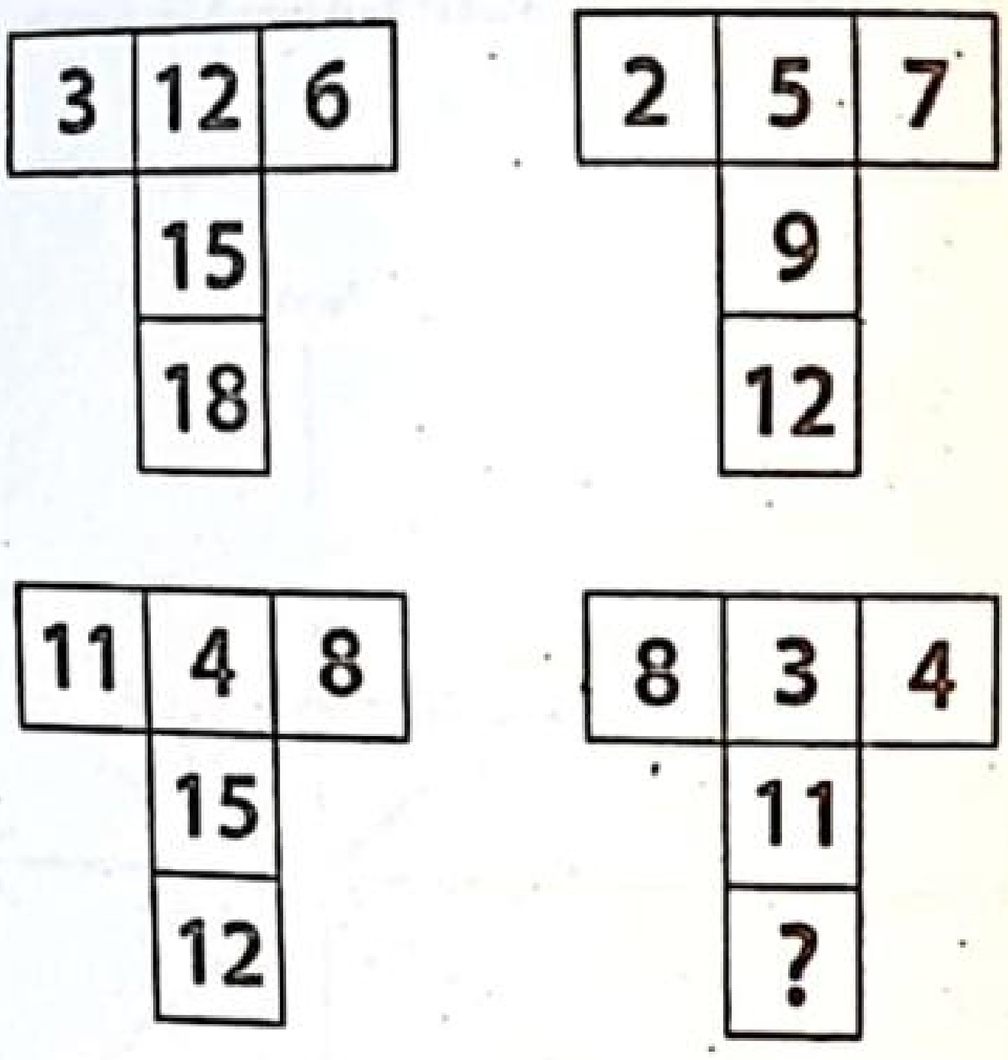
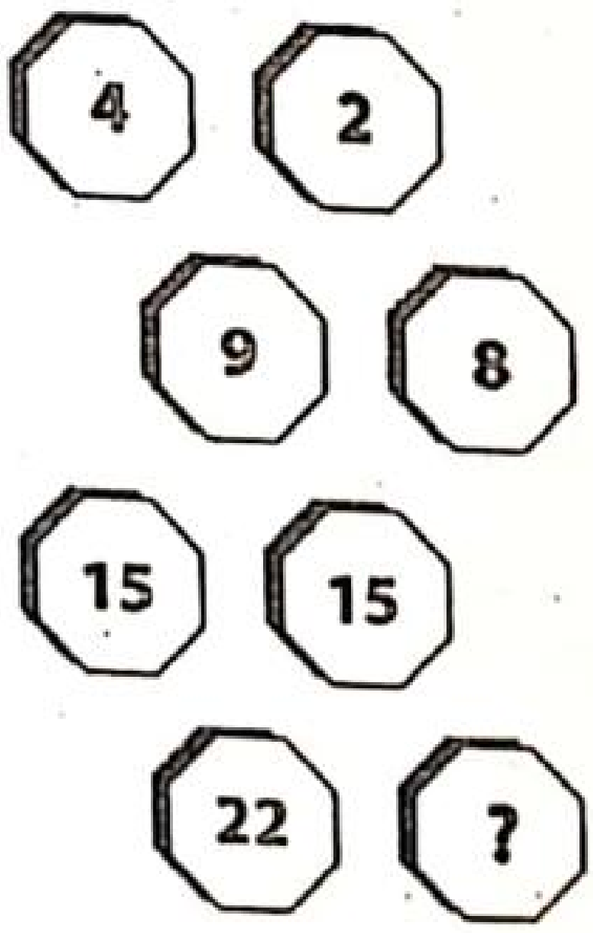
6) Which number replaces the question mark?



