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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION (UPDATED)

CLASS - 9

Question Paper Code : UN470

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SOLUTIONS

MATHEMATICS

01. (B) $\angle BAD = \angle CAD = \frac{90^\circ}{2} = 45^\circ$

$\angle DAE = \angle CAE = \frac{\angle CAD}{2} = 22\frac{1}{2}^\circ$

$\angle BAE = \angle BAD + \angle DAE = 45^\circ + 22\frac{1}{2}^\circ =$

$67\frac{1}{2}^\circ$

02. (D) Given $a + b + c = 10$

Squaring on both sides

$a^2 + b^2 + c^2 + 2(ab + bc + ca) = 100$

$38 + 2(ab + bc + ca) = 100$

$2(ab + bc + ca) = 100 - 38 = 62$

$ab + bc + ca = \frac{62}{2} = 31$

But $a^3 + b^3 + c^3 - 3abc$

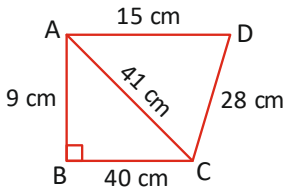
$= (a + b + c)[a^2 + b^2 + c^2 - (ab + bc + a)]$

$160 - 3abc = 10\ [38 - 31]$

$160 - 70 = 3abc$

$abc = \frac{90}{3} = 30$

03. (C) Given $\angle ABC = 90° = AC^2 = AB^2 + BC^2$



$= 40^2 + 9^2$

$= 1600 + 81$

$AC = \sqrt{1681} = 41$ cm

In ΔACD, a = 41 cm, b = 28 cm & c = 15 cm

$$s = \frac{a+b+c}{2} = \frac{(41+28+15)\text{ cm}}{2}$$

$= \sqrt{42 \times 1 \times 14 \times 27}$

$= 14 \times 9\ cm^2$

$= 126\ cm^2$

Area of the quadrilateral ABCD = (180 + 126)cm^2 = 306 cm^2

04. (B) Given $p(x) = \frac{2x+1}{x-2}$

$$\therefore \quad p\left(\frac{2x+1}{x-2}\right) = \frac{2\left(\frac{2x+1}{x-2}\right)+1}{\frac{2x+1}{x-2}-2}$$

$$= \frac{\frac{4x+2}{x-2}+1}{\frac{2x+1-2(x-2)}{(x-2)}}$$

$$= \frac{4x+\cancel{2}+x-\cancel{2}}{(x-2)} \times \frac{(x-\cancel{2})}{(\cancel{2x}+1-\cancel{2x}+4)}$$

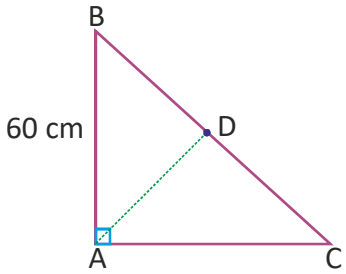
$$= \frac{\cancel{5}x}{\cancel{5}}$$

$= x$

05. (D) Given $\angle BAC = 90°$

$\therefore$ $BC^2 = AB^2 + BC^2 = 100^2$

$\therefore$ BC = 100 cm



Let BD = x cm $\Rightarrow$ DC = $(100 - x)$ cm

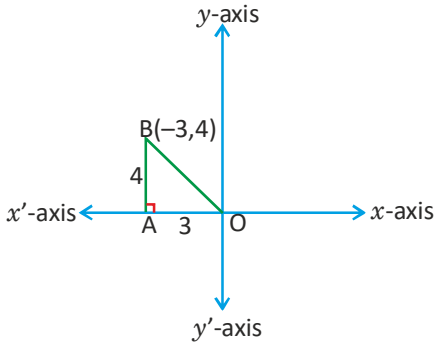
Given perimeter of ΔABD = perimeter of ΔACD

$60 + x + \cancel{AD} = 80 + 100 - x + \cancel{AD}$

$x + x = 180 - 60 = 120$

BD = x = 60 cm

06. (C)



