SOLVED PAPER - 2020

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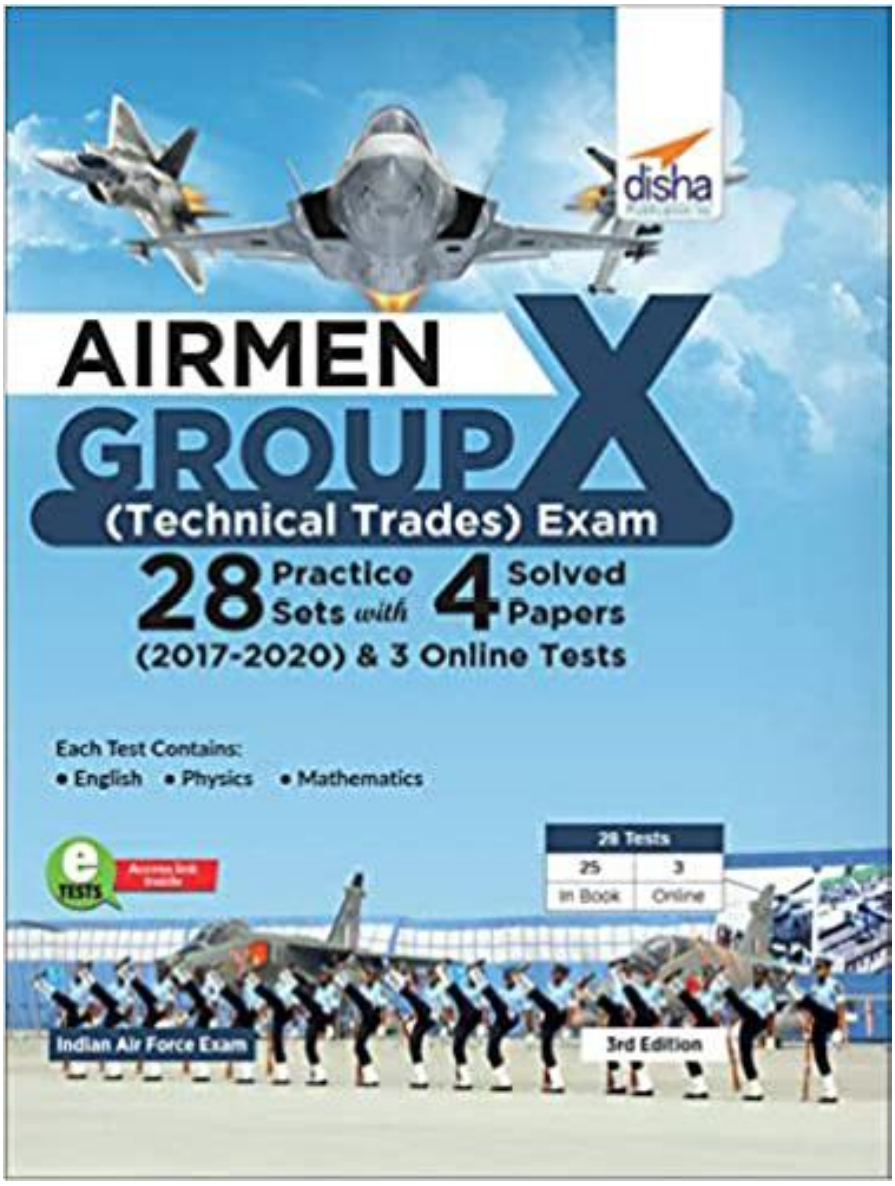

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INDIAN AIR FORCE AIRMEN GROUP X
SOLVED PAPER - 2020
(Memory Based)

ENGLISH LANGUAGE

1. Find the one which is best expresses the meaning of the given word.
Compatible
(a) Suited
(b) Inconsistent
(c) Unfitted
(d) Conflictive

2. Find the word opposite in meaning to the given word.
Abrupt
(a) Quick (b) Rushing
(c) Gradual (d) Hasty

3. Find the noun form of the word.
Compel
(a) Compulsory (b) Compulsion
(c) Compeller (d) Compellingly

4. Find the verb form of the word.
Valid
(a) Validly (b) Validation
(c) Validates (d) Validate

5. Find the plural form of the word.
Sheep
(a) Sheep (b) Sheeps
(c) Sheepish (d) Sheepishly

6. Choose the one which can be substituted for the given sentence.
One who can throw his voice
(a) Omnipotent (b) Omniscient
(c) Omnipresent (d) Ventriloquist

7. Find the correctly spelt word.
(a) Genatics (b) Sterage
(c) Grossest (d) Granaite

8. Find the meaning of the idiom/phrase.
Song and dance
(a) to have an interest in music and dance
(b) to make an unnecessary fuss
(c) to be excited
(d) to treat someone with all due respect

9. The following sentence has been given in Active/ Passive voice. From the given alternatives, choose the one which best expresses the given sentence in Passive /Active voice.
My niece wrote a beautiful poem.
(a) A beautiful poem was written by my niece.
(b) A beautiful poem has been written by my niece.
(c) A beautiful poem had been written by my niece.
(d) A poem which was beautiful had been written by my niece.

