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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION

Paper Code: UN436

Solutions for Class : 10

MATHEMATICS

1. **(C)** LCM × HCF = a × b.

LCM × 12 = 1800

LCM = 150.

2. **(A)** Height of cone = 15.5 – 3.5 = 12 cm

$l = \sqrt{h^2 + r^2}$

$= \sqrt{(3.5)^2 + (12)^2}$ = 12.5 cm.

C.S.A. = $\pi r l$ = 137.5 sq cm.

C.S.A. of hemisphere = $2\pi r^2$

= 77 sq cm.

$\therefore$ Total area of the top = 214.5 sq cm.

3. **(B)** n(P) = 20 n(M) = 17 $n(P \cap M) = 5$

$n(P \cup M) = n(P) + n(M) - n(P \cap M)$

$n(P \cup M) = 32$

Total = 32 + 10 = 42

4. **(D)** $BD = \frac{1}{3}CD$ (Given)

$\Rightarrow BD = \frac{1}{4}BC = \frac{1}{4}a$ and

$CD = \frac{3}{4}a$

$AD^2 = AB^2 - BD^2 = c^2 - \frac{1}{16}a^2$ ..... (1)

$AD^2 = AC^2 - CD^2 = b^2 - \frac{9}{16}a^2$ ..... (2)

$\therefore\ c^2 - \frac{1}{16}a^2 = b^2 - \frac{9}{16}a^2$

[From (1) and (2).]

$\Rightarrow 16c^2 - a^2 = 16b^2 - 9a^2$

$\Rightarrow 16b^2 = 16c^2 + 8a^2$

$\Rightarrow 2b^2 = a^2 + 2c^2$

5. **(B)** $\alpha + \beta = \frac{-b}{a}$ & $\alpha\beta = \frac{b}{a}$

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

$$= \frac{\left(\frac{-b}{a}\right)}{\sqrt{\frac{b}{a}}} + \sqrt{\frac{b}{a}} = -\sqrt{\frac{b}{a}} + \sqrt{\frac{b}{a}} = 0$$

6. **(C)** The circumference of the circle,

$C = 2\pi r \Rightarrow r = \frac{C}{2\pi}$

Area of the circle,

$A = \pi r^2 = \pi \times \left(\frac{C}{2\pi}\right)^2 = \frac{C^2}{4\pi}$

Given the circumference of the circle is increased by 50%

$\Rightarrow$ increased circumference,

$\Rightarrow C_1 = C + \frac{50C}{100}$

$\Rightarrow C_1 = C + \frac{1}{2}C = \frac{3}{2}C$

$A = \frac{\left(\frac{3}{2}C\right)^2}{4\pi} = \frac{\left(\frac{3}{2}\right)^2 C^2}{4\pi}$

$= \left(\frac{3}{2}\right)^2 \frac{C^2}{4\pi} = \frac{9}{4}A$

$\therefore$ Percentage increase in area

$= \frac{\left(\frac{9}{4}A - A\right)}{A} \times 100\%$

$= \frac{5A}{4A} \times 100\% = 125\%$

$\therefore$ Area of the circle increases by 125%.

7. **(C)** Given ABC is an equilateral triangle $\Rightarrow \angle B = \angle BAC = \angle ACB = 60^\circ$

$\Rightarrow \angle ACD = 180^\circ - 60^\circ = 120^\circ$

Given 'C' is mid point of BD $\Rightarrow$ BC = CD

But AC = BC $\Rightarrow$ AC = CD

In ΔACD, AC = CD & $\angle ACD = 120^\circ$

$\Rightarrow \angle CAD = \angle D = 30^\circ$

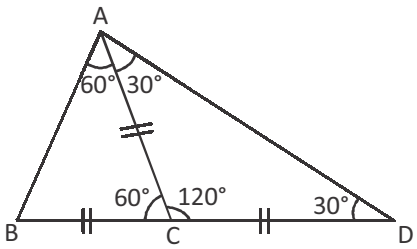
$\therefore \angle BAD = \angle BAC = \angle CAD = 60^\circ + 30^\circ$