$OB^2 = AB^2 + OA^2 = 4^2 + 3^2 = 5^2$

$\therefore$ DB = 5 units

07. (C) Slant height(l) = $\sqrt{4^2 + r^2}$

$= \sqrt{7^2 + 24^2}$

= 25

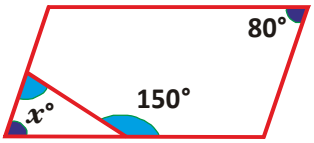
Area of the sheet required for one cap = πrl

$$= \frac{22}{\cancel{7}} \times \cancel{7} \times 25\ cm^2$$

= 550 cm^2

Area of the sheet required for 10 caps = 5,500 cm^2

08. (C)



In a parallelogram opposite angles are equal

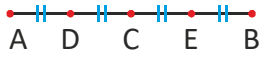
$\therefore$ $\angle B = \angle D = 80°$

In $\angle DEF$, $\angle D + x = 150°$

$80° + x = 150°$

$x = 70°$

09. (C)



$AD = \frac{1}{4} AB \Rightarrow AB = 4(AD)$

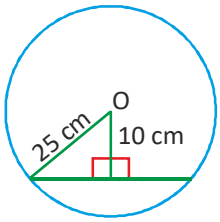
$AB = 2(AC)$

$\therefore$ $2(AC) = 4(AD)$

$AC = \frac{4(AD)}{2}$

$AC = 2(AD)$

10. (D)



In ΔAOC, $\angle ACO = 90°$

$\therefore$ $AC^2 = \sqrt{AO^2 - OC^2} = \sqrt{625 - 100}$

$= \sqrt{525}$

AC = 2AC =

$2\sqrt{525} = \sqrt{4 \times 525} = \sqrt{2100}$ units

11. (C) Diagonal of a parallelogram divides a parallelogram into two triangles of equal area and two congruent triangles

12. (A) $(x - 1)$ is also a factor of $f(x) \times g(x)$

13. (C) Volume of the platform = Volume of the earth in the well

$lbh_1 = \pi r^2 h_2$

$10.5 \text{ m} \times 8.8 \times h_1 =$

$\frac{\cancel{22}^{11}}{\cancel{7}\,\cancel{2}} \times \frac{\cancel{3.5}}{\cancel{2}} \times \frac{3.5}{\cancel{2}\,1} \times \cancel{12}^{\cancel{6}^{3}}$ m^3

$\therefore$ $h_1 = 11 \times 3.5 \times 3 \times \frac{1}{10.5 \times 8.8}$

$= \frac{\cancel{11} \times \cancel{35} \times \cancel{30}^{\cancel{10}^{5}}}{\cancel{105}_{\cancel{3}_{1}} \times \cancel{88}_{\cancel{8}_{4}}}$

= 1.25 metres

14. (D) Only option (D) is true

15. (C) $y = \frac{1}{x} = \frac{1}{7 + 4\sqrt{3}} \times \frac{7 - 4\sqrt{3}}{7 - 4\sqrt{3}} = \frac{7 - 4\sqrt{3}}{7^2 - (4\sqrt{3})^2}$

$= \frac{7 - 4\sqrt{3}}{49 - 48} = 7 - 4\sqrt{3}$

$\therefore$ $\frac{1}{x^2} + \frac{1}{y^2} = \frac{x^2 + y^2}{x^2 y^2}$

$= \frac{(x + y)^2 - 2xy}{(xy)^2}$

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

= 196 – 2

= 194

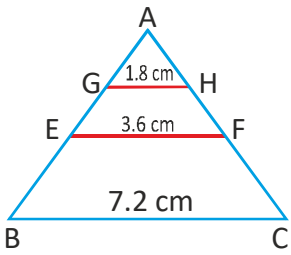
16. (B) $\angle PTQ = 90°$ [$\because$ Angle in a semicircle]

