NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION - 2013

SOLUTIONS FOR CLASS : 9

Mathematics

1. **(D)** $\dfrac{1}{x} + \dfrac{1}{y} = 2013$

$\Rightarrow \dfrac{x+y}{xy} = 2013$

$\Rightarrow xy = \dfrac{2013}{2013} = 1$

2. **(C)** $ar(\Delta PQS) = \dfrac{1}{2} ar(\Delta PQR)$ [In ΔPQR]

$ar(\Delta TSQ) = \dfrac{1}{2} ar(\Delta PQS)$ [In ΔPQS]

$= \dfrac{1}{2} \times \dfrac{1}{2} ar(\Delta PQR)$

$= \dfrac{1}{4} \times 48 = 12 \text{ cm}^2$

3. **(B)** $\sqrt{x} + \sqrt{x} = x$

$\Rightarrow 2\sqrt{x} = x$

On squaring, we get,

$4x = x^2$ or $x(x-4) = 0$

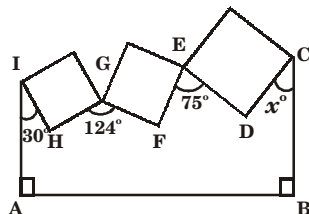$\Rightarrow x = 0$ or $x = 4$

$\therefore$ Their product $= 0 \times 4 = 0$.

4. **(A)** $720 = 20 \times 12 \times h$

$\Rightarrow \dfrac{720}{20 \times 12} = h$

$\Rightarrow 3 \text{ cm} = h$

5. **(C)**

The sum of the interior angles of the polygon ABCDEFGHI $= 180^\circ \times (9 - 2)$
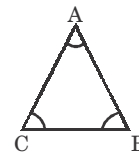
$= 180^\circ \times (7)$

$= 1260^\circ$

i.e., $30^\circ + 124^\circ + 75^\circ + x^\circ + 3(270^\circ) = 1260^\circ$

$\Rightarrow 1219^\circ + x^\circ = 1260^\circ$ or $x^\circ = 41^\circ$

6. **(A)** Since $\angle C > \angle B$

$\Rightarrow AB > AC$

$\angle B > \angle A$

$\Rightarrow AC > BC$

Also, $\angle C > \angle A$

$\Rightarrow AB > BC$ (Since the greatest angle has the longest side opposite to it.)

7. **(C)** $x = 2\sqrt{2} + \sqrt{7} = \sqrt{8} + \sqrt{7}$

$\Rightarrow \dfrac{1}{x} = \dfrac{1}{\sqrt{8} + \sqrt{7}} = \sqrt{8} - \sqrt{7}$

$\dfrac{1}{2}\left(x + \dfrac{1}{x}\right) = \dfrac{1}{2}\left(2\sqrt{8}\right) = \sqrt{8}$ or $2\sqrt{2}$

8. **(C)** Number of lead shots $= \dfrac{\dfrac{4}{3}\pi \times 4 \times 4 \times 4}{\dfrac{4}{3}\pi \times 1 \times 1 \times 1}$

$= 4 \times 4 \times 4 = 64$

9. **(C)** Let one angle be x.

Then the other angle is $\dfrac{4}{5}x$.

Now, $x + \dfrac{4}{5}x = 180^\circ$

$9x = 180^\circ \times 5 = 900^\circ$
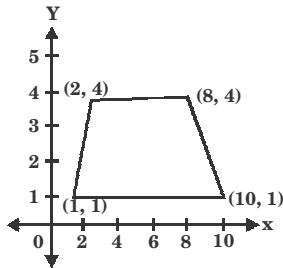
or $x = 100^\circ$

$$\Rightarrow \frac{4x}{5} = \frac{4}{5} \times 100^\circ = 80^\circ$$

10. **(D)** Since $p^4 + p^2 = 20 \Rightarrow p^4 + p^2 - 20 = 0$

$\Rightarrow (p^2 - 4)(p^2 + 5) = 0$

and p is an integer

$\Rightarrow p^2 = 4$ or $p = 2, -2$.

$\therefore$ The required sum = $2 + (-2) = 0$

11. **(D)** Clearly, the figure formed has one pair of parallel sides i.e., the line joining (2, 4) (8, 4) and (1, 1) : (10, 1).

Hence, the quadrilateral is a trapezium.