$= 90^\circ$

In ΔBAD, $\angle BAD = 90^\circ$

$BD^2 = AB^2 + AD^2$

$= AC^2 + AD^2$ $(\because AB = AC)$



8. **(B)** Let original length & breadth be l & b

Given $(l + 2)(b - 2) = lb - 28$

$lb - 2l + 2b - 4 = lb - 28$

$l - b = 12 \quad \rightarrow \quad (1)$

Given $(l - 1)(b + 2) = lb + 33$

$lb - 2l - b - 2 = lb + 33$

$2l - b = 35 \quad \rightarrow \quad (2)$

Solving (1) & (2)

$l = 23$

$b = 11$

9. **(B)** 102, 108, 114, ... 996 are the three digit numbers which are divisible by 6.

$a = 102$

$d = 108 - 102 = 6$ and

$a_n = 996$

$996 = 102 + (n-1)\,d$

$996 - 102 = (n-1)(6)$

$894 = (n-1)\,6$

$n - 1 = 149$

$n = 150$

10. **(A)** The perpendicular from A to BC bisects BC at D.

$\therefore$ The length of

$AD = \sqrt{AB^2 - BD^2} = \sqrt{6^2 - (2.5)^2}$

$= \sqrt{36 - 6.25}$

$= \sqrt{29.75} = 5.45$

11. **(B)** Base side of triangle part = 6cm – 3cm = 3cm.

Height of triangle part = 5cm – 2cm = 3cm

Volume of the solide = volume of cuboid + volume of triangular prism

$= 6 \times 4 \times 2\ cm3 + \frac{1}{2} \times 3 \times 3 \times 4\ cm^3$

$= 48\ cm^3 + 18\ cm^3$

$= 66\ cm^3$

12. **(D)** Given equation is $x^2 + kx + 12 = 0$.

$\alpha + \beta = \frac{-b}{a} = -k$ and $\alpha\beta = 12$

$\alpha - \beta = 1$ (Given)

$\Rightarrow \alpha = 1 + \beta$

$\alpha\beta = (1+\beta)\beta = 12$

$\Rightarrow \beta^2 + \beta - 12 = 0$

$\Rightarrow (\beta + 4)(\beta - 3) = 0$

$\Rightarrow \beta = 3, -4$

If $\beta = 3, \alpha = 4$

$\beta = -4, \alpha = -3$

$\alpha + \beta = 7$ or $-7 = k$

13. **(B)** Given $\log_2 (5 \times 2^x + 1)$, $\log_4 (2^{1-x} + 1)$, 1 are in AP.

$\therefore \quad 2\log_4(2^{1-x} + 1) = \log_2 (5 \times 2^x + 1) + 1$

$2\log_{2^2}(2^{1-x} + 1) = \log_2(5 \times 2^x + 1 + \log_2 2$

$\frac{2}{2}\log_2 (2^{1-x} + 1) = \log_2 (5 \times 2^x + 1)(2)$

$2^{1-x} + 1 = 10 \times 2^x + 2$

$\frac{2}{2^x} = 10 \times 2^x + 1$

Let $2^x = a \Rightarrow \frac{2}{a} = 10a + 1$

$\Rightarrow 10a^2 + a - 2 = 0$

$\Rightarrow 10a^2 + 5a - 4a - 2 = 0$

$\Rightarrow 5a(2a+1) - 2(2a+1) = 0$

$(2a+1)(5a-2) = 0$

$2a + 1 = 0$

$2a = -1$ & 1

$a = \frac{-1}{2}$ (OR) $a = \frac{2}{5}$

$2^x = \frac{2}{5}$

$\Rightarrow x = \log_2\left(\frac{2}{5}\right)$

$= \log_{2^2} - \log_{2^5}$

$= 1 - \log_{2^5}$

14. **(D)** Distance from origin for $\left(\frac{13}{2}, 0\right)$

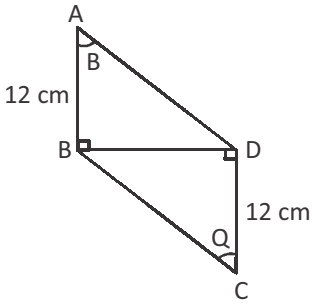
$= \sqrt{\left(\frac{13}{2}\right)^2 - 0^2} = \frac{13}{2}$

Distance from origin to $\left(-6, \frac{5}{2}\right)$

$= \sqrt{\frac{25}{4} + 36} = \frac{13}{2}$

$\therefore$ The point in option (D) lies on the circle.