a) 3 b) 5 c) 7 d) 9

7) Find the missing number:



a) 56 b) 34 c) 23 d) 42

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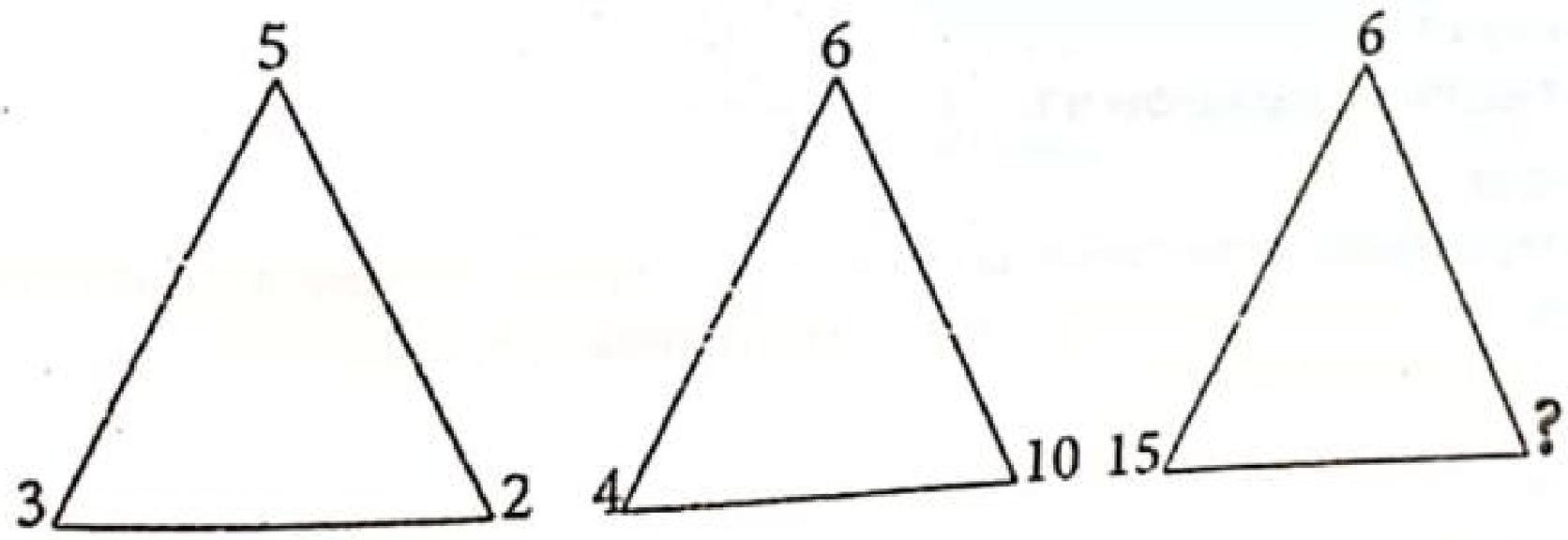
8) Find the missing number:

3	5
4	1
4	7
5	3
5	?

a) 3 b) 5 c) 7 d) 9

9) Find the missing number:



a) 19 b) 16 c) 12 d) 9

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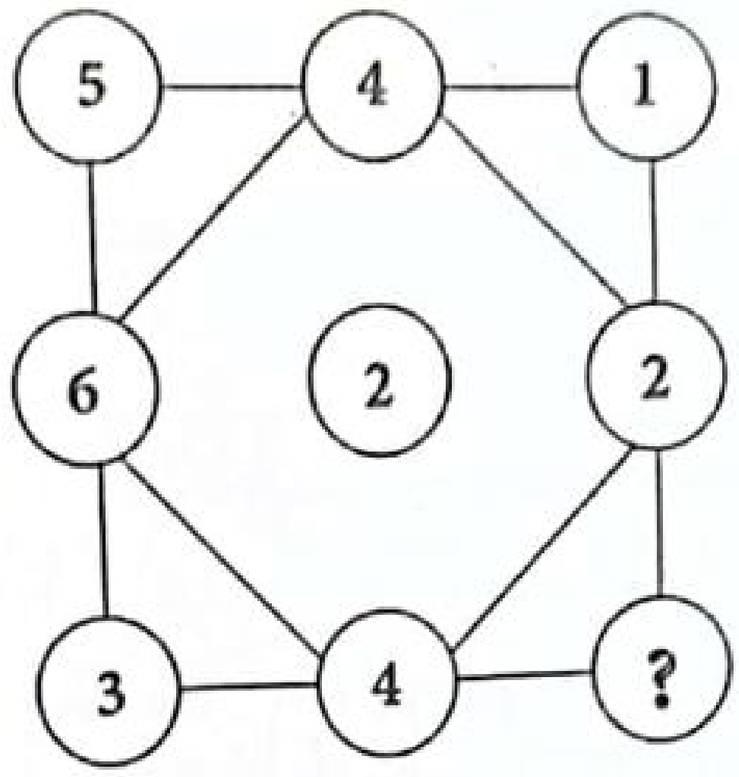
10) Find the missing number:



a) 3 b) 5 c) 1 d) 7

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Answers of Number Reasoning

1) 35

Logic: This sequence is known as Fibonacci sequence, starting from 3rd term, each term is equal to the sum of previous two terms.

$3 + 5 = 8$

$5 + 8 = 13$

$8 + 13 = 22$

So, the number that should replace the question mark must be:

$13 + 22 = 35$

2) 16

Logic: Starting from the bottom left, i.e., from 1, and moving clockwise along the triangle, the numbers follow the following sequence:

$1^2 = 1$ $2^2 = 4$ $3^2 = 9$

So, the missing number must be: $4^2 = 16$

This sequence continues till $9^2 = 81$

3) 4

Logic: In each triangle, the number in center is equal to "half of the sum of numbers" written outside the triangle.

This can be written as:

Central Number = $\frac{1}{2}$ (Sum of numbers written outside)

For example, for 1st triangle:

$$\frac{1}{2}(1 + 3 + 4) = \frac{1}{2}(8) = 4$$

So, for 3rd triangle:

$$6 = \frac{1}{2}(5 + 3 + ?)$$

$$12 = 5 + 3 + ?$$

$$12 - 5 - 3 = ?$$

$$4 = ?$$

Thus, the missing number is 4.

4) 5

Logic: In each triangle, the number written at the top is equal to "half of the sum of numbers" written at the bottom.

For example, for 1st triangle:

$$\frac{1}{2}(7 + 3) = \frac{1}{2}(10) = 5$$

So, for 3rd triangle:

$$5 = \frac{1}{2}(5 + ?)$$

$$10 = 5 + ?$$

$$5 = ?$$

Thus, the missing number is 5.