12. **(C)** $\dfrac{\pi r^2 h}{2\pi r h} = \dfrac{924}{264}$

$\Rightarrow r = \dfrac{924 \times 2}{264} = 7$

$\Rightarrow$ Diameter = $7 \times 2 = 14$ m

13. **(B)** $\angle AED = \angle EDC + \angle ECD$

$= 31^\circ + 31^\circ = 62^\circ$
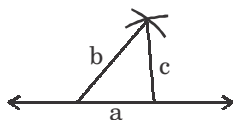
14. **(D)** $(x - 13)^2 = 2013^2$

$\Rightarrow x - 13 = \pm 2013$

$\Rightarrow x = 2013 + 13$ or $x = -2013 + 13$

$\therefore$ Sum = $2013 + 13 - 2013 + 13 = 26$

15. **(B)** $\dfrac{1}{6}\left(6x^2 + x - 1\right)$

$= \dfrac{1}{6}\left[6x^2 + 3x - 2x - 1\right]$

$= \dfrac{1}{6}\left[3x(2x + 1) - 1(2x + 1)\right]$

$= \dfrac{1}{6}(2x + 1)(3x - 1)$

16. **(D)** $\dfrac{a}{4}\sqrt{4b^2 - a^2}$
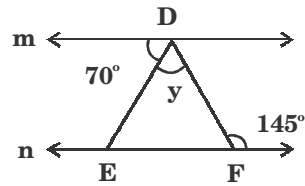
17. **(C)**

18. **(C)** The expression

$x^4 + 4x^3 + 4x^2 - 13 = (x^2 + 2x)^2 - 13$

$= (45)^2 - 13$

$= 2025 - 13 = 2012$

19. **(B)** Each of the ordered pairs has the two coordinates as additive inverse of one another.

Hence, their sum must be zero.

$\therefore$ The equation is $x + y = 0$.

20. **(B)**

$\Rightarrow y + 70^\circ = 145^\circ$ (Alternate angles)

$\Rightarrow y = 75^\circ$

21. **(C)** $S = \dfrac{6 + 4 + 8}{2} = 9$ cm

Area of $\Delta PQR = \sqrt{9(9-6)(9-4)(9-8)}$

$= \sqrt{9 \times 3 \times 5 \times 1}$

$= 3\sqrt{15}$ cm^2.

22. **(A)** $4z^2 - 15z\pi - 4\pi^2 = (4z + \pi)(z - 4\pi)$

$\Rightarrow z = \dfrac{-\pi}{4}, \ 4\pi$

23. **(A)** Let T be the foot of the perpendicular from Q to the line SR extended to T.
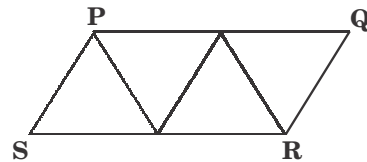
ΔRQT is half of an equilateral triangle with length of its side equal to 1. Hence the length of RT is $\dfrac{1}{2}$ and hence ST has length $1 + 1 + \dfrac{1}{2} = \dfrac{5}{2}$.

$QT = \dfrac{\sqrt{3}}{2}$

By Pythagoras' theorem, in ΔQTS,

$SQ^2 = QT^2 + ST^2$

$= \left(\dfrac{\sqrt{3}}{2}\right)^2 + \left(\dfrac{5}{2}\right)^2$

$= \dfrac{3}{4} + \dfrac{25}{4}$

$= \dfrac{28}{4} = 7$ or $SQ = \sqrt{7}$.

24. (C)   A—P—B

∴ AP + PB = AB

(Note: P may or may not be the mid point.)

25. (A)   1 + 1 + 1 + ... 2012 times = 2012

Physics

26. (B)   W = mg

200.6 = m (1.7)

$m = \dfrac{200}{1.7} = 118$ kg

Mass of rock on the moon = mass of rock on the earth = 118 kg.

27. (B)   The area under the a - t graph gives the change in velocity of a particle.

28. (A)   When a bus starts suddenly, the passengers are pushed backwards, the feet of the passengers that are in contact with the bus are still under the state of rest, while their body is under motion. This is due to inertia of rest. It is in accordance with Newton's first law of motion.

29. (A)   Centre of buoyancy is the centre of gravity of the displaced liquid.

