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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION - 2013

SOLUTIONS FOR CLASS : 10

Mathematics

1. (A) Mid pt. of AB = (0, 2) ; length of median to AB $=\sqrt{26}$

Mid pt. of BC = (3, 1) ; length of median to BC = $2\sqrt{5}$

Mid pt. of AC = (2, 2); length of median to AC = $\sqrt{2}$

Hence, option (A) is not the length of median.

2. (A) The denominator in option (A) can be expressed in the form of $2^n \times 5^m$ i.e.,

$$\frac{231}{2^2 \times 5^2 \times 7} = \frac{33}{2^2 \times 5^2}$$

Hence, the rational number in option (A) is a terminating decimal.

3. (D) Let the present age of man be x years.

According to the problem, $x + 6 = 3(y + 6)$ and $x - 3 = 9(y - 3)$

$\Rightarrow x + 6 = 3y + 18$ and $x - 3 = 9y - 27$

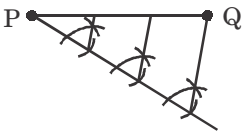
$\Rightarrow x - 3y = 12$ and $x - 9y = -24$

Solving the two equations, we get

$y = 6 \Rightarrow x = 30$

4. (C) $3 + 6 + 4 = 13$

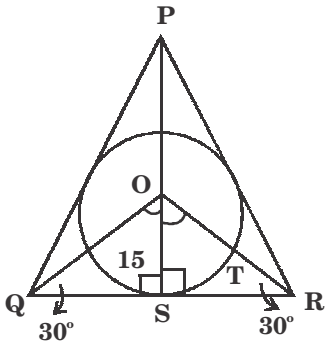
5. (C)



6. (B) $x^2 + (x - 7)^2 = 13^2$

(Since in a right Δ, (base)^2 + (altitude)^2 = (hypotenuse)^2]

7. (B)



PQ = QR = QP

i.e., ΔPQR is equilateral.

ΔOSR is half of ΔPQR

Hence OR = 2OS = 2(15) = 30

But, PO = OR

$\therefore$ Height of cone = PO + OS = 30 + 15 = 45 cm.

8. (D) $\frac{n}{2}\left[2(120^\circ) + (n-1)5\right] = (2n-4) \times 90^\circ$

$\Rightarrow 5n^2 - 125n + 720 = 0$

$\Rightarrow n^2 - 25n + 144 = 0$

$n = 9, 16$

n = 16 cannot be considered as

$t_{16} = 195^\circ > 180^\circ$ is not possible as the polygon is convex.

9. (D) $= \cot 9^\circ \cot 27^\circ \cot 45^\circ \cot 63^\circ \cot 81^\circ$

$= (\cot 9^\circ \tan 9^\circ)(\cot 27^\circ \tan 27^\circ) \cot 45^\circ = 1$

10. (D) $|\alpha - \beta| = 1$

$\sqrt{b^2 - 4c} = 1$

$\Rightarrow b^2 - 4c = 1$

11. (A) $\Delta BKL \sim \Delta DYZ$

$$\frac{ar(BKL)}{ar(DYZ)} = \frac{BK^2}{DY^2} = \frac{KL^2}{YZ^2} = \frac{BL^2}{DZ^2}$$

$$= \frac{KL^2}{25KL^2} = \frac{1}{25}$$

12. (C) $n^3 - n$ is always divisible by 6 $\forall\, n \in N$

13. (D) A = (4, 5); B = (–10, 2)

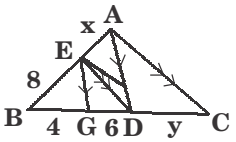
y-axis divides $\overline{AB}$ in the ratio = $-x_1 : x_2$
= –4 : –10 = 2 : 5

14. (A) The zeroes of the polynomial are 4, –2, 3 and the possible difference among the options is 1.