15. **(D)**



Given $\tan \tan\beta = \frac{3}{4}$

In $\Delta ABD \tan\beta = \frac{BD}{AB} = \frac{BD}{12\text{ cm}}$

$\therefore \frac{BD}{12\text{ cm}} = \frac{3}{4} \Rightarrow BD = 9\text{ cm}$

In ΔBCD ; $\angle BDC = 90 \Rightarrow CD^2 = BC^2 - BD^2$

$CD = 12$ cm

$\cos\theta = \frac{CD}{BC} = \frac{12\text{ cm}}{15\text{ cm}} = \frac{4}{5}$

16. **(B)**

$$\begin{array}{r} 2-x^2 \overline{)x^4 - 5x + 6} (-x^2 - 2 \\ x^4 - 2x^2 \\ \hline + 2x^2 - 5x + 6 \\ 2x^2 \quad -4 \\ \hline -5x + 10 \end{array}$$

$-5x + 10 = px + q$

$\Rightarrow p = -5$ and $q = 10$

17. **(C)** $4x + 3y = 1$

$4x + 3(x + 5) = 1$

$4x + 3x + 15 = 1$

$7x = -14$

$x = -2$

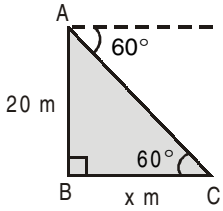
$y = 3$

$b(-2) + 5(3) = 3$

$-2b = -12$

$b = 6$

18. **(D)** Let AB be the tower and BC be the distance of the car from the tower.

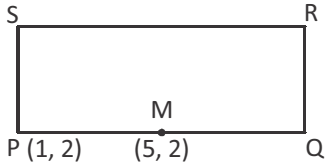


$\therefore \tan 60° = \frac{20}{x}$

$\Rightarrow x = \frac{20}{\tan 60°} = \frac{20}{\sqrt{3}} = 11.54$

$\cong 12$ m

19. **(A)** 'M' is midpoint of PQ is Q = (9, 2) [$\therefore$ PM = 4 Units] 'R' os 4 units away from 'Q' in the vertical line $\therefore$ R = (9, 6)



20. **(D)** The sequence is an arithmetic progression.

Common difference,

$d = y - 8$ or $d = 18 - y$.

$\therefore y - 8 = 18 - y$

$\Rightarrow y + y = 18 + 8 = 26$

$\Rightarrow y = \frac{26}{2} = 13$

21. **(B)** Let Rs 5 notes be 'x' Rs 10 notes be 'y'

$x + y = 7$; $\quad 5x + 10y = 40$

$x + 2y = 8$

22. **(D)** Given a, b, c are in AP.

$2b = a+c$

$b-a = c-b \Rightarrow a^{b-a} = a^{c-b}$

$$\frac{(ab)}{(a^a)} = \frac{a^c}{(a^b)}$$

$(ab)2 = aa \times ac$

$\therefore$ a^a, a^b, a^c are in GP.

23. **(D)** A rational number is a non- derminating decimal if the denominator is not of the form $2^m \times 5^n$, where 'm' and 'n' are non-negative integers.

$1600 = 2^6 \times 5^2$

So, $\frac{24}{1600}$ is a terminating decimal.

$800 = 2^5 \times 5^2$

So, $\frac{171}{800}$ is a terminating decimal.

$2^2 \times 5^3$ is clearly of the form $2^m \times 5^n$. So,

$\frac{123}{2^2 \times 5^3}$ is a terminating decimal.

In $\frac{145}{2^3 \times 5^2 \times 7^2}$, the denominator has 7^2.

So, $\frac{145}{2^3 \times 5^2 \times 7^2}$ is a non-terminating repeating decimal.