30. (B)   If the motion of a body is along a straight line without any change in its direction, then the magnitude of displacement is equal to the distance covered by the body.

31. (C)   Ultrasonic waves are sound waves and they are longitudinal in nature.

32. (A)   (i) The orbit of a planet is elliptical with the sun at one of its foci

(ii) The line joining the planet and the sun sweeps equal areas in equal intervals of time.

(iii) The cube of the mean distance of a planet from the sun is directly proportional to the square of time it takes to move around the sun.

33. (D)   Mass of fuel burnt (m) = 0.4 kg

Velocity of ejected gases (v) = 8×10^3 m s⁻¹

Momentum of ejected gases = $0.4 \times 8 \times 10^3$

$= 3.2 \times 10^3$ N s

These gases exert a thrust on the rocket in the forward direction.

Ft = Change of momentum

$F \times 1 = 3.2 \times 10^3$

∴ $F = 3.2 \times 10^3$ N

34. (B)   During the motion of a body projected vertically upwards, the body moves in a straight line. Secondly, the velocity and acceleration are in the opposite directions to each other.

35. (B)   Let the masses of water and the liquid be 'm' each.

R.D. of water = 1

R. D. of liquid = 2

Density of water = 1 g cm⁻³

Density of liquid = 2 g cm⁻³

Density of the mixture

$= \dfrac{\text{Total mass of mixture}}{\text{Total volume}}$

$= \dfrac{(m+m)}{\left(\dfrac{m}{1} + \dfrac{m}{2}\right)} = \dfrac{2m \times 2}{(2m+m)} = \dfrac{4m}{3m} = \dfrac{4}{3}$

36. (D) $v^2 - u^2 = 2aS$

$4^2 - 0^2 = 2 \times a \times 16$

$\Rightarrow a = \dfrac{16}{2 \times 16} = 0.5$ m s⁻²

37. (A)   Mass of the gun (M) = 4 kg

Mass of the bullet (m) = 40 g

Velocity of the bullet = 500 m s⁻¹

Let 'v' be the velocity of the recoil of the gun, then according to the law of conservation of momentum,

$-V = \dfrac{mv}{M} = \dfrac{0.04 \times 500}{4}$

$= 0.01 \times 500 = 5$ m s⁻¹

38. (A)   Given $\dfrac{m}{t} = 100$ kg s⁻¹

Power delivered $= \dfrac{mgh}{t} = 100 \times 10 \times 120$

$= 120 \times 10^3$ W

(or) 120 kW

39. (A)   In retarded motion, speed as well as velocity decrease.

40. (B) $V \times \rho_{wood} = V_{immersed} \ \rho_{liquid}$

$V\rho_{wood} = \dfrac{1}{4} V(0.8)$

$\rho_{wood} = 0.2$ g cm⁻³ or 200 kg m⁻³

41. (A)   On an initially stationary object, the action of balanced forces causes the object to remain in its previous state of rest as the net resultant force is equal to zero.

42. (B)   r = 14 cm

$\Delta t = \dfrac{1}{2} h = 30$ min $= 30 \times 60 = 1800$ s

$\text{Speed} = \dfrac{\text{distance travelled}}{\text{total time taken}}$

$\dfrac{\pi \times r}{1800} = \dfrac{22 \times 14}{7 \times 1800} = \dfrac{11}{450}$ cm s⁻¹

43. (D) Let the initial velocity of the body be 'u'.

F = 20 N

m = 10 kg

t = 8 s

According to Newton's second law,

$$F = m\left(\frac{v-u}{t}\right)$$

$$20 = 10\left(\frac{2u-u}{8}\right)$$

$$u = 2 \times 8$$

(or) $u = 16$ m s^{-1}

44. (A) Mass of the object = 100 g

Volume of the object = 20 cm^{-3}

$$\text{Density} = \frac{\text{Mass of the object}}{\text{Volume of the object}}$$

Density of the object = $\frac{100}{20}$ = 5 g cm^{-3}

As the density of the object is more than the density of water, it sinks in water.

45. (B) The weight of the object is 'mg' and the distance moved by the weight in the direction of the lifting force is 'h'.

Gravitational potential energy = mgh

$$= 2 \times 10 \times 3 = 60 \text{ J}$$

46. (B) A common characteristic of all moving bodies is that they change their position with time.