10. The following sentence has been given in direct/ indirect speech. From the given alternatives, choose the one which best expresses the given sentence in direct/indirect speech.
Pallavi said, "I will go to Agra tomorrow".
(a) Pallavi said that she would go to Agra the next day.
(b) Pallavi said she would go to Agra tomorrow.
(c) Pallavi said she will be going to Agra the next day.
(d) Pallavi said that she would go to Agra tomorrow.

DIRECTIONS (Qs. 11-12) : *In the following question, some parts of the sentence have errors and some have none. Find out which part of a sentence has an error. The number of that part is your answer. If a sentence is free from error, then your answer is (D) i.e. No Error:.*

11. A person I met (A) /in the theatre (B)/ was the playwright himself (C). / No Error (D).
(a) (A) (b) (B)
(c) (C) (d) (D)

12. Zoya Akhtar, who conceived, co-authored (A)/ and directed a number of good films, was(B)/ one of India's most talented film maker. (C)/ No Error (D).
(a) (A) (b) (B)
(c) (C) (d) (D)

DIRECTIONS (Qs. 13-14) : *Given below are four jumbled sentences. Out of the given options pick the one that gives their correct order.*

13. The white American underclass is in thrall
P: and used heroin needles
Q: to a vicious, selfish culture
R: whose main products are misery
(a) PQR (b) QRP
(c) RPQ (d) RQP

14. A certified, verifiable,
P: would be a valuable
Q: all-purpose identity card
R: document for many people
(a) QPR (b) RQP
(c) PQR (d) PRQ

DIRECTIONS (Qs. 15-16) : *In the following questions, sentences are given with blanks to be filled in with an appropriate and suitable word. Four alternatives are suggested for each question. Choose the correct alternative out of the four alternatives.*

15. The man _____ heavy losses in his investments.
(a) raised (b) reaped
(c) earned (d) incurred

16. It is very difficult for him to give up smoking as he is an _____ smoker.
(a) Indifferent (b) Inveterate
(c) Insensitive (d) Innate

DIRECTIONS (Qs. 17-20) : *Read the following passage carefully and choose the best answer to each question out of the four given alternatives.*

On a surface which is free from obstacles, such as a clear road or path, only two or three species of snakes can hope to catch up with a human being, even if they are foolish to try. A snake seems to move very fast but its movements are deceptive. In spite to the swift, wave-like motions of its body, the snake crawls along the ground at no more than the speed of a man's walk. It may, however, have an advantage inside a jungle, where the progress of a man is obstructed by thorny bushes. But in such places, the footsteps of a man are usually more than enough to warn snakes to keep away. Although they have no ears of the usual kind, they can feel slight vibrations of the ground through their bodies, and thus get an early warning of danger.

17. What is deceptive about the snake is its?
(a) Speed
(b) Crawling
(c) Sense of direction
(d) Movement

18. The snake has an advantage over men inside a jungle, because there?
(a) it can crawl faster
(b) Man's movement is obstructed
(c) It is dark
(d) It gets warning

19. What helps snakes to receive advance warning is their sensitivity to?
(a) Light
(b) Smell
(c) Darkness
(d) Movements

20. The speed at which a snake normally moves is?
(a) Less than man's
(b) Greater than man's
(c) As fast as that of a man
(d) As deceptive as that of a man

PHYSICS

21. Which is more dangerous?
(a) 220 V AC
(b) 290 V DC
(c) Both produce same effect
(d) Can't say

22. The correct fromula of escape velocity is
(a) $V = \sqrt{\frac{Gm}{R}}$ (b) $V = \sqrt{\frac{2GM}{R}}$
(c) $V = \sqrt{\frac{3GM}{R}}$ (d) $V = \sqrt{\frac{GM}{2R}}$

23. What will be the same in microwave, gamma ray and x-ray?
(a) frequency (b) wavelength
(c) speed in vacuum (d) Both (a) & (b)

24. Rainbow is formd due to
(a) The dispersion of light suffering refraction and total internal reflection
(b) the reflection of light
(c) the refraction of light
(d) the scattering of light

25. Which is the semiconductor among the following?
(a) copper (b) silver
(c) silicon (d) lithium

26. The S.I unit of magnetic flux density is
(a) newton metre ampere
(b) newton metre^{-1} amprere^{-1}
(c) newton mere coulomb^{-1}
(d) newton metre coulomb

27. In a circular moton if radius is half then the force is
(a) doubled (b) one-fourth
(c) four times (d) halved

28. NOR gate is the combination of
(a) NOT and OR gate
(b) NOT and AND gate
(c) AND and NOT gate
(d) AND and OR gate

29. A one-ton car moves with a constant velocity of 15 ms^{-1} on a rough horizontal road. The total resistance to the motion of the car is 12% of the weight of the car. The power required to keep the car moving with the same constant velocity of 15ms^{-1} is [Take g = 10 ms^{-2}]
(a) 9 kW (b) 18 kW
(c) 24 kW (d) 36 kW

30. If in a parallel plate capacitor, which is connected to a battery, we fill dielectrics in whole space of its plates, then which of the following increases?
(a) Q and V (b) V and E
(c) E and C (d) Q and C