15. (C) Let AE = x, DC = y,

In ΔABD, $\frac{8}{x} = \frac{4}{6}$ (BPT)

$\Rightarrow x = 12$



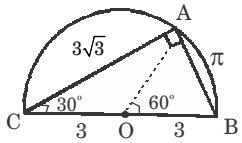
In ΔABC, $\frac{8}{x} = \frac{10}{y} \Rightarrow y = 15$

$\therefore$ BC = BD + DC = 25 cm

16. (B) The intercepted arc

$\overset{\frown}{AB} = \frac{1}{6}$ of the circle = π

Length of AC = $3\sqrt{3}$



and given radius = 3 $\Rightarrow$ diameter = 6 cm

$\therefore$ Perimeter = $6 + 3\sqrt{3} + \pi$

≈ 14.34 cm

17. (A) $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$

$\Rightarrow \frac{2}{2a} = \frac{3}{a+b} = \frac{7}{28}$

$\Rightarrow \frac{1}{a} = \frac{3}{a+b}$

$\Rightarrow a + b = 3a \Rightarrow b = 2a$

18. (C) $= \sin^2\left(\frac{\pi}{4}\right) + \sin^2\left(\frac{\pi}{4}\right) + \sin^2\left(\frac{\pi}{4}\right) + \sin^2\left(\frac{\pi}{4}\right)$

$= 4\left(\frac{1}{2}\right) = 2$

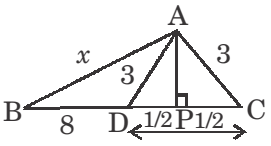
19. (D) $2 \times 3 \times 43 + 13 = 258 + 13 = 271$

20. (B) Let AB = x cm

In ΔABP, $x^2 - (8.5)^2 = AP^2$

In ΔADP, $9 - 0.25 = AP^2$

$x^2 - (8.5)^2 = 9 - 0.25$



$x^2 = 81$ or $x = 9$ cm

21. (B) $\frac{-b}{a}$ = sum of zeros < 0

So, $\frac{b}{a} > 0$,

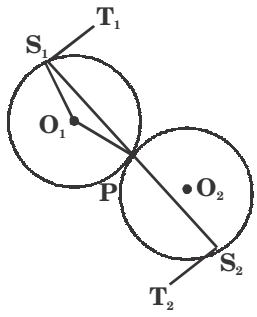
Product of zeros = $\frac{c}{a} > 0$

Hence, all a, b and c have the same sign.

22. (C) Area of $\Delta ABC = \frac{1}{2}|0(b-y) + 0(y-0) + x(0-b)|$

$\frac{1}{2}|-bx| = \frac{bx}{2}$ sq.units

23. (C) $O_1S_1 \perp S_1T_1 \Rightarrow \angle O_1S_1T_1 = 90^\circ$



$\angle O_1PS_1 = 20^\circ$

$= \angle O_2PS_2$ (vert.)

$= O_2P = O_2S_2$ = radius

$\therefore \angle O_2S_2P = 20^\circ$

$\angle O_2S_2T_2 = 90^\circ$ (radius $\perp$ target)

$\Rightarrow \angle PS_2T_2 = 90 - 20 = 70^\circ$

24. (C) $d = 13\frac{3}{4} - 15 = -1\frac{1}{4} = -\frac{5}{4}$

$t_n = a + (n-1)\,d < 0$

$\Rightarrow 15 + (n-1)\left(-\frac{5}{4}\right) < 0$

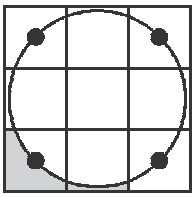
$\Rightarrow 60 - 5n + 5 < 0$

$\Rightarrow 65 < 5n$

$\Rightarrow n > 13$

Thus, the 14th term of the sequence is the first negative term.

25. (B) Radius of circle = diagonal one cm of square $= \sqrt{2}$



Area of circle = $\pi\left(\sqrt{2}\right)^2 = 2\pi$

Area of square = $(1 + 1 + 1)^2 = 3^2 = 9$

Area of shaded region = $\frac{1}{4}[9 - 2\pi]$

Physics

26. (A) As R decreases, I increases and V increases. According to Ohm's law, $V \propto I$.

27. (A) A concave mirror is that spherical mirror in which the reflection of light takes place at the concave surface (or bent-in-surface).

28. (B) Rating of bulb, V = 240 V

P = 100 W

Since, the bulb is connected to a voltage source of 120 V (i.e., the rated voltage of bulb is greater than the supply voltage), the bulb lights up but it is dim.

29. (A) A magnetic field is produced when the current is passing through a long straight wire. The strength of the magnetic field increases, if the magnitude of the current increases.

30. (C) The S.I. unit of power of lens is diopter (D).

$$P = \frac{1}{f} = \frac{1}{1\,\text{metre}} = 1 \text{ Diopter}$$

31. (C) Violet light undergoes maximum deviation, due to which it has the minimum speed in glass prism. Hence, it has least wavelength.

32. (B) The function of the commutator in a D.C. motor is to reverse the flow of current in the coil at every half rotation.