24. **(D)** from 'C' CD & CP are the tangents drawn to the circel.

$\therefore$ $\quad CD = CP$

Similary PB = BE

$2AE = AE + AD$

$= AB + BE + CD + AC$

$= AB + BP + PC + AC$

$2AE = AB + BC + CA$

25 **(B)** $\frac{1}{2^{\log_{\left(\frac{1}{2}\right)} 2017}} = \frac{1}{2^{\log_{(2^{-1})} 2017}}$

$= \frac{1}{2^{-1\log_2 2017}}$

$= 2^{\log_2 2017} = 2017$

PHYSICS

26. **(A)** Solar constant is the amount of solar energy received per second per square metre area of the near earth space perpendicular to the rays of the sun.

27. **(D)** Resistivity, $\rho = \frac{R \times A}{l}$

Here, Resistance, $R = 4.5 \times 10^{-2}\ \Omega$

Area of cross-section, $A = 1.7 \times 10^{-6}\ m^2$

And, Length, $l = 4.5$ m

$$\rho = \frac{4.5 \times 10^{-2} \times 1.7 \times 10^{-6}}{4.5}$$

$= 1.7 \times 10^{-8}\ \Omega$ m

Thus, the resistivity of copper is 1.7×10^{-8} ohm-metre.

28. **(B)** The direction of motion of proton is the direction of the current. According to Fleming's left-hand rule, the force on the proton will be upwards.

29. **(D)** Vacuum is optically a rarer medium as compared to water and glass. Velocity of light in rarer medium is more than in denser medium. Hence $V_c > V_w$ but $V_w < V_g$.

30. **(A)** Power of lamp = 40 W = 0.04 kW

Duration of operation = 30 min = 0.5 h

Energy used = Pt = 0.04 kW × 0.5 h = 0.02 kWh

31. **(B)** When white light passes through a dispersive medium it breaks up into various colours because velocity of light for different colours is different as they differ in wavelength. Secondly, velocity of light for violet is less than the velocity of light for red.

32. **(B)** By using the lens equation, $\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$

$$\frac{1}{20} + \frac{1}{30} = \frac{1}{f} \Rightarrow \frac{1}{f} = \frac{1}{20} + \frac{1}{30}$$

$$\Rightarrow \frac{1}{f} = \frac{3+2}{60} = \frac{5}{60} \Rightarrow f = 12\,cm$$

33. **(D)** Coke has 98% of carbon.

34. **(B)** When the temperature of a pure metallic conductor is increased, the resistance of the conductor also increases.

35. **(D)** Options (A), (B) and (C) increase the strength of the magnetic field of a current carrying circular coil.

36. **(A)** The focal length of the required concave lens is 60 cm.

$$\text{Power } P = \frac{1}{f} = \frac{1}{-0.6} = -1.66 \text{ D.}$$

37. **(D)** A nuclear fuel should have fissionable nucleus but titanium is not a fissionable element. It is a stable element.

38. **(D)** All the statements are true.

39. **(D)** Focal length f is 15 cm.

Object distance u is 10 cm.

As u < f, the image formed will be virtual, upright and enlarged.

40. **(D)** Given ten 1Ω resistors.

If all these resistors are connected in series a maximum value of resistance is obtained then $R_{eq} = 10(1\Omega) = 10\Omega$

41. **(B)** The least wind speed necessary for generating electricity is about 15 kmh^{-1}.

42. **(A)** The light coming from the object, enters our eye through the cornea (X). The lens (Y) lies behind the pupil (Y). X is cornea and Y is lens.

43. **(B)** Maximum force is experienced by a conductor when it is placed perpendicular to a magnetic field.

44. **(D)** $n_i \sin i = n_r \sin r$

$(1.3) \sin 60^\circ = (1.5) \sin (r)$

$\sin r = 0.751$

$r = 48.6^\circ$

45. **(B)** $P = VI$

$$I = \frac{P}{V} = \frac{10 \times 100}{240} = 4.16 \text{ A}$$

Hence, a fuse of 5 A is suitable for this circuit.