47. (A) Thrust is the force or weight acting normally on a surface. Units of thrust are kg m s^{-2}, dyne, newton or g cm s^{-2}.

48. (C) Displacement is the shortest distance from diametric end A to diametric end B which is equal to 2r.

Distance = πr (Half the circumference of the circle).

∴ Ratio = | displacement | : Distance

$$= 2r : \pi r = 2 : \pi$$

49. (B) Action - reaction forces always act on two different bodies.

50. (A) Archimedes' principle has many applications. It is used in designing ships and submarines. Lactometers are used to determine the purity of a sample of milk and hydrometers are used for determining the density of liquids are based on this principle. Barometers used in the determination of atmospheric pressure are not based on Archimedes' principle.

Chemistry

51. (C) The intermolecular forces of attraction in solids, liquids and gases are as follows :

Solids > liquids > gases.

i.e., S > L > G

52. (A) Zn reacts with H_2SO_4 and NaOH as shown below.

$$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2\uparrow$$

$$Zn + 2\,NaOH \rightarrow Na_2ZnO_2 + H_2\uparrow$$

So, the same amount of Zinc when treated with excess of dil.H_2SO_4 and NaOH liberates H_2 in the ratio of 1 : 1 by volume.

53. (C) The following is the correct combination:

  (i) Drying of wet clothes – Evaporation

  (ii) Decrease in the size of napthalene balls - Sublimation

  (iii) Formation of clouds - Condensation

  (iv) Formation of ice from water - solidification

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

54. (B) As the size of particles in colloidal solutions are bigger than those in true solutions, their motion is slow.

55. (D) A gas does not have a definite shape or volume. Hydrogen is a gas, so it does not have a definite shape or volume.

56. (D) (i) The particles which are present in an atom are known as subatomic particles.

  (ii) The particles which are present in a nucleus are known as nucleons.

  (iii) An alpha particle is a doubly ionised helium nucleus.

  (iv) The mass of an electron is 9.1×10^{-31} kg and its charge is 1.602×10^{-19} C.

57. (B) The mixture of the white of an egg and water forms a colloidal solution, which is translucent in nature.

58. (A) According to the given information, particles are free to move. This implies that matter must be either in the liquid or in the gaseous states. The particles move freely and slide past over one another due to slightly weak interparticle forces of attraction. The particles are held together by fairly strong attractive forces. So, particles of liquid are described. The option is (A), i.e. milk and water.

59. (B) The ratio of the number of neutrons present in a potassium atom and a magnesium atom with the given mass numbers is 5 : 3.

60. (D) The important characteristic properties of colloids (or colloidal solutions) are as follows:

  (i) A colloid (or colloidal solution) appears to be homogeneous but actually it is heterogeneous.

(ii) The size of particles in a colloid (or colloidal solution) is bigger than those in a true solution but smaller than those in a suspension. It is between 1 nm and 100 nm in diameter.

(iii) The particles of most of the colloids (or colloidal solutions) cannot be seen even with a microscope.

(iv) The particles of a colloid (or colloidal solution) can pass through a filter paper. So, a colloid cannot be separated by filtration.

(v) The colloids (or colloidal solutions) are quite stable. The particles of a colloid do not separate on keeping it still.

(vi) A colloid (or colloidal solution) scatters a beam of light passing through it (because its particles are fairly large).

61. **(B)** Mol. wt of $Mg(NO_3)_2$ = 24 + 2 [14 + (16 × 3)]

$$= 24 + 2 [14 + 48]$$

$$= 24 + (2 × 62)$$

G.M.W of $Mg(NO_3)_2$ = 148 g = 24 + 124

$$= 148$$

G.M.W of $Mg(NO_3)_2 = \dfrac{\text{weight of } Mg(NO_3)_2}{\text{G.M.W of } Mg(NO_3)_2}$

⇒ Weight of 1 mole = 148 g.

Weight of 0.885 moles = 148 × 0.885

$$= 130.98 \text{ g.}$$

(or) 131 g

62. **(A)** The two factors which decide whether a given substance would be in a solid, liquid or gaseous state are temperature and pressure.

By changing the temperature and pressure of matter, its physical state can be altered.

63. **(D)** One mole of any gas always occupies a fixed volume at N.T.P.

