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**NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION**

**Paper Code: UN426 (UPDATED)**

**Solutions for Class : 7**

**Mathematics**

1. (C) Given,  $5^x = 999$

$$\text{Consider, } 5^{x-3} = \frac{5^x}{5^3} \quad \left[ \frac{a^m}{a^n} = a^{m-n} \right]$$

$$= \frac{999}{125}$$

2. (A)  $124 \times 4 - 3 + 118 \div 2$   
 $= 496 - 3 + 59$   
 $= 493 + 59$   
 $= 552$

3. (C) Let the number of children be  $x$ .  
 Then  $(x - 3)16 = 144$   
 $\Rightarrow x = \frac{144}{16} + 3 = 9 + 3 = 12$

4. (B)  $(-a)^n$  is positive, when  $n$  is an even number.

5. (C) We know that,  
 $\angle x = 40^\circ$  [vertically opposite angles]  
 Now  $CD \parallel EF$   
 $\therefore \angle EOA = 180^\circ - 40^\circ$   
 [Interior angles on the same side of transversal]  
 Now,  $\angle y = \angle EOA$  [vertically opposite angles]  
 $\therefore \angle y = 140^\circ$

6. (B)  $x\%$  of  $x = \frac{x^2}{100}$

Let  $\frac{x^2}{100}$  is equal to 10% of  $y$

$$\frac{10}{100} \times y = \frac{x^2}{100}$$

$$y = \frac{x^2}{100} \times \frac{100}{10} = \frac{x^2}{10}$$

7. (C)  $\triangle AEC \cong \triangle ADB$ .

8. (C) Let the C.P of the heater be ₹  $x$ .

$$\text{Then, gain} = ₹ \left( \frac{x}{6} \right)$$

$$\Rightarrow \text{S.P} = ₹ \left( x + \frac{x}{6} \right) = ₹ \frac{7x}{6}$$

$$\Rightarrow \frac{7}{6}x = 322$$

$$\Rightarrow x = \left( 322 \times \frac{6}{7} \right) = 276$$

$\therefore$  C.P = ₹ 276 and S.P = ₹ 322

$$\Rightarrow \text{Gain} = (\text{S.P}) - (\text{C.P})$$

$$= ₹ (322 - 276) = ₹ 46$$

$$\Rightarrow \text{Gain}\% = \left( \frac{\text{Gain}}{\text{C.P}} \times 100 \right)\%$$

$$= \left( \frac{46}{276} \times 100 \right)\% = \frac{50}{3}\% = 16\frac{2}{3}\%$$

$$\text{Hence, gain}\% = 16\frac{2}{3}\%$$

9. (D) Given that third pair of sides are not equal and they cannot be congruent.

10. (B)  $2a + 2a + 2 + 4a - 2 = 24$  cm  
 $\Rightarrow 8a = 24$  cm  
 $\therefore a = 3$  cm.  
 $\therefore$  The sides of the triangle are  $2(3)$  cm,  $(2(3)+2)$  cm and  $(4(3)-2)$  cm i.e, 6 cm, 8 cm and 10 cm.

$\therefore$  Hence, the shortest side of the triangle is 6 cm

11. (A) For 10 observations, the median would be the average of the 5<sup>th</sup> and 6<sup>th</sup> observations. Since they are unaffected with the increase in 7<sup>th</sup> entry, the median will be unchanged.

12. (A) In  $\Delta ABD$ ,  $\angle BAD + \angle b + 90^\circ = 180^\circ$   
 $\angle b = 180^\circ - 90^\circ - 48^\circ = 180^\circ - 138^\circ$   
 $\angle b = 42^\circ$   
 $\angle DAC = 360^\circ - (290 + 48) = 22^\circ$   
 In  $\Delta ADC$ ,  $\angle DAC + \angle a + 90^\circ = 180^\circ$   
 $\angle a = 180^\circ - 90^\circ - 22^\circ$   
 $\angle a = 68^\circ$   
 difference =  $68^\circ - 42^\circ = 26^\circ$

13. (C)  $\square + \square = \triangle + \square + \triangle$   
 $\Rightarrow 2 \square = 2\triangle + \square$   
 $\Rightarrow \square = 2\triangle$   
 $\Rightarrow 50 = 2\triangle$  ( $\square$  Given  $\square = 50$ )  
 $\therefore \triangle = 25$

