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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION - 2015 (UPDATED)

Paper Code: UN412

Solutions for Class : 7

Mathematics

1. (C) 20^{15} has unit digit 0 which is an **even number**.

2. (C) Reverse the test fraction, i.e., $\frac{1}{3}$ becomes

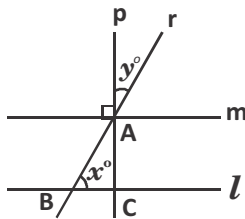
$$\frac{3}{1} = 3.$$

Reverse each alternative and find which alternative is greater than $\frac{3}{1}$.

$$\frac{63}{22} < \frac{3}{1}, \frac{11}{4} < \frac{3}{1}, \frac{46}{15} > \frac{3}{1}, \frac{98}{33} < \frac{3}{1}$$

∴ Required fraction is $\frac{15}{46}$.

3. (C)



In $\triangle ABC$, $\angle BAC = y^\circ$
(since alternate angles)

$$\therefore x^\circ + y^\circ + 90^\circ = 180^\circ$$

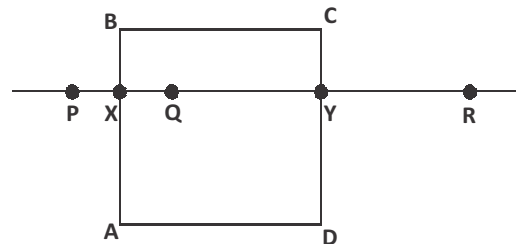
$$\Rightarrow x^\circ + x^\circ = 90^\circ$$

$$x^\circ = 45^\circ$$

4. (B) Let x be a rational number whose decimal expansion terminates, then x can be

expressed in the form $\frac{p}{q}$, where p and q are coprime, and the **prime factorization of q is of the form $2^n 5^m$** , where n, m are non-negative integers.

5. (A)
$$\frac{2 \times 3^4 \times 2^5}{9 \times 4^2} = \frac{2^6 \times 3^4}{3^2 \times 2^4}$$
$$= 2^{6-4} \times 3^{4-2} = 2^2 \times 3^2$$
$$= 4 \times 9 = 36$$



6. (B)

Given, $BC = 4 \Rightarrow XQ + QY = 4$

P, Q are symmetric about line AB

$$\Rightarrow PX = XQ$$

Q, R are symmetric about line CD

$$\Rightarrow QY = YR$$

$$\therefore PR = PX + XQ + QY + YR$$

$$= XQ + XQ + QY + QY$$

$$= 2(XQ + QY) = 2(XY) = 8$$

∴ **The length of PR is 8.**

7. (D)

$BC = AD = 4$ units

Length of 1 rectangle is 4 units.

Breadth of rectangle is 1 unit.

$$AB = 1 + 4 = 5 \text{ units}$$

$$\text{Perimeter} \rightarrow 1 + 4 + 4 + 1 + 4 + 4 = 18 \text{ units}$$

$$18 \text{ units} \rightarrow 54 \text{ cm}$$

$$1 \text{ unit} \rightarrow 54 \div 18 = 3 \text{ cm}$$

$$AD = BC = 4 \times 3 = 12 \text{ cm}$$

$$AB = DC = 5 \times 3 = 15 \text{ cm}$$

$$\text{Area of } ABCD = AB \times AD = (15 \times 12) \text{ cm}^2 = 180 \text{ cm}^2$$

The area of $ABCD$ is **180 cm²**.

8. (C)

From the options it can be found the $50 - 5 = 45$ and $20 - 5 = 15$

i.e., $15 \times 3 = 45$, this satisfies the first condition

and $50 + 10 = 60$ and $20 + 10 = 30$

i.e., $30 \times 2 = 60$, this satisfies the second condition.

Hence, the present ages of man and his son are **50 years** and **20 years** respectively.

9. (A) According to the properties of triangles, the sum of any two sides of a triangle is always greater than the third side.

Number of different triangles with the sides **2, 7 and x** is one.

10. (C) $0.\overline{xy} = \frac{xy}{99}$
11. (B) One positive integer is enough to make the sum of eleven different integers as zero. Hence, the required least number of positive integers is **one**.