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5) 5

Logic: In each given "H shaped" figure, the central number is equal to the difference between the (sum of the 3 left hand numbers) and the (sum of the 3 right hand numbers).

This means, add the numbers in each column, and then subtract the sum of right column from the left column. This can be written as:

Central Number = Sum of Left Column – Sum of Right Column

So,

The missing number would be:

Central Number = (4 + 8 + 2) – (5 + 1 + 3)

Central Number = 14 – 9

Central Number = 5

6) 7

Logic: In each diagram, the sum of the upper left and upper middle numbers is written in the central box, and the sum of the upper right and upper middle numbers is written in the lowest box.

For example, for first figure:

3 + 12 = 15 (written in central box)

6 + 12 = 18 (written in lowest box)

So, for the final figure:

8 + 3 = 11

4 + 3 = 7

Thus, the missing number is 7.

7) 23

Logic: Looking at the diagram as two different columns, numbers in the left-hand column increase by 5, 6 and 7. Numbers in the right-hand column increase by 6, 7, 8.

For right-hand column:

2 + 6 = 8

8 + 7 = 15

So, the next number must be:

15 + 8 = 23

8) 9

Logic: Reading each pair of numbers in a row as a 2-digit number, values increase by 6 as we move down the figure.

First number is 35, then 41, 47, 53.

So, the final number must be 59. And, therefore, the missing number is 9.

9) 9

Logic: In each triangle, the sum of two smaller numbers is equal to the 3rd number.

3 + 2 = 5

6 + 4 = 10

Now, for 3rd triangle, we have two possible cases:

Case 1: The missing number is the largest number

In this case, sum of 15 and 6 must be the missing number and answer should be available in the options.

This sum is 21. Since 21 is not available in the choices, we neglect this case.

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Case 2: 15 is the largest number

In this case sum of "6 and missing number" must be equal to 15. For this condition, the missing number should be 9, which is available in the given choices.

From here, we can conclude that the missing number is 9.

10) 3

Logic: The sum of numbers in each row is 10.

The sum of digits in first row is:

$5 + 4 + 1 = 10$

For 2nd row the sum is:

$6 + 2 + 2 = 10$

Therefore, the sum of digits in 3rd row must be 10.

$3 + 4 + ? = 10$

$? = 3$

So, the missing number is 3

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FORMULA SHEET FOR NET ENGINEERING BY OETP

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The following pages contain formulas from Fsc 1st Year Mathematics. Since, there were a lot many formulas (as you can see from the following pages), we decided to arrange them for the candidates. Candidates, in their own best interest, should make a similar formula sheet for Fsc 2nd year Mathematics, and for Physics as well. Learn and revise them after every few days. The solutions in our Engineering Guidebook cover almost all the formulas of Mathematics and Physics.

Tip: After memorizing the formulas, try writing them down on a paper (based on your memory) and see how many of these you can get correct. Repeat this process after every few days, till you get all of them correct.

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1) Multiplicative Inverse of a Complex Number:

The multiplicative inverse of a complex number (a,b) is $\left(\frac{a}{a^2+b^2}, \frac{-b}{a^2+b^2}\right)$ and its identity element is $(1,0)$.

2) Polar form of a Complex Number:

$$x+iy = r\cos(\theta) + ir\sin(\theta)$$

$$r = \sqrt{x^2+y^2}$$

$$\theta = \tan^{-1}\left(\frac{y}{x}\right).$$

3) De Moivre's Theorem:

$$(\cos(\theta) + i\sin(\theta))^n = \cos n(\theta) + i\sin(n\theta),$$

$\forall n \in Z$

4) Modulus of a Complex Number:

$$z = x+iy = (x,y) \text{ then}$$

$$|z| = \sqrt{x^2+y^2}$$

5) De Morgan's Law:

$$(A \cup B)' = A' \cap B'$$
$$(A \cap B)' = A' \cup B'$$

6) Converse of a statement:

Let $p \to q$ be the given conditional statement then its converse is:

$$q \to p$$

7) Inverse of a statement:

The inverse of $p \to q$ is $\sim p \to \sim q$

8) Contrapositive of a statement:

The contrapositive of $p \to q$ is $\sim q \to \sim p$

9) Determinant of a 2×2 matrix:

If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ determinant of A is $\begin{vmatrix} a & b \\ c & d \end{vmatrix}$.

$$|A| = \begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$$

10) Singular and non-singular matrix:

If the determinant of a matrix is 0 then the matrix is called singular matrix.