Also,  $\triangle + \square = 2 \circ$   
 $\Rightarrow 25 + 50 = 2 \circ$   
 $\Rightarrow 75 = 2 \circ$   
 $\therefore \circ = 37.5$

Hence,  $\triangle < \square$

14. (A)  $\frac{3}{4}x - \frac{2}{5}ax - y + \frac{1}{3}ax - \frac{1}{8}x$   
 $\Rightarrow x\left(\frac{3}{4} - \frac{1}{8}\right) - ax\left(\frac{2}{5} - \frac{1}{3}\right) - y$   
 $\Rightarrow x\left(\frac{6-1}{8}\right) - ax\left(\frac{6-5}{15}\right) - y$   
 $\Rightarrow x\left(\frac{5}{8}\right) - ax\left(\frac{1}{15}\right) - y$   
 Given  $a = 3$ ,  $x = -2$ ,  $y = -6$   
 $\Rightarrow -2\left(\frac{5}{8}\right) - (3)(-2)\left(\frac{1}{15}\right) - (-6)$   
 $\Rightarrow \frac{-5}{4} + \frac{2}{5} + 6$   
 $\Rightarrow \frac{-25+8+120}{20}$   
 $\Rightarrow \frac{103}{20} = 5\frac{3}{20}$

15. (C)  $(-3) \square (-8) \square (-4) \square 2 \square$   
 $(-2) = 3$   
 $(-3) + (-8) \div (-4) - 2 \times (-2)$   
 $(-3) + 2 + 4 = -3 + 6 = 3$

16. (D) In the given figure :  
 $MD = MC = EC = EB = AB$   
 $\Rightarrow DC = MD + MC = CE + EB = CB \dots (i)$   
 and  $AB = EC \dots (ii)$

Consider  $\Delta DEC$  and  $\Delta CAB$   
 $DE = CA$  [given]  
 $DC = CB$  [from Eq.(i)]  
 $EC = AB$  [from eq.(ii)]  
 $\Delta DEC \cong \Delta CAB$

17. (A)  $\frac{C.P}{S.P} = \frac{5}{6}$   
 $\Rightarrow S.P = \frac{6}{5}C.P$   
 $\text{gain \%} = \frac{S.P - C.P}{C.P} \times 100$   
 $\Rightarrow \frac{\left(\frac{6}{5} - 1\right)C.P}{C.P} \times 100$   
 $\Rightarrow \frac{1}{5} \times 100 = 20\%$

18. (C) The  $\Delta ABC$  cannot be constructed as vertex B cannot be uniquely located.

19. (C) Given  
 $A = 10w^3 + 20w^2 - 55w + 60$   
 $B = -25w^2 + 15w - 10$   
 $C = 5w^2 - 10w + 20$   
 $A + B = (10w^3 + 20w^2 - 55w + 60) + (-25w^2 + 15w - 10)$   
 $A + B = 10w^3 + 20w^2 - 25w^2 - 55w + 15w + 60 - 10$   
 $A + B = 10w^3 - 5w^2 - 40w + 50$   
 Now,  $A + B - C = (10w^3 - 5w^2 - 40w + 50) - (5w^2 - 10w + 20)$   
 $A + B - C = 10w^3 - 10w^2 - 30w + 30$

20. (D) AAA is not a congruent criteria

21. (B)  $RT = (n - 1) \times 100$

$$R = \frac{(2-1) \times 100}{20}$$

$R = 5\%$

22. (B)  $a > b < c$   
 $\therefore$  'b' is the smallest rational number.

23. (B) If an angle is its own supplementary angle, then  
 $x + x = 180^\circ$   
 $\Rightarrow 2x = 180^\circ$   
 $\therefore x = 90^\circ$

24. (D) Total letters = 11  
 Vowels in the word PROBABILITY = O, A, I, I  
 $\therefore$  Required probability =  $\frac{4}{11}$

25. (A) Let the number be x. Then according to the problem,  
 $\frac{(x+4) \times 5 - 20}{8} = 10$   
 $\Rightarrow x = 16$