TQRS is a cyclic quadrilateral

$\therefore$ $\angle QTS + \angle SRQ = 180°$

$\therefore$ $x + y = \angle PTQ + \angle QTS + \angle SRQ = 90° + 180° = 270°$

17. (C)



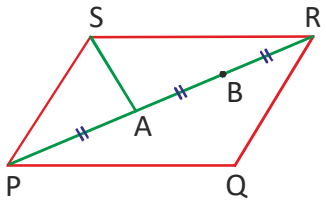
EF = 2 × GH = 3.6 cm

BC = 2 × EF = 2 × 3.6 cm

∴ BC = 7.2 cm

18. (C) Option (C) satisfies the given conditions

19. (B)



Given PA = AB = BR

Area of ΔPSR = $\frac{1}{2}$ × 84 cm² = 42 cm²

Area of ΔPAS = $\frac{1}{3}$ of area of ΔPSR

= $\frac{1}{3}$ × 42 cm²

= 14 cm²

20. (C) (0,0), (–1,1), (1,1), (0,2) are four ordered pairs satisfies the given condition that $x^{2020} + y^2 = 2y$

21. (A) LHS = $\frac{3\sqrt{2}}{\left(\sqrt{6}+\sqrt{3}\right)} \times \frac{\left(\sqrt{6}-\sqrt{3}\right)}{\left(\sqrt{6}-\sqrt{3}\right)} + \frac{\sqrt{6}}{\left(\sqrt{3}+\sqrt{2}\right)}$

$\frac{\left(\sqrt{3}-\sqrt{2}\right)}{\left(\sqrt{3}-\sqrt{2}\right)} - \frac{4\sqrt{3}}{\left(\sqrt{6}+\sqrt{2}\right)} \times \frac{\left(\sqrt{6}-\sqrt{2}\right)}{\left(\sqrt{6}-\sqrt{2}\right)}$

$= \frac{\cancel{3}\sqrt{2}\left(\sqrt{6}-\sqrt{3}\right)}{\cancel{3}} + \sqrt{6}\left(\sqrt{3}-\sqrt{2}\right)$

$- \frac{\cancel{4}\sqrt{3}\left(\sqrt{6}-\sqrt{2}\right)}{\cancel{4}}$

$= \sqrt{\cancel{12}} - \sqrt{\cancel{6}} + \sqrt{\cancel{18}} - \sqrt{\cancel{12}} - \sqrt{\cancel{18}} + \sqrt{\cancel{6}}$

= 0

22. (C) $2021^2 + 4034 = 2021^2 + 4042 - 8$

$= x^2 + 2x - 8$ where $x = 2021$

$= (x + 4)(x - 2)$

$= (2021 + 4)(2021 - 2)$

$= (2025) \times 2019$

23. (B) ∠NLM = 72°

$x° = 180° - (72° + 48°)$

$x° = 60°$

24. (D) Height of the pyramid =

$\sqrt{(\text{slant height})^2 - \left(\frac{\text{side}}{2}\right)^2}$

$= \sqrt{(13\ \text{cm}^2) - (5\ \text{cm})^2}$

= 12 cm

Volume of the pyramid = $\frac{1}{3}$ base area × height

$= \frac{1}{\cancel{3}} \times 10 \times 10 \times \cancel{12}^{4}\ \text{cm}^3$

= 400 cm³

25. (A) Given 2πr = 220 cm

$2 \times \frac{22}{7} \times r = 220$ cm

$r = 220\ \text{cm} \times \frac{7}{22} \times \frac{1}{2} = 35$ cm

Volume of the cylinder = πr²h

$= \frac{22}{7} \times 35 \times 35 \times 63\ \text{cm}^3$

= 242550 cm³

PHYSICS

26. (C) $g = GM / R^2$ or $M = g R^2 / G$. Cavendish determined the value of G.