33. (B) According to the given flow chart,

Y – renewable sources of energy

– geothermal energy

X – Non-renewable source of energy

– petroleum

34. (D) The pupil of a human eye appears black because no light is reflected from it.

35. (B) f = 10 cm ; u = ?

For a convex lens to act as a magnifying glass, the position of object must be between f and the lens so that a virtual, erect and magnified image is formed.

So, 'u' must be less than, f i.e. less than 10 cm which is 7 cm.

36. (A) Total charge

= number of electrons × charge of each electron

$= 4\times10^{16}\times1.6\times10^{-19}$

$= 6.4\times10^{-3}\,C$

$$i = \frac{\text{charge}}{\text{time}} = \frac{6.4\times10^{-3}}{1} = 6.4\,mA$$

37. (C) Due to atmospheric refraction, the stars seem to be higher in the sky than they actually are.

Light from a star is refracted (bent) as it leaves the space and enters the earth's atmosphere. Air which is higher up in the sky is rarer but that nearer the earth's surface is denser. So, as the light from a star comes down, the dense air bends the light more. Due to refraction of star's light, the star appears to be at a higher position.

38. (C) When current is represented by a straight line, it means that the current is passing through a straight conductor, the magnetic field produced due to the current through a straight conductor is in the form of concentric circles and are in a plane perpendicular to the plane of the linear conductor. It means the magnetic field is circular.

39. (B) When a ray of light is incident on a glass prism (due to change in media from air to glass) it bends towards the normal. It undergoes refraction in the glass prism and comes out as an emergent ray towards the base of a prism.

40. (C) Electrical energy = power × time

(A) $E = 3kW\times\frac{10}{60} = 0.5\,kWh$

(B) $E = 1\times100\times6 = \frac{600}{1000} = 0.6\,kWh$

(C) $E = 5kW\times2 = 10\,kWh$

(D) $E = 1\times100\times24 = \frac{2400}{1000} = 2.4\,kWh$

Among the given appliances, 5kW oven consumes the greatest electrical energy.

41. (C) An electromagnet is a temporary magnet. Its magnetism lasts as long as the current passes through it. The polarity of an electromagnet can be changed by changing the direction of current in its coil. An electromagnet can produce very strong magnetic forces. The strength of an electromagnet can be changed by changing the number of turns in its coil or by changing the current passing through it.

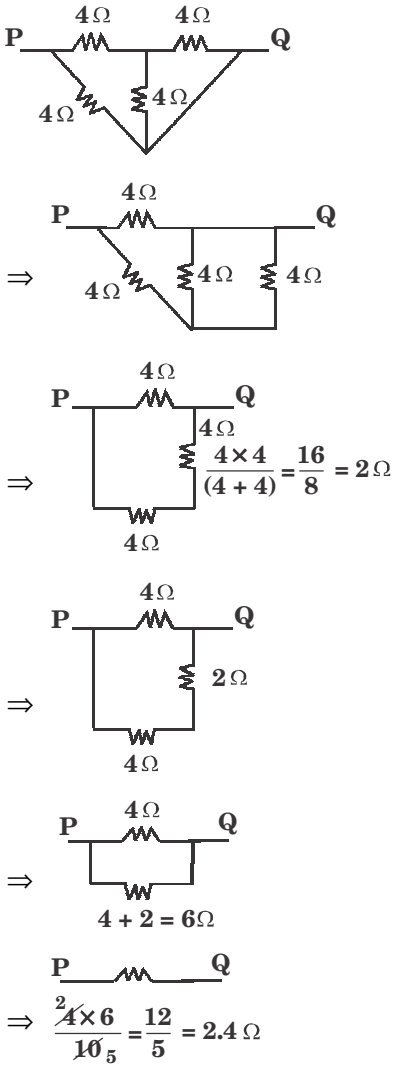
42. (C) The angle between the incident ray and the emergent ray is called the angle of deviation.

43. (B) Bending a wire does not affect the electrical resistance.

Resistance of a wire is proportional to resistivity of the material.

44. (A) The blue colour of the sky and the red colour of the sun at sunrise and at sunset are the effects produced by the scattering of sunlight by the earth's atmosphere.

45. (C)



46. (C) A lemon kept in water in a glass tumbler appears to be bigger than its actual size. This is due to refraction of light.

47. (B) The optical instruments like camera, microscope and telescope work on the principle of refraction of light.