### Physics

26. (A) When the air trapped in the dough of a cake gains heat, it expands, so the dough rises when heated. After taking out the cake from the oven for a few minutes, the cake will become cooler as it will lose heat to the surroundings. Hence, the air trapped in the cake will contract and occupy less space due to shrinking.
27. (C) Distance covered (S) = 30 m.  
 Time (t) = 1.5 min = 90 s  
 $\therefore \text{Speed} = \frac{S}{t} = \frac{30 \text{ m}}{90 \text{ s}} = 0.33 \text{ m/s}$
28. (A) A current carrying wire behaves like a magnet and affects other magnets in its magnetic field.
29. (C) During the day, the land gets heated up more quickly than the sea. The air above the land becomes warm and rises. Cooler air above the sea rushes into replace the rising air. This is known as the sea breeze. At night, the land loses heat more quickly than the sea. The warm air above the sea rises and is replaced by cooler air from above the land. This is known as the land breeze.
30. (B) One of the factors that determines the strength of the electromagnet is the number of turns per unit length on the coil. The more concentrated the turns are being packed, the stronger will be the magnetic field strength. It also depends on the flow of current through the coil.

	Coil (cm)	Turns (No.)
Option (A)	10	100
Option (B)	5	200
	5	200
Option (C)	10	200
Option (D)	20	200

So, if we double the length of coil in option (B)  $5 + 5 = 10$  cm and also the turns  $200 + 200 = 400$  turns to equate with option (A), (C), coil with 5 or 10 cm length with 200 or 400 turns produces a strong electromagnet.

Option (B) has an equivalent of 400 turns in a coil length of 10 cm.

31. (B) Total distance travelled is  $4 \text{ km} + 5 \text{ km} + 6 \text{ km} = 15 \text{ km}$ .

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}} = \frac{15 \text{ km}}{25 \text{ km per hour}}$$

$$= 0.6 \text{ hour} = 36 \text{ minutes}$$

32. (C)
- (i) A plane mirror always forms a virtual, erect image of the same size as that of the object.
  - (ii) A concave mirror forms a virtual, erect and magnified image of an object.
  - (iii) A concave lens always forms a virtual, erect and diminished image of an object.
33. (B) Water becomes less dense as it is heated. By placing the heating element at the base of the water heater, it heats up the water at the bottom of the heater first. The heated water rises and is replaced by cooler water, resulting in a convection current. Thus, the water in the heater will be heated more quickly and evenly.

34. (B)  $1 \text{ h} = 3600 \text{ s}$   
 $1 \text{ km} = 1000 \text{ m}$   
 Student P's speed in m/s =  $12000/3600$   
 $= 3.33 \text{ m/s}$   
 Student Q's speed in m/s =  $\frac{4000}{3600}$   
 $= 1.11 \text{ m/s}$ .  
 Therefore, student Q runs faster than student P.

35. (D) As light travels in straight lines, he could not see the candle flame through the holes because the holes in the cards were not arranged in a straight line. In order for him to see the candle flame, the holes in the cards must be aligned.

36. (C) If similar terminals of identical cells in the circuit are connected together, no electric current flows in the circuit. Hence, the bulb does not glow.

37. (B) Light is a form of energy.

38. (A) The image is at the same distance behind the plane mirror as the object is in front.

39. (D) Steel is a good heat conductor. The steel ruler would conduct heat away quickly from the boy's hand/fingers. As his hand/fingers would lose more heat to the steel ruler than to the plastic ruler, his hand felt cooler when touching the steel ruler.

40. (D) The amount of heat produced in a wire depends on the

(i) material, (ii) length and (iii) thickness.

41. (D) All states of matter expand on heating. However, solids expand the least, liquids more and gases the most for the same rise in temperature. Liquids expand more than solids for the same temperature change.

42. (D) Electric iron is one of the devices which produces heat as a useful form of energy. It changes electrical energy into heat energy.

43. (C) Average speed

$$= \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

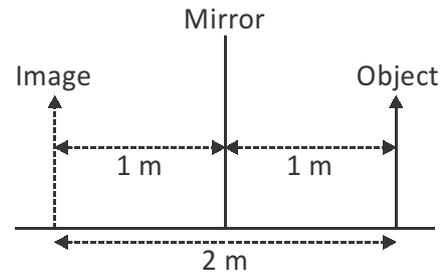
$$= \frac{250 \text{ km} + 250 \text{ km}}{5 \text{ h} + 5 \text{ h}}$$

$$= \frac{500 \text{ km}}{10 \text{ h}} = 50 \text{ km/h.}$$

Thus, the average speed of the bus for the whole journey (both ways) is 50 kilometres per hour.