27. (C) Mass of the automobile vehicle (m) = 1500 kg

Negative acceleration (a) = -1.7 m/s^2

Force needed to stop the vehicle (F) = ?

Now, putting these values in the equation F = m × a, we get

F = 1500 kg × (-1.7 m/s^2)

F = -2550 kg m/s^2

F = -2550 N

The negative value of the force indicates that it is acting in the direction opposite to the direction of motion. So, the retarding force needed to stop the vehicle is 2550 N.

28. (B) Power depends upon the time taken in doing the work.

Power (P) = Work done/Time = W/T. Both the men have same mass and do the same work, but there is a difference in time for reacing the same height

$$P_1 = \frac{W}{15} \qquad P_2 = \frac{W}{20}$$

$$\text{or } \frac{P_1}{P_2} = \frac{t_2}{t_1} = \frac{20}{15} = 4/3$$

29. (A) As per the given distance-time graph, at P, the car moves with a constant speed. At Q, the car is stationary. (The distance remains the same). At R, the car moves with a constant speed. At S, the car moves with a decreasing speed. At T, the car moves with an increasing speed. So, at point S, the car is moving with a decreasing speed.

30. (B) F = ma

$$a = \frac{F}{m}$$

The mass, m, of an object needs to be known.

31. (A) Power = 4.9 kW = 4900 Watt

Work done (30 min) = 4900 × 30 × 60 J

If m is the mass of water in kg that is pumped out from a depth of 20 m in 30 minutes, then total work done in minutes = mgh = m × 9.8 × 20 J

$\therefore$ 4900 × 30 × 60 = m × 9.8 × 20

$$\Rightarrow m = \frac{4900 \times 30 \times 60}{9.8 \times 20} = 45\ k\ell$$

32. (A) For a moving particle, if displacement decreases with time, the body is moving towards its initial position.

33. (D) The impulse delivered to the ball is equal to its change in momentum. The momentum of the ball was mv before hitting the wall and m(-v) after. Therefore, the change in momentum is m(-v) – mv = –2mv, so the magnitude of the momentum change (and the impulse) is 2mv.

34. (A) As the force and the displacement of the box and the mass upward are in the same direction, the work done is positive as there is an increase in potential energy.

35. (D) Mass of the earth = 6×10^{24} kg

Radius of the earth = 6.4×10^3 km

G = 6.67×10^{-11} N m^2 kg^{-2}

Mass of a ball = 60 kg

$$F = G \times \frac{m_1 m_2}{r^2}$$

$$\Rightarrow F = \frac{6.67 \times 10^{-11} \times 6 \times 10^{24} \times 60}{(6.4 \times 10^6)^2} = 586.2 \text{ N}$$

CHEMISTRY

36. (D) $C + O_2 \rightarrow CO_2$

The atomic mass of C is 12 g/mol.

The number of moles of C

$$= \frac{1.5g}{12\ g/mol} = 0.125\ mol$$

1 mole of C reacts with 1 more of O_2 0.125 moles of C will react with 0.125 moles of O_2.

The molecular weight of O_2 is 32 g/mol.

Mass of O_2 = 0.125 mol × 32 g/mol = 4 g

37. (C) A saturated salt water solution on heating dissolves some more solute, but on cooling again that extra solute dissolved crystallizes out. But as no more salt is added, no change takes place.

38. (B) Gram atomic weight of He = 4 g

Number of moles

$$= \frac{\text{Given weight of element}}{\text{Gram atomic weight}} = \frac{6.46}{4}$$

= 1.615 moles

39. (A) A mixture of water and milk cannot be separated by filtration as both get mixed due to their miscibility and homogeneous nature.

A mixture of powdered salt and sugar can be separated by fractional crystallisation.

Loading is a process that involves use of alum.

Salt from sea water is obtained by evaporation.

40. (C) Boiling point of ethane = – 88°C. Temperature on Kelvin scale = Temperature on Celsius scale + 273.15 Kelvin = – 88°C + 273.15 K = 185.15 K

41. (D) Molecules of both phosphorus (P_4) and ammonia (NH_3) are tetra-atomic.