48. (C) Tyndall effect is illustrated in the given situation. When a beam of sunlight enters a dusty room through a window its path becomes visible to us. This is because the tiny dust particles present in the air of room scatter the beam of light all around the room. When the scattered light enters our eyes, we see the beam of light.

49. (C) According to the given figures,

Let 'R' be the resistance of each bulb

$$\text{I in the circuit} = \frac{2V}{2R} = \frac{V}{R} = \frac{3}{R}$$

$$\therefore V_1 = IR = 3V$$

$$I = \frac{2V}{2R} = \frac{V}{R} = \frac{3}{R}$$

$$\therefore V_2 = IR = 3\,V$$

$$I = \frac{V}{R} = \frac{1.5}{R}$$

$$\therefore V_3 = IR = \frac{V}{R} \times R = 1.5\,V$$

$$I = \frac{2V}{R} = \frac{3}{R}$$

$$\therefore V_4 = \frac{3}{R} \times R = 3\,V$$

50. (D) When a charged particle moves through a magnetic field, it undergoes a change in its direction of motion.

Chemistry

51. (A) Copper has a high melting point, it is a good conductor of electricity and is malleable. These are the reasons why copper is used in the making of vessels and electrical wires.

52. (D) Sodium has low ionisation energy, so it easily donates an electron (metallic nature) to chlorine. Chlorine being (non-metallic) accepts an electron from sodium due to its high value of electron affinity.

This results in the formation of a stable ionic salt, sodium chloride.

53. (D) The important characteristics of a chemical relation are:

(i) Change in state, colour and temperature.

(ii) Evolution of a gas.

(iii) Formation of a precipitate.

54. (B) Cracking is decomposition of large alkane molecules into smaller ones at high temperature and pressure using a catalyst. The petrol obtained by the above process has better fuel characteristics and also meets 50% of the demand.

55. (B) According to the given information;

Solution X has pH = 3 so it is an acid. Acids on reacting with metals produce H_2 gas Solution Y has pH = 7 it is a neutral solution. Solution Z has pH = 12 it is a basic solution. Solution Z and solution X on reacting undergo neutralisation reaction forming salt and water. Solution X reacts with calcium carbonate to give off CO_2 gas.

56. (A) Ripening of fruits and fermentation of molasses involves change in chemical properties. So, they are chemical changes. Magnetisation of iron is a physical change. During the process of magnetisation the molecular magnets arrange in a proper direction resulting in net magnetic moment (i.e. net magnetisation).

57. (C) In a nettle plant, the leaves possess stinging hair. These hair inject methanoic acid which on being touched cause a burning pain.

58. (A) Reactive metals high up in the reactivity series form very stable oxides that cannot be reduced into their respective metals by heating with carbon. Metal zinc being placed in the middle of reactivity series is reduced to metal zinc using carbon as below:

$ZnO(s) + C(s) \xrightarrow{\Delta} Zn(s) + CO(g)$

59. (C) Propanoic acid is the third member of the carboxylic acid series while butanol is the fourth member of the alcohol series.

60. (B) Carbon and Germanium belong to the 14^{th} group in the periodic table. The electronic configuration of carbon = 2, 4

Germanium = 2, 8, 18, 4

These elements possess four valence electrons in their outermost orbit.

61. (B) Ethene is an unsaturated hydrocarbon that can undergo addition reaction with bromine to form a colourless compound.

$$H_2C = CH_2 + Br_2 \rightarrow \begin{array}{l} H \quad H \\ | \quad | \\ H - C - C - H \\ | \quad | \\ Br \quad Br \end{array}$$

62. (A) When electricity is passed through an aqueous solution of sodium chloride (called brine), it decomposes sodium chloride to form sodium hydroxide (X), hydrogen (Z) and chlorine (W). This process is called the chlor-alkali (Y) process because of the products formed: Chlor for chlorine and alkali for sodium hydroxide.

At cathode $\rightarrow H_2$ is formed (Z)

At anode $\rightarrow Cl_2$ is formed (W)

63. (D) The 2^{nd} and 3^{rd} periods in the periodic table have the following 's' and 'p' block elements.

's' block elements	**'p' block elements**
Li, Be	B to Ne
Na, Mg	Al to Ar

64. (B) Aluminium, zinc and lead form respective oxides at ordinary temperature. Gold does not form an oxide even at high temperatures.

65. (D) The given reaction is that of a double decomposition reaction.

$CuSO_4 + 2NaOH \rightarrow Cu(OH)_2 + Na_2SO_4$

So, a mutual exchange of ions (i.e. SO_4^{-2} exchanges with $[OH]^-$) takes place.