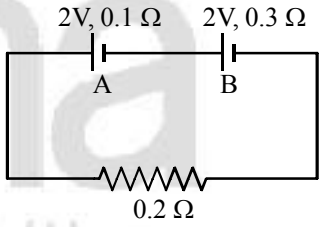
31. The decreasing order of wavelength of infrared, microwave, ultraviolet and gamma rays is
(a) microwave, infrared, ultraviolet, gamma rays
(b) gamma rays, ultraviolet, infrared, micro-waves
(c) microwaves, gamma rays, infrared, ultraviolet
(d) infrared, microwave, ultraviolet, gamma rays

32. Eddy currents are produced when
(a) a metal is kept in varying magnetic field
(b) a metal is kept in steady magnetic field
(c) a circular coil is placed in a magnetic field
(d) through a circular coil, current is passed

33. The frequency of A.C. mains in India is
(a) 30 c/s (b) 50 c/s
(c) 60 c/s (d) 120 c/s

34. Which of the following processes is adiabatic ?
(a) Melting of ice
(b) Bursting of tyre
(c) Motion of piston of an engine with constant speed
(d) None of these

35. The internal resistance of two cells shown are 0.1 Ω and 0.3 Ω. If R = 0.2 Ω, the potential difference across the cell



(a) B will be zero
(b) A will be zero
(c) A and B will be 2V
(d) A will be >2V and B will be < 2V

36. In order that a floating object be in a stable equilibrium, its centre of buoyancy should be
(a) vertically above its centre of gravity
(b) below its centre of gravity
(c) horizontally in a line with its centre of gravity
(d) may be anywhere

37. A geostationary satellite is orbiting the earth at a height of 5R above that surface of the earth, R being the radius of the earth. The time period of another satellite in hours at a height of 2R from the surface of the earth is

(a) 5 (b) 10

(c) $6\sqrt{2}$ (d) $\frac{6}{\sqrt{2}}$

38. Nucleus of an atom whose atomic mass is 24 consists of
(a) 11 electrons, 11 protons and 13 neutrons
(b) 11 electrons, 13 protons and 11 neutrons
(c) 11 protons and 13 neutrons
(d) 11 protons and 13 electrons

39. The mass of neutron is the same as that of
(a) a proton (b) a meson
(c) an epsilon (d) an electron

40. The tides in sea are primarily due to the
(a) atmospheric effect of the earth
(b) gravitational effect of venus on the earth
(c) gravitational effect of the sun on the earth
(d) gravitational effect of the moon on the earth

41. A galvanometer of resistance 100 Ω gives a full scale deflection for a current of 10^{-5} A. To convert it into a ammeter capable of measuring upto 1 A, we should connect a resistance of
(a) 1 Ω in parallel
(b) 10^{-3} Ω in parallel
(c) 10^{5} Ω in series
(d) 100 Ω in series

42. The S.I. unit of latent heat is
(a) J Kg^{-1} (b) J mol^{-1}
(c) N Kg^{-1} (d) N mol^{-1}

43. A hollow insulated conduction sphere is given a positive charge of 10 μC. What will be the electric field at the centre of the sphere if its radius is 2 metres?
(a) Zero (b) 5 μCm^{-2}
(c) 20 μCm^{-2} (d) 8 μCm^{-2}

44. The radius of the earth is 4 times that of the moon and its mass is 80 times that of the moon. If the acceleration due to gravity on the surface of the earth is 10 m/s^2, then on the surface of the moon its value will be
(a) 1 ms^{-2} (b) 2 ms^{-2}
(c) 3 ms^{-2} (d) 4 ms^{-2}

45. A step-up transformer has transformation ratio of 3 : 2. What is the voltage in secondary, if voltage in primary is 30 V?
(a) 45 V (b) 15 V
(c) 90 V (d) 300 V

MATHEMATICS

46. The incenter of the triangle with vertices $(1, \sqrt{3})$, $(0, 0)$ and $(2, 0)$ is
(a) $(1, \sqrt{3}/2)$ (b) $(2/3, 1/\sqrt{3})$
(c) $(2/3, \sqrt{3}/2)$ (d) $(1, 1/\sqrt{3})$

47. The equation of a straight line, which passes through the point (a, 0) and whose perpendicular distance from the point (2a, 2a) is a, is
(a) $3x - 4y - 3a = 0$
(b) $x - a = 0$
(c) both (a) and (b)
(d) Neither (a) nor (b)

48. The equation of the circle, the end points of whose diameter are the centres of the circles $x^2 + y^2 + 6x - 14y = 1$ and $x^2 + y^2 - 4x + 10y = 2$, is
(a) $x^2 + y^2 + x - 2y - 41 = 0$
(b) $x^2 + y^2 + x + 2y - 41 = 0$
(c) $x^2 + y^2 + x + 2y + 41 = 0$
(d) None of these

49. $f(x) = \sqrt{\frac{(x+1)(x-3)}{(x-2)}}$ is a real valued function in the domain
(a) $(-\infty, -1] \cup [3, \infty)$
(b) $(-\infty, -1] \cup (2, 3]$
(c) $[-1, 2) \cup [3, \infty]$
(d) None of these