64. **(D)** Mol. wt of Al_2O_3 = 2(27) + 3(16) = 102

Mass of Al = $\dfrac{2(27) × 204}{102}$ = 108 g

65. **(D)** (i) Perspiration is our body's method of maintaining a constant temperature.

(ii) Water evaporating from the leaves of plants/trees through transpiration also cools the surrounding air.

(iii) Water taken in earthern pots has a large number of extremely small pores in its walls. Some of the water continuously keeps seeping through these pores to the outside of the pot. This water evaporates continuously and takes the latent heat required for evaporation from the earthern pot and the remaining water in it. In this way the remaining water loses heat and is cooled.

The above three are applications illustrating that evaporation leads to cooling.

66. **(C)** Tin – element

Fog – colloid (mixture)

Methane – compound

Soil – mixture

67. **(C)** Butter is an emulsion.

68. **(C)** Molecular weight of C_2H_6

$$= (2 × 12) + (6 × 1) = 30$$

Amount of C_2H_6 = $\dfrac{20}{30}$ mol.

Equal amounts of different gases occupy the same volume under the same conditions.

Amount of C_3H_6 = $\dfrac{20}{30}$ mol.

Mol. wt of C_3H_6 = (3 × 12) + (6 × 1) = 42

Mass of C_3H_6 = $\dfrac{20}{30} × 42$ = 28 g.

69. **(D)** Colloidal particles are in a state of constant and rapid zig-zag motion, called Brownian motion.

Start

70. **(B)** Mg^{+2} has 10 electrons, 12 protons and 12 neutrons.

F^- has 10 electrons, 9 protons and 10 neutrons.

So, Mg^{+2} and F^- differ only in protons and neutrons.

Biology

71. **(C)** Nucleus controls all cell functions, chloroplast that contain chlorophyll pigment help to synthesise food in the form of starch. Cell membrane controls the entry and exit of substances. Cell wall maintains the shape of the cell.

72. **(B)** Pencillin antibiotic is extracted from the fungus Penicillium sps.

73. **(C)** Cardiac muscles are involuntary muscles. They are cylindrical, branched and uninucleate.

74. **(A)** Disease causing viruses, bacteria, fungi and protozoans are called pathogens.

75. **(C)** The given process is an overall reaction or equation of aerobic respiration in living organisms. It helps in the maintenance of the balanced between oxygen and carbon dioxide gas in atmosphere.

76. (D) The sub groups of various levels in the classification are (1) kingdom, phylum, class, order, family, genus and species.

77. (D) Cockroach is an arthropod. The word arthropod means jointed legs and jointed body. A cockroach has two pairs of wings and three pairs of legs.

78. (D) The given figure is of marsilea. It is an example of Pteridophyte. In this group the plant body is differentiated into roots, stem and leaves and has specialised tissue for the conduction of water and food substances.

79. (B) The given figure is of earthworm. It belongs to phylum annelida. The name annelida or annuli means rings or segments are lined up one after the other from head to tail.

80. (A) In the given figures P represents longitudinal parenchyma. The characteristic feature of parenchymatous tissue is the presence of loosely packed cells with large spaces between cells called lamella.

81. (C) The given figure is of a plant cell with chloroplasts. It is taken from the stem of the cactus plant.

82. (B) Drinking boiled water does not help to kill larvae of malaria causing germ. Boiling drinking water prevents water borne diseases like cholera, dysentry, typhoid etc.

83. (C) In the given figure P-Dendrite, Q-Cyton or cell body, R-Nucleus, S-Axon.

84. (D) In the given figure the number labelled as IV is host, III plasmodium parasite,

I Mosquito carrier of Pathogen.

85. (B) Reproductive cells or gametes like sperm and ovum are haploid cells.

86. (D) Mixed cropping eg: Wheat + gram or wheat + Crop rotation is the growing of different crops on a piece of land in a pre planned succession. Inter cropping is growing of two or more crops eg. Soyabean + Maize + Millet.

87. (B) Cyperinus rotundus is the scientific name of motha. It is a weed. It compete with food crops for food, space and light.

88. (A) Red blood cells help in the exchange of gases.

89. (C) Mammals produce live young ones. They suckle their young ones.

90. (A) In the given cycle arrow labelled P represents photosynthesis. Green plants take in carbon dioxide from the atmosphere to synthesis its food in the presence of sunlight and chlorophyll pigment.