If the determinant of a matrix is not equal to 0 than the matrix is called non-singular matrix.

11) Adjoint of a matrix:

$A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ adjoint of matrix is $\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$ and is denoted by "adj A".

12) Inverse of a Matrix:

If A is a non-singular matrix of order 2 then $AB = BA = I_2$

$I_2 = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$. Here B is the multiplicative inverse of A and is denoted by A^{-1}.

$$B = A^{-1} = \frac{Adj\ A}{|A|}$$

13) Crammer's Rule:

$$\left.\begin{aligned} a_{11}x_1 + a_{12}x_2 &= b_1 \\ a_{21}x_1 + a_{22}x_2 &= b_2 \end{aligned}\right\}$$

$$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \end{bmatrix}$$

$$\to AX = B, \qquad \to X = A^{-1}B$$

$$x_1 = \frac{\begin{vmatrix} b_1 & a_{12} \\ b_2 & a_{22} \end{vmatrix}}{|A|}, \qquad x_2 = \frac{\begin{vmatrix} a_{11} & b_1 \\ a_{21} & b_2 \end{vmatrix}}{|A|}$$

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14) Minor of an Element:

Let A be a square matrix of order 3.

$A=\begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix}$. Then the minor of an element a_{ij} is M_{ij}, is the determinant of $(3-1)\times(3-1)$ matrix formed by deleting its i_{th} row and j_{th} column. For example,

$$M_{12}=\begin{vmatrix} a_{21} & a_{23} \\ a_{31} & a_{33} \end{vmatrix}$$

15) Cofactor of an element:

The cofactor of an element a_{ij} denoted by A_{ij} is $A_{ij}=(-1)^{i+j}\times M_{ij}$, here M_{ij} is the minor of element a_{ij} of matrix A.

16) Quadratic Formula:

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}$$

17) Sum of roots:

$$S=\frac{-b}{a}=\frac{-\text{ coefficient of } x}{\text{coefficient of } x^2}$$

18) Products of roots:

$$P=\frac{c}{a}=\frac{\text{constant term}}{\text{coefficient of } x^2}$$

19) Formation of an equation from roots:

If the roots of an equation are given, then the equation is formed by the formula

$x^2-Sx+P=0$. Here S is the sum of roots and P is the product of roots.

20) Discriminant of a Quadratic Equation:

$$d=\pm\sqrt{b^2-4ac}$$

21) n^{th} term of Arithmetic Progression:

$a_n=a_1=(n-1)d$, here d is the common difference between two terms. n is the number of term, a_1 is the first term of AP.

22) Arithmetic Mean:

$$A=\frac{a+b}{2}$$

23) Sum of n terms of Arithmetic Series:

$$S_n=\frac{n}{2}\left[2a_1+(n-1)d\right]$$

24) n^{th} term of geometric Progression:

$a_n=a_1r^{n-1}$, here r is the common ratio.

$$r=\frac{a_n}{a_{n-1}}$$

25) Geometric Mean:

$$G=\pm\sqrt{ab}$$

26) Sum of n terms of a GP.

$$S_n=\frac{a_1(1-r^n)}{1-r} \quad \text{if } |r|<1$$

$$S_n\frac{a_1(r^n-1)}{r-1} \quad \text{if } |r|>1$$

27) Sum of Infinite Geometric Series:

$$S=\lim_{n\to\infty},\ S_n=\frac{a_1}{1-r}$$

28) General form of Harmonic sequence:

$$\frac{1}{a_1},\frac{1}{a_1+d},\frac{1}{a_1+2d},\ldots$$

Whose n_{th} term is $\frac{1}{a_1+(n-1)d}$

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29) Harmonic Mean:

$$H = \frac{2ab}{a+b}$$

30) Sum of series up to n term:

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

$$b)\ \sum_{k=1}^{n} k^2 = \frac{n(n+1)(2n+1)}{6}$$
$$= (3k^2 - 3k + 1)$$

$$c)\ \sum_{k=1}^{n} k^3 = \left[\frac{n(n+1)}{2}\right]^2$$
$$= (4k^3 - 6k^2 + 4k - 1)$$

31) Permutations:

$${}^{n}P_r = \frac{n!}{(n-r)!}$$

32) Circular Permutation:

Number of Permutations $= \frac{1}{2} \times (n-1)!$

33) Combination:

$${}^{n}C_r = \frac{n!}{r!(n-r)!}$$

$${}^{n}C_r = {}^{n}C_{n-r}$$

34) Probability:

$P(E) = \frac{n}{m} = \frac{n(E)}{n(S)}$. Here $n(E)$ is number of ways in which event can occur and $n(s)$ is number of elements in sample space.

35) Multiplication of probabilities:

If A and B are two independent events, probability that both of them occur is equal to the probability of occurrence of A multiplied by the probability of occurrence of B.

$$P(A \cap B) = P(A) \cdot P(B)$$

36) Binomial theorem of positive integer:

$$(a+x)^n = \sum_{r=0}^{n} \binom{n}{r} a^{n-r} x^r$$

37) Middle term of $(a+x)^n$:

a) n **is even:**

If n is even then $n+1$ is odd so $\left(\frac{n}{2}+1\right)$ is the middle term.

b) n **is odd:**

If n is odd then $n+1$ is even so $\left(\frac{n+1}{2}\right)th$ term and $\left(\frac{n+3}{2}\right)th$ terms will be the middle terms.

38) Binomial theorem when exponent "n" is a negative number or fraction:

$$(1+x)^n = 1 + nx + \frac{n(n-1)}{2!}x^2$$
$$+ \frac{n(n-1)(n-2)}{3!}x^3 + \cdots$$
$$+ \frac{n(n-1)(n-2)\ldots(n-r+1)}{r!}x^r + \cdots$$

39) General term in expansion of above series is:

$$T_{r+1} = \frac{n(n-1)(n-2)\ldots(n-r+1)}{r!}x^r$$

40) Fundamental Trigonometric Identities:

$$\sin^2\theta + \cos^2\theta = 1$$
$$1 + \tan^2\theta = \sec^2\theta$$
$$1 + \cot^2\theta = \csc^2\theta$$

41) Basic Trigonometric Functions:

$$\sin\theta = \frac{Opposite}{Hypotenuse}$$

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$$\cos\theta = \frac{Adjacent}{Hypotenuse}$$

$$\tan\theta = \frac{Opposite}{Adjacent}$$

42) Distance Formula:

$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

43) Fundamental Laws:

$$\cos(\alpha - \beta) = \cos\alpha\cos\beta + \sin\alpha\sin\beta$$

$$\cos(\alpha + \beta) = \cos\alpha\cos\beta - \sin\alpha\sin\beta$$

$$\cos\left(\frac{\pi}{2} - \beta\right) = \sin\beta$$

$$\cos\left(\frac{\pi}{2} + \alpha\right) = -\sin\alpha$$

$$\sin(\alpha + \beta) = \sin\alpha\cos\beta + \cos\alpha\sin\beta$$

$$\sin(\alpha - \beta) = \sin\alpha\cos\beta - \cos\alpha\sin\beta$$

$$\cos(2\pi - \theta) = \cos\theta$$

$$\sin(2\pi - \theta) = -\sin\theta$$

$$\tan(\alpha + \beta) = \frac{\tan\alpha + \tan\beta}{1 - \tan\alpha\tan\beta}$$

$$\tan(\alpha - \beta) = \frac{\tan\alpha - \tan\beta}{1 + \tan\alpha\tan\beta}$$