44. (C) For  $30^\circ\text{C}$  ( $40^\circ\text{C} - 10^\circ\text{C}$ ) change in temperature, it expands by 24 mm. Therefore for every  $5^\circ\text{C}$ , it expands by 4 mm. For a drop of  $25^\circ\text{C}$ , the contraction =  $5 \times 4 \text{ mm} = 20 \text{ mm}$ .

45. (C) The distance from the image to the mirror is 1 m.



46. (A) Distance to be covered (S) = ?

Time (t) = 45 s

Speed = 15 m/s

$$\text{Now, speed} = \frac{S}{t}$$

$$\therefore S = \text{Speed} \times t = 15 \text{ m/s} \times 45 \text{ s} = 675 \text{ m.}$$

47. (D) Cold air is denser and sinks to the ground.

Option (A): Warm air is less dense and rises.

Option (B): Warm air is less dense than cold air.

Option (C): Cold air is denser. It does not rise upwards.

48. (B) According to the laws of reflection, the angle of incidence is equal to the angle of reflection,  $\angle i = \angle r = 50^\circ$   
i.e.,  $50 + 50^\circ = 100^\circ$

49. (A) If an object is moving with a constant speed, the distance-time graph is a straight line.

50. (A) Iron is a metal and metals are good conductors of heat. Wood, rubber and plastic are not good conductors of heat.

### Chemistry

51. (D) In a chemical change, the product is chemically different from the reactant. Energy is involved in bringing about the change. The evaporation of water is a change in state – the water has changed from the liquid to gaseous state. This is a physical change.
52. (B) An anemometer is a device used for measuring wind speed.
53. (C) Powdered limestone must be added to neutralise any acid in the dilute acidic waste before disposal.
- Option (A):** The surface area of marble chips is too small to come into contact with the acid.
- Option (B):** Sodium hydroxide would neutralise acid but it is a strong alkali and it is just as harmful as acid to aquatic plants and animals.
- Option (D):** Concentrated ammonia would neutralise acid but it is a strong alkali and it is just as harmful as acid to aquatic plants and animals.
54. (B) The rotation of the earth causes the cold winds from the polar regions to blow towards the equator and they also move partially towards the west.
55. (B) White crystals of sugar on heating change into a black solid called caramel that has mainly carbon and water vapour. Examples given in options (A), (C) and (D) show changes in state, which are physical.
56. (D) Oxalic acid is found in spinach.
57. (D) The water table at a place depends on the rainfall and water seepage. Constructing factories and houses, making concrete roads and floors obstructs the rainfall and does not allow water seepage to take place. Deforestation also is another cause for depletion of water table at a place.
58. (C) Sodium bicarbonate being a base neutralises the acid released into human skin by stings of bees or ants.
59. (A) Wind movements are caused by uneven heating of air on the earth.
60. (D) Water is not an element. It is a compound made up of two hydrogen atoms and one oxygen atom bonded chemically. It can be broken down into simpler substances by chemical processes.

61. (C) If you are travelling by car or by bus, you are safe inside with windows and doors of the vehicle shut.
62. (D)  $\text{CaO}$ ,  $\text{CO}_2$  and  $\text{H}_2\text{O}$  are all compounds.
63. (A)  $\text{NaCl}$  solution in water is neutral i.e.,  $\text{pH} = 7$ , the same as that of distilled water as  $\text{NaCl}$  is formed from a strong acid and a strong base.
64. (B) Air at  $40^\circ\text{C}$  rises the highest as gases expand more when they absorb heat.
65. (D) Calcium oxide (quicklime) when placed in water reacts with it forming calcium hydroxide.
- $$\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 \text{ slaked lime} + \text{heat energy}$$
- Calcium oxide + Water  $\rightarrow$  Calcium hydroxide + heat energy.
- Quicklime when placed in water gives out a large amount of heat, such that water starts boiling. Quicklime reacts with water forming slaked lime (calcium hydroxide) which settles at the bottom forming a smooth creamy layer. The water above the slaked lime has very small amount of calcium hydroxide dissolved in it.
66. (D) Oxygen is an element, air is a mixture of gases and water vapour ( $\text{H}_2\text{O}$ ) is a compound.
67. (D) Water is utilized mainly for three purposes as given below.
- |       |                            |                  |        |
|-------|----------------------------|------------------|--------|
| (i)   | Irrigation for agriculture | –                | 85%    |
| (ii)  | Usage in industries        | –                | 7%     |
| (iii) | Domestic requirements      | –                | 3%     |
|       |                            | <hr/>            |        |
|       |                            | Total            | – 95%  |
|       |                            | <hr/>            |        |
|       |                            | Unutilized water | – 5%   |
|       |                            | <hr/>            |        |
|       |                            |                  | = 100% |
68. (D) Evaporation and condensation are physical changes. Combustion is a chemical change where new substance(s) are formed.
69. (B) Sodium, magnesium and calcium are metals. Ammonium hydroxide ( $\text{NH}_4\text{OH}$ ) is the only commonly used base (alkali) which does not have a metal in its molecule. Instead, it has ammonium ( $\text{NH}_4$ ) radical in it.
70. (C) A ball falls on to the ground due to the gravitational force exerted by the earth on the ball but not because of air (atmospheric) pressure.