50. The position vectors of the points A, B, C and D are $3\hat{i} - 2\hat{j} - \hat{k}$, $2\hat{i} + 3\hat{j} - 4\hat{k}$, $-\hat{i}$ $\hat{j}$ $2\hat{k}$ and $4\hat{i}$ $5\hat{j}$ $\lambda\hat{k}$. If these points are collinear, then λ is equal to
(a) $-\frac{146}{17}$ (b) $-\frac{137}{17}$
(c) $-\frac{154}{17}$ (d) $-\frac{162}{17}$

51. If the mean and variance of a binomial variate X are 2 and 1 respectively, then the probability that X takes a value at least one is :

(a) $\frac{2}{3}$ (b) $\frac{4}{5}$

(c) $\frac{7}{8}$ (d) $\frac{15}{16}$

52. There are 10 points in a plane, no three are collinear, except 4 which are collinear. All points are joined . Let L be the number of different straight lines and T be the number of different triangles, then
(a) T = 120 (b) L = 30
(c) T = 3 L – 4 (d) None of these

53. Given that tan A and tan B are the roots of $x^2 - ax + b = 0$. The value of $\sin^2(A+B)$ is
(a) $\frac{a^2}{a^2+(1-b)^2}$ (b) $\frac{a^2}{a^2+b^2}$
(c) $\frac{a^2}{(b+c)^2}$ (d) $\frac{a^2}{b^2+(1-a)^2}$

54. If 12 persons are seated in a row, the number of ways of selecting 3 persons from them, so that no two of them are seated next to each other is
(a) 85 (b) 100
(c) 120 (d) 240

55. The number of ways in which a mixed doubles game in tennis can be arranged from 5 married couples, if no husband and wife play in the same game, is
(a) 46 (b) 54
(c) 60 (d) None of these

56. Six teachers and six students have to sit round a circular table such that there is a teacher between any two students. The number of ways in which they can sit is
(a) 6 ! × 6 ! (b) 5 ! × 6 !
(c) 5 ! × 5 ! (d) None of these

57. Five digit number divisible by 3 is to be formed by using 0, 1, 2, 3, 4, 6 without repetition. Total number of such numbers are
(a) 312 (b) 3125
(c) 192 (d) 216

58. A boy is throwing stones at a target. The probability of hitting the target at any trial is $\frac{1}{2}$. The probability of hitting the target 5th time at the 10th throw is :
(a) $\frac{5}{2^{10}}$ (b) $\frac{63}{2^9}$
(c) $\frac{{}^{10}C_5}{2^{10}}$ (d) None

59. On which of the following intervals is the function $x^{100} + \sin x - 1$ decreasing?
(a) $(0, \pi/2)$
(b) $(0, 1)$
(c) $(\pi/2, \pi)$
(d) None

60. The mean and SD of 63 children on an arithmetic test are respectively 27, 6 and 7.1. To them are added a new group of 26 who had less training and whose mean is 19.2 and SD 6.2. The values of the combined group differ from the original as to (i) the mean and (ii) the SD is
(a) 25.1, 7.8 (b) 2.3, 0.8
(c) 1.5, 0.9 (d) None of these

61. The quartile deviation of the following items : 12, 7, 15, 10, 16, 17, 25 is
(a) 4.5 (b) 13.5
(c) 9 (d) 3.5

62. The mean of 20 observations is 15. On checking it was found that the two observations were wrongly copied as 3 and 6. The correct values are 8 and 4, then correct mean will be given by
(a) 15.15 (b) 14.69
(c) 14.74 (d) 15.25

63. The value of the limit $\lim_{x\to\infty}\left(\frac{x^2-1}{x^2+1}\right)^{x^2}$ equals to
(a) e^2 (b) e^{-2}
(c) e (d) e^{-1}

64. The value of $0.\overline{2} + 0.\overline{23}$ is equal to
(a) $0.\overline{43}$ (b) $0.\overline{25}$
(c) $0.\overline{223}$ (d) $0.\overline{45}$

65. If a, b, c, d are in G.P. then
(a) a + b, b + c, c + d are in G.P.
(b) $(b-c)^2 + (c-a)^2 + (d-b)^2 = (a-d)^2$
(c) $(a^2+b^2+c^2)(b^2+c^2+d^2) = (ab+bc+cd)^2$
(d) All are correct

66. The unit digit of

$2^{3^4} \times 3^{4^5} \times 4^{5^6} \times 5^{6^7} \times 6^{7^8} \times 7^{8^9}$ is :

(a) 0
(b) 5
(c) Can't be determined
(d) None of these

67. A cone, a hemisphere and a cylinder stand on equal bases and have the same height, the height being equal to the radius of the circular base. Their total surface areas are in the ratio:

(a) $(\sqrt{2}$ 1) : 3 : 4 (b) $(\sqrt{3}$ 1) : 3 : 4

(c) $\sqrt{2}$: 3 : 4 (d) $\sqrt{3}$: 7 : 8

68. Find the radius of maximum size sphere which can be inscribed or put in a cone whose base radius and height are 6 cm and 8 cm respectively?

(a) 4 cm (b) 5 cm
(c) 3 cm (d) None of these

69. In what ratio must a grocer mix two varieties of pulses costing ₹15 and ₹ 20 per kg respectively to obtain a mixture worth ₹16.50 per kg?