66. (A) A zig-zag line in the periodic table separates metals from non-metals. Elements like boron, silicon, germanium, arsenic, antimony, tellurium and polonium have intermediate properties both of metals and non-metals. Hence, the above elements are called semi-metals or metalloids.

67. (C) $S + O_2 \rightarrow SO_2$ is an element - element combination reaction.

68. (B) The p in pH stands for 'Potenz' in German. The meaning of 'potenz' in German is 'power' and letter H stands for hydrogen ion concentration $[H^+]$.

69. (C) (i) Non-metals do not have free electrons to carry the charge to conduct electricity.

(ii) An allotropic form of carbon called graphite is a non-metal, but it is a good conductor of electricity.

(iii) It is also used in making electrodes. In electrolytic reduction of $MgCl_2$, graphite rod is used as anode.

70. (B) All the given compounds are alkynes and they are homologous in series. The members of a homologous series have the same general formula and similar chemical properties. Alkynes have the general formula C_nH_{2n-2}.

Biology

71. (C) Keep the experimental plant in a dark place for three days to destarch its leaves. Cover a portion of leaf on both sides by using strips of black paper. Expose the plant to sunlight for four hours. Pluck the experiment leaf. Remove the black paper strips from the leaf. Test the experimental leaf for the presence of starch.

72. (D) Wet and germinating seeds respire aerobically and liberate carbon dioxide as a by-product. The liberated carbon dioxide turns lime water milky.

73. (C) When two heterozygous tall plants are crossed 25% of offsprings will be short.

74. (B) In binary fission the division of nucleus is followed by the division of the cytoplasm thus two new individuals are formed from a single parent and the parent's identity is lost. The parent's identity is maintained in budding.

75. (D) Biodegradable domestic wastes such as leftover food, fruit and vegetable peels and leaves of potted plant, paper cups are converted into compost by the action of decomposers and redworms in a pit and used as manure. Plastic flowers and glass vase are non - biodegradable wastes.

76. (D) The pulmonary vein carries oxygenated blood from lungs to the heart.

77. (C) According to ten percent law by Lindemann only about 10% of the energy available in

a trophic level is transferred to the next higher level. There is a loss of energy at each trophic level. Producers have 10000 J of energy

$$\text{Herbivores } \frac{10,00\cancel{0}}{1\cancel{0}} = 1000 \text{ J}$$

$$\text{Lower carnivores } = \frac{100\cancel{0}}{1\cancel{0}} = 100 \text{ J}$$

$$\text{Higher carnivores } = \frac{10\cancel{0}}{1\cancel{0}} = 10 \text{ J}$$

78. (B) The increase in the concentration of harmful chemical substances like pesticides in the body of living organisms at each trophic level of a food chain is called biomagnification.

79. (B) The non-directional movement of a plant part in response to the touch of an object is called nastic movements (thigmonasty).

80. (D) Fragmentation is the breaking up of the body of a simple multicellular organism into two pieces. On maturing each piece grows to form a new individual. Spirogyra and Sea anemone reproduce by the fragmentation method.

81. (A) The genotype Rryy exhibits round and green seed.

82. (C) Dodo was a large flightless bird which has become extinct.

83. (C) The ovary of a flower develops to form a fruit. The other parts of a flower like sepals, petals, stamens, stigma and style dry up and fall off.

84. (B) In the given figure 'Q' represents placenta. Placenta is a disc like special tissue that develops between the uterus wall and the embryo. The exchange of nutrients, oxygen and waste products between the embryo and the mother takes place through the placenta. P–Uterus R–Water liquid S–Embryo.

85. (C) The products of respiration are used as the raw materials in the photosynthesis.

86. (A) Analogous organs are those organs which have different basic structure but have similar appearance and perform similar functions.

87. (A) The branches of a nerve cell are called dendrites. The dendrites pick up the nerve impulses from the receptors and communicate to the cell body and then to axon. The axon passes the impulses to another neuron.

88. (A) Pollination → Fertilisation → Embryo → Seed.

89. (C) Thyroxine controls the metabolic rate Adrenaline prepares the body for an emergency. Insulin regulates the amount of sugar in blood. Parathormone controls the levels of calcium and phosphate in the blood.

i-r, ii-p, iii-s, iv-q

90. (B) In the given figure the part labelled Q, represents cerebellum. Cerebellum helps in the maintaining of posture and balance of the body.