44) Double angle Identities:

$$\sin 2\alpha = 2\sin\alpha\cos\alpha = \frac{2\tan\alpha}{1 + \tan^2\alpha}$$

$$\cos 2\alpha = \cos^2\alpha - \sin^2\alpha = \frac{1 - \tan^2\alpha}{1 + \tan^2\alpha}$$

$$\cos 2\alpha = 2\cos^2\alpha - 1 = 1 - 2\sin^2\alpha$$

$$\tan 2\alpha = \frac{2\tan\alpha}{1 - \tan^2\alpha}$$

45) Half angle identities:

$$\cos\frac{\alpha}{2} = \pm\sqrt{\frac{1 + \cos\alpha}{2}}$$

$$\sin\frac{\alpha}{2} = \pm\sqrt{\frac{1 - \cos\alpha}{2}}$$

$$\tan\frac{\alpha}{2} = \pm\sqrt{\frac{1 - \cos\alpha}{1 + \cos\alpha}}$$

46) Triple angle Identities:

$$\sin 3\alpha = 3\sin\alpha - 4\sin^3\alpha$$

$$\cos 3\alpha = 4\cos^3\alpha - 3\cos\alpha$$

$$\tan 3\alpha = \frac{3\tan\alpha - \tan^3\alpha}{1 - 3\tan^2\alpha}$$

47) Product of sin and cos:

$$2\sin\alpha\cos\beta = \sin(\alpha + \beta) + \sin(\alpha - \beta)$$

$$2\cos\alpha\sin\beta = \sin(\alpha + \beta) - \sin(\alpha - \beta)$$

$$2\cos\alpha\cos\beta = \cos(\alpha + \beta) + \cos(\alpha - \beta)$$

$$-2\sin\alpha\sin\beta = \cos(\alpha + \beta) - \cos(\alpha - \beta)$$

48) Sum and Difference of sin and cos:

$$\sin P + \sin Q = 2\sin\frac{P + Q}{2}\cos\frac{P - Q}{2}$$

$$\sin P - \sin Q = 2\cos\frac{P + Q}{2}\sin\frac{P - Q}{2}$$

$$\cos P + \cos Q = 2\cos\frac{P + Q}{2}\cos\frac{P - Q}{2}$$

$$\cos P - \cos Q = -2\sin\frac{P + Q}{2}\sin\frac{P - Q}{2}$$

49) Law of cosine:

$$a^2 = b^2 + c^2 - 2bc\cos\alpha$$

$$b^2 = a^2 + c^2 - 2ac\cos\beta$$

$$c^2 = a^2 + b^2 - 2ab\cos\gamma$$

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50) Law of sine:

$$\frac{a}{\sin\alpha}=\frac{b}{\sin\beta}=\frac{c}{\sin\gamma}$$

51) Law of Tangents:

$$\frac{a-b}{a+b}=\frac{\tan\frac{\alpha-\beta}{2}}{\tan\frac{\alpha+\beta}{2}}$$

$$\frac{b-c}{b+c}=\frac{\tan\frac{\beta-\gamma}{2}}{\tan\frac{\beta+\gamma}{2}}$$

$$\frac{c-a}{c+a}=\frac{\tan\frac{\gamma-\alpha}{2}}{\tan\frac{\gamma+\alpha}{2}}$$

52) Sine of half angles in term of Sides:

$$\sin\frac{\alpha}{2}=\sqrt{\frac{(s-b)(s-c)}{bc}}$$

$$\sin\frac{\beta}{2}=\sqrt{\frac{(s-a)(s-c)}{ac}}$$

$$\sin\frac{\gamma}{2}=\sqrt{\frac{(s-a)(s-b)}{ab}}$$

53) Cos of half angle in term of Sides:

$$\cos\frac{\alpha}{2}=\sqrt{\frac{s(s-a)}{bc}}$$

$$\cos\frac{\beta}{2}=\sqrt{\frac{s(s-b)}{ac}}$$

$$\cos\frac{\gamma}{2}=\sqrt{\frac{s(s-c)}{ab}}$$

54) Tan of half angles in term of Sides:

$$\tan\frac{\alpha}{2}=\sqrt{\frac{(s-b)(s-c)}{s(s-a)}}$$

$$\tan\frac{\beta}{2}=\sqrt{\frac{(s-c)(s-a)}{s(s-b)}}$$

$$\tan\frac{\gamma}{2}=\sqrt{\frac{(s-b)(s-a)}{s(s-c)}}$$

55) Area of triangle in term of 2 sides and their included angle:

$$\Delta=\frac{1}{2}bc\sin\alpha=\frac{1}{2}ca\sin\beta=\frac{1}{2}ab\sin\gamma$$