46. **(C)** l = 625 mm = 0.625 m ; R = 4 W
$\rho = 4.8 \times 10^{-7}$ ohm metre ; A = ?

$$R = \rho\frac{l}{A} \Rightarrow A = \rho\frac{l}{R}$$

$$A = \frac{4.8 \times 10^{-7} \times 0.625}{4} = 0.75 \times 10^{-7}$$

Area of cross section is 0.75×10^{-7} m^2

47. **(A)** When a parallel beam of light rays fall on a plane mirror, it neither converges or diverges as its focal length is said to be infinite or at infinity. It means that it is limitless.

48. **(A)** The power of accommodation of the normal eye is 4 D. i.e.,

$P = \frac{1}{0.25} = 4$ D as least distance of distinct vision is 25 cm.

49. **(C)** The centre portion of a bar magnet has a very weak magnetic strength. When a steel bar is placed on it as shown in figure 2, there is almost no attractive force.

When a bar magnet's pole is placed at the centre of a steel bar, the steel bar will induce magnetism, resulting in a strong attraction between the objects.

50. **(C)** Voltage across wire XY

$$= \frac{\text{resistance of XY}}{\text{total resistance}} \times \text{e.m.f}$$

Voltage across wire XY

$$= \frac{10\ \Omega}{12\ \Omega} \times 12\text{ V} = 10\text{ V}$$

Voltage across wire XZ

$$= \frac{\text{length XZ}}{\text{length XY}} \times \text{voltage across XY}$$

$$= \frac{1.5}{2.0} \times 10\text{ V} = 7.5\text{ V}$$

CHEMISTRY

51. **(D)** An unbalanced chemical equation has an unequal number of atoms of one or more elements in the reactants and products.

52. **(D)** 1 mole of acetic acid reacts with 1 mole of ethyl alcohol to form 1 mole of ester.

53. **(C)** Cu_2S on roasting in air forms copper oxide and sulphur dioxide gas escapes out. Roasting copper oxide and left over Cu_2S in the absence of air forms copper metal and SO_2 gas is evolved.

54. **(D)** Lead, copper and iron are less reactive than zinc. Aluminium is more reactive than zinc and can displace zinc from zinc sulfate solution.

55. **(B)** Plaster of Paris is used in all the given applications.

56. **(D)** (i) The given properties belong to alkali metals. They are lithium, sodium and potassium.

(ii) Sodium and potassium are soft metals and they can be cut with a knife.

(iii) They catch fire and start burning when exposed to air. So, they are stored under kerosene oil

(iv) Sodium oxide and potassium oxide dissolve in water to form alkalis.

57. **(D)** Combustion of ethanol :

$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ (Water is a product)

Manufacture of ethanol:

$C_2H_4(g) + H_2O(g) \rightarrow C_2H_5OH(l)$ (Water is a reactant)

Oxidation of ethanol:

$C_2H_5OH + 2[O] \rightarrow CH_3COOH + H_2O$ (Water is a product)

58. **(C)** Iodine is the only non-metal that has a metallic lustre.

59. **(D)** All the given properties belong to hydrogen chloride.

60. **(D)** Elements like calcium, strontium and barium form a triad based on the given characteristics.

61. **(A)** After complete combustion of methane, CO_2 and H_2O are formed. However, when the combustion is incomplete, C (soot) and CO are also formed.

62. **(D)** Water of crystallisation forms a part of crystal structure. They also obtain their shape and colour.

63. **(A)** Aluminium metal is extracted by the electrolytic reduction (or electrolysis) of molten aluminium oxide. When electric current is passed through molten aluminium oxide, it decomposes to form aluminium metal and oxygen gas:

The positively charged aluminium ions (Al^{3+}) are attracted to the cathode (negative electrode). The aluminium ions accept electrons from the cathode and get reduced to form aluminium atoms (or aluminium metal)

Aluminium metal is formed at the cathode.

The negatively charged oxide ions (O^{2-}) are attracted to the anode (positive electrode). The oxide ions give electrons to the anode and get oxidised to form oxygen gas.

Oxygen gas is produced at the anode.