(a) 1 : 2 (b) 2 : 1
(c) 3 : 7 (d) 7 : 3

70. In what ratio should freely available water be mixed with the wine worth ₹ 60 per litre so that after selling the mixture at ₹ 50 per litre, the profit will be 25%?

(a) 1 : 2 (b) 2 : 3
(c) 3 : 4 (d) 4 : 5

Hints & Explanations

1. (a) Compatible means (of two things) able to exist or occur together without problems or conflict; suited means adapted for an occasion or use.
2. (c) Abrupt means sudden and unexpected while Gradual means proceeding in small stages which is antonym.
3. (b) The simplest noun form of compel (verb) is compulsion.
4. (d) Valid means legally or officially acceptable; validate (verb) means declare or make legally valid.
5. (a) The plural form of the word sheep is sheep.
6. (d) Ventriloquist means a person, especially an entertainer, who can make their voice appear to come from somewhere else, typically a dummy of a person or animal.
7. (c) Grossest means before any deductions; other correctly spelt should be genetics, Steerage and Granite.
8. (b) If someone is making song and dance, you mean they are making an unnecessary fuss about it.
9. (a) The general rule for sentences in simple past passive is: 'Object + was / were + past participle of main verb (third form)' in an affirmative sentence. 'Was / were + object + past participle of main verb (third form)' in the case of a question.
10. (a) The Helping verb of Future Simple tense will convert to 'Would' in the Indirect (reported) Speech. Tomorrow become the next day.
11. (a) Replace 'A' by 'The'. The is used before specified objects.
12. (c) Replace 'maker' by 'makers'. One of the/ Many/Most of the + Plural Noun + ….
13. (b) The idiom 'in thrall' means in a state of being controlled or strongly influenced by someone or something and it is followed by the preposition 'to'. Hence, correct sequence is 'QRP'.
14. (a) All-purpose complements with certified, verifiable; hence, the correct sequence is 'QPR'.
15. (d) **Incur:** become subject to (something unwelcome or unpleasant) as a result of one's own behavior or actions.

    Reap means cut or gather (a crop or harvest).
16. (b) Inveterate means always doing something and unlikely to stop which perfectly complements with a habit which is here smoking.
17. (d) It is mentioned in the passage that the movement of the snakes is deceptive.
18. (b) The snake has an advantage over men inside a jungle because there man's movement is obstructed
19. (d) Movements help snakes to receive advance warning with their sensitivity.
20. (c) The speed at which a snake normally moves is as fast as that of a man.
21. (a) 220 V AC means rms value, not the actual magnitude so,

    rms value of 220 V AC = 311 V

    Clearly magnitude of 220 V AC (311 V) > 290 V DC

    Hence 220 V AC is more dangerous than 290 V DC.
22. (b) Escape velocity, $V = \sqrt{\frac{2GM}{R}} = \sqrt{2gR}$
23. (c) Microwave, gamma ray and x-ray are electromagnetic wave and velocity of electromagnetic wave in vacuum

    $$c = \frac{1}{\sqrt{\varepsilon_0 \mu_0}} = 3 \times 10^8 \, m/s$$

24. (a)

25. (c) Silicon and germanium are the semiconductors whose conductivity is between the conductors like- copper, silver, lithium etc and insulators.

26. (b) Magnetic flux density $= \frac{\text{Force}}{\text{Current} \times \text{length}}$

27. (a) In circular motion, force

$$F = \frac{mv^2}{r}$$

28. (a) NOR gate is the combination of NOT & OR gate.

29. (b) $F = \frac{12}{100} \times 1000 \times 10$ N $\quad 1200$ N

$P = Fv = 1200\ \text{N} \times 15\ \text{ms}^{-1} = 18\ \text{kW}.$

30. (d) Since battery remains connected so P.D. between the plates is constant. But as we introduce the dielectric, the capacitance increases and hence charge increases.

31. (a) The decreasing order of the wavelengths is as given below :

32. (a)

33. (b) In India the frequency of A.C. current is 50 Hz.

34. (b)

35. (a) Applying Kirchhoff's second law,

$$(2+2) = (0.1+0.3+0.2)i \Rightarrow = i = \frac{20}{3} A$$

Hence potential difference across A

$$= 2 - 0.1 \times \frac{20}{3} = \frac{4}{3} V [< 2V]$$

Potential difference across B

$$= 2 - 0.3 \times \frac{20}{3} = 0$$

36. (a)

37. (c) According to Kepler's law of period $T^2 \propto R^3$

$$\frac{T_1^2}{T_2^2} \quad \frac{R_1^3}{R_2^3} \quad \frac{(6R)^3}{(3R)^3} \quad 8$$

$$\frac{24 \times 24}{T_2^2} \quad 8$$

$$T_2^2 \quad \frac{24 \times 24}{8} = 72 = 36 \times 2$$

$$T_2 \quad 6\sqrt{2}$$

38. (c) Nucleus does not contain electron.

39. (a)

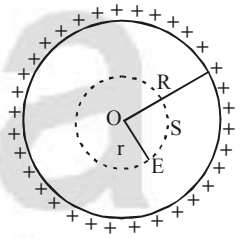
40. (d) Tides occurs due to gravitational pull of moon on the earth & they have regular character. On new moon & full moon high tides occur.