12. (D) P, Q, R and S are the nets of the cuboid.

13. (D) If $\triangle ABC \cong \triangle PQR$, then $AB = PQ$,

$AC = PR$, $BC = QR$

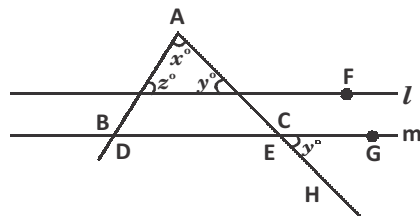
$\angle ABC = \angle PQR$, $\angle BCA = \angle QRP$,
 $\angle CAB = \angle RPQ$

14. (B) $(2a^3 - 3)(5a^3 - 2)$
 $= 2a^3 \times (5a^3 - 2) + (-3) \times (5a^3 - 2)$
 $= 10a^6 - 4a^3 - 15a^3 + 6$
 $= 10a^6 - 19a^3 + 6$
 $= -19a^3$

15. (C) Let the initial price be ₹ 100.
Price after increase of 10% = ₹ 110
% decrease in the new price = 25%
 \therefore The price after decrease of 25%
 $= \frac{75}{100} \times 110 = ₹ 82.5$

\therefore The required percentage = $\frac{82.5}{100} \times 100$
= 82.5%

16. (D)



$\angle BCA = \angle ECF = \angle HEG = y^\circ$

In $\triangle ABC$, $x^\circ + y^\circ + z^\circ = 180^\circ$

$z^\circ = 180^\circ - x^\circ - y^\circ$

17. (C) Given a, b are odd integers
 $\Rightarrow (a + 1)b = \text{even}$ [since, $a + 1$ is even]
 $(a + 1) + b = \text{odd}$
[sum of even and odd numbers]
 $(a + 1) - b = \text{odd}$
[Difference of even and odd numbers]
 \therefore (ii) and (iii) are odd integers.

18. (A) $x(y - z) - y(z - x) - z(x - y)$
 $= xy - xz - yz + xy - zx + yz$
 $= 2xy - 2zx$
 $= 2x(y - z)$

19. (D) The given expression, $3p - 2 = 7$ can be expressed as 2 is subtracted from $3p$ to get 7, difference of $3p$ and 2 for $3p > 2$ to get the result as 7.

But $3p$ is 7 more than 2 gives expression as $3p = 7 + 2$

Hence, **$3p$ is not 2 less than 7.**

20. (D) Since, in a triangle, sum of two sides is greater than third side.

Hence, a triangle can be constructed with side **7, 8, 9.**

21. (B) Perimeter of each semicircle = πr
 $= 3.14 \times 10 = 31.4 \text{ m}$

\therefore Perimeter of 5 semicircles = 5×31.4
 $= 157 \text{ m}$

Hence, length of wire needed to form the given figure is **157 m.**

22. (A) The given numbers can be arranged in ascending order as

$$\frac{1}{5} < \frac{3}{5} < \frac{7}{5} < \frac{9}{5}$$

The greatest number = $\frac{9}{5}$;

The least number = $\frac{1}{5}$.

We have, $\frac{9}{5} \times \frac{x}{100} = \frac{1}{5}$

$$\Rightarrow x = \frac{100}{9} = 11\frac{1}{9}\%$$

23. (B) $\frac{8^a}{2^a} = 2$, since $b \neq 0$
 $\therefore 2^{3a-a} = 2^1$
 $\Rightarrow 2a = 1$

$$\therefore a = \frac{1}{2}$$

24. (B) $y + 3 = 25^\circ \Rightarrow y = 22^\circ$
 $x - 8 = 65^\circ \Rightarrow x = 73^\circ$

\therefore The values of x and y are **73° and 22° .**

25. (D) Let S.P. be ' x '.