56) Area of triangle in term of 1 side and 2 angles:

$$\Delta=\frac{c^2\sin\alpha\sin\beta}{2\sin\gamma}$$

$$\Delta=\frac{a^2\sin\gamma\sin\beta}{2\sin\alpha}$$

$$\Delta=\frac{b^2\sin\gamma\sin\alpha}{2\sin\beta}$$

57) Hero's Formula:

$$\Delta=\sqrt{s(s-a)(s-b)(s-c)}$$

Here $s=\frac{a+b+c}{2}$

58) Circum-radius:

$$R=\frac{a}{2\sin\alpha}=\frac{b}{2\sin\beta}=\frac{c}{2\sin\gamma}$$

$$R=\frac{abc}{4\Delta}$$

59) In-radius:

$$r=\frac{\Delta}{s}$$

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60) e-radius:

$$r_1 = \frac{\Delta}{s-a}$$

$$r_2 = \frac{\Delta}{s-b}$$

$$r_3 = \frac{\Delta}{s-c}$$

61) Addition and Subtraction of Inverse Trigonometric Functions:

$$\sin^{-1} A + \sin^{-1} B = \sin^{-1}\left(A\sqrt{1-B^2} + B\sqrt{1-A^2}\right)$$

$$\sin^{-1} A - \sin^{-1} B = \sin^{-1}\left(A\sqrt{1-B^2} - B\sqrt{1-A^2}\right)$$

$$\cos^{-1} A + \cos^{-1} B = \cos^{-1}\left(AB - \sqrt{(1-A^2)(1-B^2)}\right)$$

$$\cos^{-1} A - \cos^{-1} B = \cos^{-1}\left(AB + \sqrt{(1-A^2)(1-B^2)}\right)$$

$$\tan^{-1} A + \tan^{-1} B = \tan^{-1}\frac{A+B}{1-AB}$$

$$\tan^{-1} A - \tan^{-1} B = \tan^{-1}\frac{A-B}{1+AB}$$

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62) Domain and Range of Trigonometric Functions

Functions	Domain	Range
$y=\sin x$	$-\frac{\pi}{2}\le x\ge\frac{\pi}{2}$	$-1\le y\le 1$
$y=\sin^{-1}x$	$-1\le x\le 1$	$-\frac{\pi}{2}\le y\ge\frac{\pi}{2}$
$y=\cos x$	$0\le x\le\pi$	$-1\le y\le 1$
$y=\cos^{-1}x$	$-1\le x\le 1$	$0\le y\le\pi$
$y=\tan x$	$-\frac{\pi}{2}<x<\frac{\pi}{2}$	$(-\infty,\infty)$
$y=\tan^{-1}x$	$(-\infty,\infty)$	$-\frac{\pi}{2}<y<\frac{\pi}{2}$
$y=\cot x$	$0<x<\pi$	$(-\infty,\infty)$
$y=\cot^{-1}x$	$(-\infty,\infty)$	$0<y<\pi$
$y=\sec x$	$[0,\pi], x\ne\frac{\pi}{2}$	$y\ge -1$ or $y\le 1$
$y=\sec^{-1}x$	$x\ge -1$ or $x\le 1$	$[0,\pi], y\ne\frac{\pi}{2}$
$y=\csc x$	$\left[-\frac{\pi}{2},\frac{\pi}{2}\right], x\ne 0$	$y\le -1$ or $y\ge 1$
$y=\csc^{-1}x$	$x\le -1$ or $x\ge 1$	$\left[-\frac{\pi}{2},\frac{\pi}{2}\right], y\ne 0$

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