41. (b) Here, $R_g = 100\ \Omega$; $I_g = 10^{-5}$ A; I =1A; S = ?

$$S \quad \frac{I_g R_g}{I - I_g} \quad \frac{10^{-5} \times 100}{1 - 10^{-5}} \quad 10^{-3}\ \Omega \text{ in parallel}$$

42. (a) $L = \frac{Q}{m} = \frac{J}{kg} = J\,kg^{-1}$

43. (a) Charge resides on the outer surface of a conducting hollow sphere of radius R. We consider a spherical surface of radius r < R. By Gauss theorem



$\int_s \vec{E}.\vec{ds} = \frac{1}{\varepsilon_0} \times$ charge enclosed or

$$E \times 4\pi r^2 = \frac{1}{\varepsilon_0} \times 0 \Rightarrow E = 0$$

i.e electric field inside a hollow sphere is zero.

44. (b)

45. (a) Transformation ratio $k = \frac{N_S}{N_P}$

Since $\frac{V_S}{V_P} = \frac{N_S}{N_P} \quad \therefore \quad V_S = \frac{N_S}{N_P} \times V_P$

$$V_S = \frac{3}{2} \times 30 = 45V$$

46. (d) Here, $AB = BC = CA = 2$. So, it is an equilateral triangle and the incenter coincides with the centroid. Therefore, the centroid is

$$\left(\frac{0+1+2}{3}, \frac{0+0+\sqrt{3}}{3}\right) \equiv \left(1, \frac{1}{\sqrt{3}}\right)$$

47. (c) Equation of line passing through (a, 0) is $y = m(x-a)$

$\Rightarrow mx - y - ma = 0$ ....(i)

Its distance from the point (2a, 2a) is

$$\left|\frac{2am - 2a - ma}{\sqrt{m^2+1}}\right| = a \qquad \text{(given)}$$

$$\Rightarrow (m-2)^2 = (m^2+1)$$

$$\Rightarrow m^2 - 4m + 4 = m^2 + 1$$

$$\Rightarrow 0m^2 - 4m + 3 = 0 \Rightarrow m = \frac{3}{4}, \infty$$

[If a = 0 then one root of $ax^2 + bx + c = 0$ is infinite]

This result must be taken into care otherwise one root will be lost.

The required equation of lines are, from (i)

$3x - 4y - 3a = 0$ and $x - a = 0$.

48. (a) Since centred of circle $x^2 + y^2 + 6x + 14y = 1$ is (–3, 7) and cenre of circle $x^2 + y^2 + 4x + 10y$ is (2, –5)

$$\therefore \text{centred required circle} = \left(\frac{-3+2}{2}, \frac{7-5}{2}\right)$$

$$= \left(-\frac{1}{2}, 1\right)$$

$$\text{Radius} = \frac{1}{2}\sqrt{(2+3)^2 + (7+5)^2}$$

$$= \frac{1}{2}\sqrt{25+144} = \frac{13}{2}$$

Equation of circle is

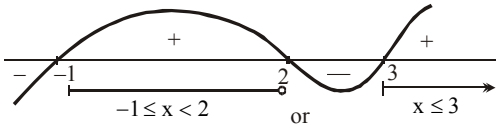
$$\left(x + \frac{1}{2}\right)^2 + (y-1)^2 = \left(\frac{13}{2}\right)^2$$

$$\Rightarrow x^2 + y^2 + x - 2y - 41 = 0$$

49. (c) $\sqrt{\{g(x)\}}$ is real if $g(x) \geq 0$

or $\frac{(x+1)(x-3)}{(x-2)} \geq 0$ or $\frac{(x+1)(x-2)(x-3)}{(x-2)^2} \geq 0$

or $[x-(-1)](x-2)(x-3) \geq 0,\ x \neq 2$



Domain = $[-1\ \ 2) \cup [3\ \infty)$

50. (a) Given position vectors of points A, B, C and D are

$3\hat{i} - 2\hat{j} - \hat{k}, 2\hat{i} + 3\hat{j} - 4\hat{k},$

$-\hat{i}\quad \hat{j}\quad 2\hat{k}$ and $4\hat{i}\quad 5\hat{j}\quad \lambda\hat{k}$ respectively.

$\therefore$ points are A(3, –2, –1), B(2, 3, –4),

C (–1, 1, 2) and D (4, 5, λ).

These are collinear if

$$\begin{vmatrix} (2-3) & [3-(-2)] & -4-(-1) \\ -1-3 & 1+2 & 2+1 \\ 4-3 & 5-(-2) & \lambda-(-1) \end{vmatrix} = 0$$

$$\Rightarrow \begin{vmatrix} -1 & 5 & -3 \\ -4 & 3 & 3 \\ 1 & 7 & \lambda+1 \end{vmatrix} = 0 \Rightarrow \lambda = \frac{-146}{17}$$