**Biology**

71. (C) As X and Y are storage roots, they cannot make food by themselves. During photosynthesis, the leaves make food and transport it downwards through the phloem tubes in the stem. The excess food is stored as starch in X and Y.
72. (D) The diagram shows a villus. It is richly supplied with blood vessels and it increases surface area for better absorption of digested food.
73. (C) The life cycle of a plant starts with a seed, followed by the radicles which help absorb water from the soil. Soon, the plumule will appear and it will grow leaves.
74. (C) The digested food is absorbed in the small intestine in the human digestive canal.
75. (B) Plasma of blood carries digested food and urea.
76. (A) X is the stem of a plant. Arrows P and Q represent water which is absorbed by the roots of the plant and transported by the stem to the green leaf. The green leaf makes food for the plant. R and S represent the food. The food is transported by the stem to the roots.
77. (A) The lungs have minute air sacs called alveoli. Alveoli are the small sacs where the exchange of gases takes place. In the lungs, oxygen from the air we breathed in is absorbed into the blood and unwanted carbondioxide is removed from the blood.
78. (D) During the process of photosynthesis green plants prepare food in the presence of sunlight and chlorophyll. The absorbed light energy from the sun is used by plants to make seeds, flowers, fruits etc., that has chemical energy.
79. (C) Formation of RBC's is called erythropoiesis. It occurs in liver and spleen of foetus. It also occurs in bone marrow. Human RBC's remain functional in the blood for about 120 days. The worn out RBC's are destroyed by phagocytosis.
80. (B) Saliva contains amylase and which breaks down the starch in bread to maltose, disaccharide which tastes sweet.
81. (B) Saliva does not contain any metabolic waste products or toxins and is therefore not an example of an excretory product. Exhalation contains carbon dioxide which is the metabolic waste product of respiration. Sweat and urine contains nitrogenous waste products and excess mineral salts.
82. (A) If the stigma is removed, there is no place for the pollen grains to land on. Hence, the pollen grains from the anther will not be able to reach the ovum in the ovary. Thus, fertilisation will not take place.
83. (D) Small intestine in herbivores is longer than in carnivores as they feed on plants. Eating plants needs a longer time to allow complete digestion of cellulose.
84. (C) Ureter carries the urine produced in the kidney to the urinary bladder.
85. (B) P represents artery, Q – vein and R - capillaries.
86. (D) Respiration is both aerobic and anaerobic. The products of anaerobic respiration in yeast are carbon dioxide and ethanol. The products of anaerobic respiration in muscle cells are carbon dioxide and lactic acid. Glucose is not a product of respiration but a substrate.
87. (D) P represents the trachea because it is the tube that brings in air from the outside to the balloons which represent the lungs. The trachea then branches out into two bronchi, represented by Q. R is the bell jar which contains the balloons in an airtight chamber and it most closely resembles the rib cage.
88. (A) The correct order is root hair, root, xylem tube and lastly the leaf.
89. (D) In the given figure P - Emergent, Q - Canopy, R - Understorey and S - Forest floor.
90. (C) The given figure shows photosynthesis in hydrilla plant. Due to photosynthesis oxygen gas is released. Oxygen is needed by all organisms, for combustion and burning things brightly.
91. (A)      92. (A)      93. (C)  
94. (C)      95. (D)      96. (A)  
97. (C)      98. (C)      99. (A)  
100. (D)