42. (D) Mixtures that are heterogeneous and solid-in-liquid can be separated by filtration.

43. (B) Gram molecular weight of NaOH

= 23 + 16 + 1 = 40 g

Number of moles in 60 g of NaOH

$$= \frac{60}{40} = 1.5 \text{ moles}$$

44. (D) The zig-zag motion exhibited by the particle is called Brownian motion.

45. (A) Symbol of tin is Sn. Symbol of uranium is U, carbon is C and boron is B respectively.

BIOLOGY

46. (B) It helps in protein synthesis

47. (B) Mitochondria and ribosomes are present in all cells.

48. (D) Tendon made of collagen, connects muscle to bone, capable of bearing stress, is a tough connective tissue.

49. (D) Undigested matter, unconsumed matter and waste products are all stores of chemical energy that are not assimilated by subsequent trophic levels, and hence are lost to the environment.

50. (D) When excess fertilisers containing nitrates and phosphates are washed into a river, the concentration of these nutrients will increase. They can be used the growth of algae and aquatic plants. Eventually, an algal bloom develops on the surface but it will deprive submerged plants of sunlight. When the submered plants die, they will be decomposed by bacterial cells, which use up oxygen in the river. Eventually, other organisms such as fish and aquatic animals will die.

51. (D) The skin is suitable as the first line of defence in the human body due to its cornified outer layer serves as an effective barrier to microorganisms, sweat from the sweat glands contains the enzyme lysozyme and the mucous like nature of sebum traps microorganisms. Mast cells produce histamine and macrophages help to fight infection.

52. (D) Coelenteron is the gastrovascular cavity present in Cnidariant

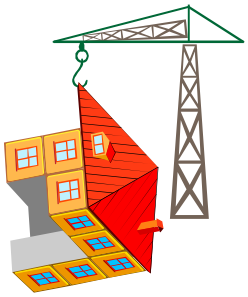
53. (D) The lignified walls of the cell wall provide greater structural support to prevent the xylem vessels from collapsing. Mature xylem vessels also lack protoplasm and cross walls between cells to minimise obstruction to the flow of water up the stem. Statement 1 is not a specific adaptation of the xylem because all plant cells have cellulose cell walls.

54. (A) The red blood cell or erythrocyte transports oxygen as oxyhaemoglobin and carbon dioxide as carbamino haemoglobin.

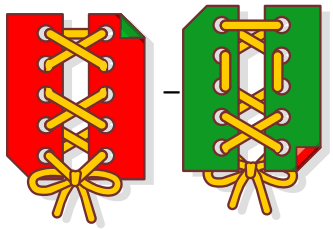
55. (D) The first line of defence in the human body is the skin that provides a barrier to the entry of any bacteria and the mucous membrane and the cilia of the tracheal epithelium helps to trap and eliminate pathogens.

CRITICAL THINKING

56. (A)



57. (C)



58. (A) Since one-half of the four hobbies are extreme sports, two of the bobbies are not extreme sports. It is not clear which hobbies are kite sports or mountain sports.

59. (B) Sum of digits 12:00 to 12:09 is 75

Sum of digits 12:10 to 12:19 is 85

Sum of digits 12:20 to 12:29 is 95

Sum of digits 12:30 to 12:39 is 105

Sum of digits 12:40 to 12:49 is 115

Sum of digits 12:50 to 12:59 is 125

Hence, sum of all the digit 12:00 to 12:59 is 75 + 85 + 95 + 105 + 115 + 125 = 600.

60. (C) Since, after every rest the exercise time of the boy reduces by 2 minutes, his exercise times are 15, 13, 11, 9, 7 and 5 which total up to 60 minutes. Since between every two sessions, the boy takes a rest of 2 minutes, the total rest required before he completes 60 minutes of exercise is 10 minutes i.e. Option C.

The End