51. (d) We have mean = np = 2

Variance = npq = 1 $\Rightarrow q = \frac{1}{2}$ and $p = \frac{1}{2}$

According to given, $n.\frac{1}{2} = 2 \Rightarrow n = 4$

Thus, $P(X \geq 1) = 1 - P(X = 0)$

$$= 1 - {}^4C_0\left(\frac{1}{2}\right)^4 = 1 - \frac{1}{16} = \frac{15}{16}$$

52. (c) $L = {}^{10}C_2 - {}^4C_2 + 1 = 45 - 6 + 1 = 40$

$T = {}^{10}C_3 - {}^4C_3 = 120 - 4 = 3L - 4$

53. (a) Here, $\tan A + \tan B = a$, $\tan A \tan B = b$

Now,

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

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

[where $t = \tan(A+B)$]

and $t = \tan(A+B) = \frac{\tan A + \tan B}{1 - \tan A \ \tan B} = \frac{a}{1-b}$

$$\sin^2(A+B) = \frac{2 \cdot a^2/(1-b)^2}{2[1+a^2/(1-b)^2]}$$

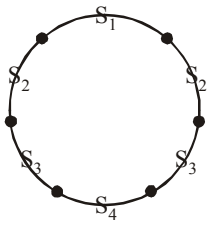
$$= \frac{a^2}{a^2+(1-b)^2} \quad \left[\text{Using } \cos 2\theta = \frac{1-\tan^2\theta}{1+\tan^2\theta}\right]$$

54. (c) The number of ways of selecting 3 persons from 12 person under the given conditon :
= Number of ways of arranging 3 person among 9 people seated in a row, so that no two of them are consecutive
= Number of ways of choosing 3 places out of the 10 [8 in between and 2 extremes]

$$= {}^{10}C_3 = \frac{10\times9\times8}{3\times2\times1} = 5\times3\times8 = 120$$

55. (c) Let the sides of the game be A and B. Given 5 married couples, i.e., 5 husbands and 5 wives.
Now, 2 husbands for two sides A and B can be selected out of $5 = {}^5C_2 = 10$ ways.
After choosing the two husbands their wives are to be excluded (since no husband and wife play in the same game). So we have to choose 2 wives out of remaining $5-2=3$ wives i.e., ${}^3C_2 = 3$ ways.
Again two wives can interchange their sides A and B in $2! = 2$ ways.
By the principle of multiplication, the required number of ways $= 10 \times 3 \times 2 = 60$

56. (b)



Six students $S_1, S_2, \ldots\ldots, S_6$ can be arranged round a circular table in 5 ! ways. Among these 6 students there are six vactant places, shown by dots (•) in which six teachers can sit in 6 ! ways.
Hence, number of arrangement = 5 ! × 6 !

57. (c) ∵ sum of given 6 digits
$= 0+1+2+3+4+6 = 16$
and we have to use 5 digits out of given six digits i.e. 1 digits is not to be used and that is either 1 or 4 (Because a number is divisible by 3 if sum of its digits is divisible by 3.)

Case-1	**Case-2**
$\boxed{1}\times$	$\boxed{4}\times$
0, 2, 3, 4, 6	0, 1, 2, 3, 4
×, ×, ×, ×, ×	×, ×, ×, ×, ×
$4\times4\times3\times2\times1=96$	$4\times4\times3\times2\times1=96$

Total = 96 + 96 = 192

58. (b) The probability of hitting the target 5th time at the 10th throw = P(the probability of hitting the target 4 times in the first 9 throws) × (the probability of hitting the target at the 10th throw)

$$= \left[{}^9C_4\left(\frac{1}{2}\right)^4\left(\frac{1}{2}\right)^5\right]\left(\frac{1}{2}\right) = \frac{9!}{4!5!}\times\left(\frac{1}{2}\right)^{10} = \frac{63}{2^9}$$

59. (d)

$f(x) = x^{100} + \sin x - 1 \Rightarrow f'(x) = 100x^{99} + \cos x.$

If $0 < x < \pi/2$, then $f'(x) > 0$,

therefore f(x) is increasing on $(0, \pi/2)$.

If $0 < x < 1$, then $100x^{99} > 0$ and $\cos x > 0$

[∵ x lies between 0 and 1 radian]

$\Rightarrow f'(x) = 100x^{99} + \cos x > 0$

$\Rightarrow$ f(x) is increasing on (0, 1).

If $\pi/2 < x < \pi$, then $100\,x^{99} > 100$

[∵ $x > 1, \therefore x^{99} > 1$]

$\Rightarrow 100x^{99} + \cos x > 0$

[∵ $\cos x \geq -1, \ \therefore 100x^{99} + \cos x > 99$]

$\Rightarrow f'(x) > 0 \Rightarrow$ f(x) is increasing on $(\pi/2, \pi)$.

60. (a) Mean and SD σ of the combined group are

$$m = \frac{63\times27.6 + 26\times19.2}{63+26} = 25.1$$

Thus, AM is decreased by $27.6 - 25.1 = 2.5$.

$$\sigma^2 = \frac{63\times(7.1)^2 + 26\times(6.2)^2}{89} + \frac{63(25.1-27.6)^2 + 26(25.1-19.2)^2}{89}$$

$\Rightarrow \sigma = 7.8$ (approx.)