64. **(A)** A precipitation reaction to form an insoluble barium sulphate is not a redox reaction. There is no change in the oxidation states of barium, sulphur and oxygen.

65. **(C)** **S**oaps are the sodium salts of fatty acids with the ionic group [$-COO^-Na^+$].

66. **(C)** The correct matching is
a-3, b-5, c-2, d-1, e-4

Dobereiner – Law of triads

Mendeleev – Periodic table

Neils Bohr - Long form of periodic table

Linus Pauling - Electro- negativity scale

Newland-Law of octaves

67. **(B)** In a double displacement reaction, two compounds react and exchange their negative ions to form two new compounds.

68. **(A)** Both mercury and copper can be extracted just by heating their sulphide ores in air. The oxides obtained are further heated to get pure metals.

69. **(A)** In aqueous solution, CH_3COONa will dissociate into its constituent ions as

$CH_3COONa \rightarrow CH_3COO^- + Na^+$

Na+ being the cation of a strong base remains dissociated in aqueous solution while CH_3COO^- being a anion of a weak acid gains proton from water to form hydroxide ions in solution as given below:

$CH_3COO^- + H_2O \rightarrow CH_3COOH + OH^-$

Solution will be basic due to the presence of OH^- ions. Therefore, pH will be greater than 7.

70. **(B)** When ZnO reacts with NaOH (a strong base), sodium zincate and water are formed.

BIOLOGY

71. **(B)** Blood pressure is measured on the left arm above the elbow as the heart is at the same level. Because it is at approximately the same height as the least.

72. **(C)** The cell that is observed is of yeast. It is a single celled microorganism. It reproduces by budding and the buds have the same identical genetic material.

73. **(D)** The direction of arrow S is wrong. Heart pumps oxygenated blood to all parts of the body and receives carbon dioxide from all parts of the body.

74. **(B)** The pollen grain germinates on the stigma of style and develops pollen tube. The pollen tube grows down through the style. The pollen tube reaches the ovary and the male gamete move into the ovule to fuse with the egg.

75. **(D)** Placenta enables the fetus to take oxygen and nutritients and secrete progesterone and oestrogen Ammoniotic acid acts as shock absorber

76. **(A)** A plant is not hunted and killed by another for food. Prey is an animal hunted or caught for food. It is defenseless, especially in the face of attack.

77. **(B)** In the given equation X is carbon dioxide and Y is oxygen.

78. **(D)** In the given flow chart X-represents testes, Y-Ovum and Z-fertilization.

79. **(D)** In the given flow chart P is a green plant i.e., a producer and Q is a decomposer, it recycles mineral nutrients.

80. **(B)** Organs which have same basic structure but different functions are called homologous organs, forelimb of a man and wing of a bird.

81. **(C)** A food chain always start with the producer.

82. **(A)** 'R' represents Medulla oblongata. Medulla oblongata controls heart beating, respiration swallowing, coughing and sneezing.

83. **(C)** The digested food in the small intestine passes through the walls of the small intestine and blood vessels to get into the bloodstream. The blood in the blood vessels carries the digested food to different parts of the body.

84. **(C)** Person with blood group B can donate blood to B and AB blood group.

85. **(A)** X - Antipodal cells, Y - Polar nuclei and Z - Synergids.

86. **(C)** When proteins are consumed, they will be digested into amino acids and absorbed into the bloodstream. The excess amino acids would be deaminated by the liver to produce urea. This urea would then be excreted by the kidneys in the urine.

87. **(D)** In the given figure X is cerebrum, the functions of cerebrum are processes and integrates information. Y is cerebellum controls body posture and equilibrium and Z is medulla oblongata controls breathing.

88. **(C)** Fertilisation takes place in fallopian tube. Due to tubal ligation sperms cannot fertilise ovum.

89. **(A)** In the given figure part labelled P is called ovary. Ovary produces ovules.

90. **(A)** Crude oil extracted from the seas

GENERAL AWARENESS

91. **(C)** 92. **(D)** 93. **(B)**

94. **(C)** 95. **(B)** 96. **(B)**

97. **(A)** 98. **(B)** 99. **(A)** 100. **(D)**