61. (d) The given data in ascending order of magnitude is
7, 10, 12, 15, 16, 17, 25
Here, lower quartile $Q_1 = 10$,
median = 15 and upper quartile $Q_3 = 17$

$$\therefore \text{Q.D.} = \frac{Q_3 - Q_1}{2} = \frac{17-10}{2} = 3.5$$

62. (a) Correct mean

$$= \frac{300 - (3+6) + (8+4)}{20} = 15.15.$$

63. (b)

$$\lim_{x\to\infty}\left(\frac{x^2+1-2}{x^2+1}\right)^{x^2} = \lim_{x\to\infty}\left(1+\frac{-2}{x^2+1}\right)^{x^2}$$

$$= \lim_{x\to\infty}\left[1+\frac{-2}{x^2+1}\right]^{\frac{x^2+1}{-2}\cdot\frac{-2x^2}{x^2+1}} = e^{-2}$$

64. (d) $0.\overline{2} + 0.\overline{23} = \frac{2}{9} + \frac{23}{99}$

$$= \frac{22+23}{99} = \frac{45}{99} = 0.\overline{45}$$

65. (d) We have $\frac{b}{a} = \frac{c}{b} = \frac{d}{c} = r$

$b = ar$, $c = br = ar^2$, $d = cr = br^2 = ar^3$

Now, $\frac{b+c}{a+b} = \frac{ar+ar^2}{a+ar} = r$ and

$$\frac{c+d}{b+c} = \frac{br+cr^2}{b+c} = r$$

$\therefore a+b, b+c, c+d$ are in G.P.

Again $(b-c)^2 + (c-a)^2 + (d-b)^2$

$$= (ar-ar^2)^2 + (ar^2-a)^2 + (ar^3-ar)^2$$

$$= a^2r^2(1-r)^2 + a^2(1-r^2)^2 + a^2r^2(1-r^2)^2$$

$$= a^2(1-r)^2[r^2 + (1+r)^2 + r^2(1+r)^2]$$

$$= a^2(1-r)^2[r^2 + (1+r)^2(1+r)^2]$$

$$= a^2(1-r)^2\left[r^2 + (1+r^2)^2 + 2r(1+r^2)\right]$$

$$= a^2(1-r)^2(r+1+r^2)^2$$

$$= a^2(1-r^3)^2 = (a-ar^3)^2 = (a-d)^2$$

Further, $(a^2+b^2+c^2)(b^2+c^2+d^2)$

$$= (a^2 + a^2r^2 + a^2r^4)(a^2r^2 + a^2r^4 + a^2r^6)$$

$$= a^4r^2(1+r^2+r^4)(1+r^2+r^4)$$

$$= \left[a^2r(1+r^2+r^4\right]^2$$

$$= (a.ar + ar.ar^2 + ar^2.ar^3)^2 = (ab+bc+cd)^2$$

66. (a) $(\text{Even number})\times 5 \longrightarrow$ unit digit 0.

$(\text{Odd number})\times 5 \longrightarrow$ unit digit 5.

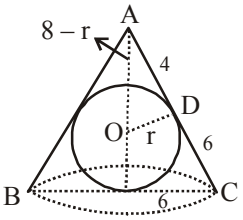
Here, 2^{3^4}, 4^{5^6} and 6^{7^8} are even terms and 5^{6^7} is an odd multiple of 5. Hence the unit digit of the expression will be zero.

67. (a) $\pi r(r+l) : 3\pi r^2 : 2\pi r(r+h)$

$= \pi\times 1\ (1\quad \sqrt{2}) : 3\times\pi\times 1 : 2\times\pi\times 1\ (1+1)$

$= (\sqrt{2}\quad 1) : 3 : 4$

68. (c)



AC $\sqrt{6^2\quad 8^2} \Rightarrow l = 10$

In ΔODA, $AO^2 = OD^2 + AD^2$

$\Rightarrow \quad (8-r)^2 = r^2 + 4^2$

$\Rightarrow \quad 64 + r^2 - 16r = r^2 + 16$

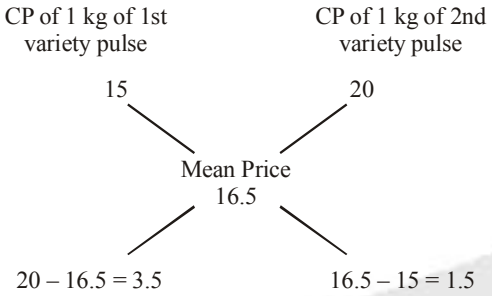
$\Rightarrow \quad 16r = 48 \Rightarrow r = 3$ cm

Alternate: –

Radius of maximum size sphere

$$= \frac{hr}{l+r} = \frac{8 \times 6}{10+6} = 3 \text{ cm}$$

69. (d) By rule of alligation,



Required ratio = 3.5 : 1.5 = 35 : 15 = 7 : 3

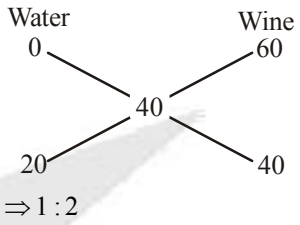
70. (a) Selling price = ₹ 50

Therefore, the cost price

= ₹ 40, which is the average price.

It means the wine, worth ₹ 60 becomes worth ₹ 40 when the water was mixed in it. So we can conclude that in the mixture of ₹ 60, there is wine worth ₹ 40 and the rest is water. Therefore, the ratio of water and wine is 20 : 40 i.e., 1 : 2 :

Alternatively :



$\Rightarrow 1 : 2$