$$\frac{S.P_1}{100 + x_1} = \frac{S.P_2}{100 + x_2}$$

$$\Rightarrow \frac{x}{100 + 16} = \frac{x + 20}{100 + 20}$$

$$\Rightarrow \frac{x}{116} = \frac{x+20}{120}$$

$$x = 580$$

We have

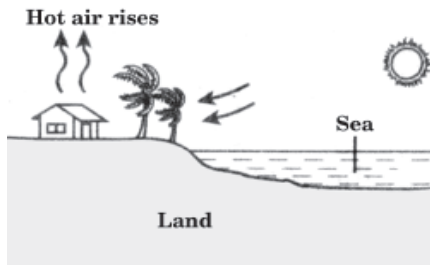
$$\text{C.P.} = \frac{100 \times \text{S.P.}}{100 + x}$$

$$= \frac{100 \times 580}{100 + 16}$$

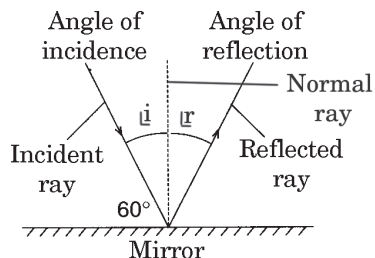
$$= 500$$

Physics

26. (A) Heat received from the sun during the day time makes the air above the land warmer than that above the water. This makes the air over the land to rise up. The cooler air from over the sea flows in towards the land to take the place of the rising air. So, the temperature of the land is higher than the temperature of water as shown below.



27. (A)



The angle between the plane mirror and the normal ray is 90° . An incident ray strikes the plane mirror at 60° to the normal ray and gets reflected.

The angle formed between the incident ray and the normal is the angle of incidence i.e., $90^\circ - 60^\circ = 30^\circ$.

The angle formed between the reflected ray and the normal is the angle of reflection i.e., $90^\circ - 60^\circ = 30^\circ$.

As per the laws of reflection the angle of incidence is equal to the angle of reflection. As the angle of incidence = 30° , the angle of reflection is also 30° .

28. (D) Option (D) correctly represents the energy changes in electric iron, television and tubelight when electricity flows through them.

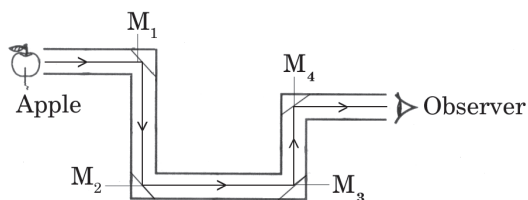
29. (B) Periodic events are used for the measurement of time. Periodic motion of a pendulum (swinging) is used to make clocks and watches.
30. (C) Objects grouped under 'X' are insulators and 'Y' are conductors of heat and electricity. Iron nails are made of metals which are good conductors of heat and electricity. Cotton is a poor conductor or insulator of heat and electricity.
31. (C) Electromagnet is not used in an electric bulb.
32. (D) Time taken by the sand to fall completely from the upper part to the lower part of the hourglass = 20 minutes. Time taken by a snail to eat a small leaf is the time taken for $\frac{3}{4}$ of the sand to fall to the bottom of the hourglass.

$$= 20 \times \frac{3}{4} = 15 \text{ minutes}$$

Time taken by the snail to eat a small leaf = 15 minutes.

33. (D) When the pencil is moved from position P to Q in front of a plane mirror, the image of the pencil remains unchanged. The image formed by a plane mirror is of the same size as the object. When the object is moved towards the mirror the image also moves behind the mirror.
34. (D) Tap water is around room temperature. The temperature inside the freezer is lower than 0°C . The temperature of melting ice is 0°C .
35. (C) Distance = (300×2) km
Speed = 60 km/h
Time taken = $\frac{2 \times 300}{60}$ h
 \therefore Time they can go off duty
 $= 8 \text{ a.m.} + \frac{2 \times 300}{60} \text{ h}$
 $= 6 \text{ p.m.}$
The policemen can go off the duty at 6 p.m. on the same day.
36. (A) Four plane mirror strips must be fixed at the four corners at an angle of 45° with the sides of the tube. The light rays coming from the object (apple) are reflected four times by the plane mirrors as shown in the given figure and reach the eye of the observer

who sees the image of the object (apple).



37. (D) Heating elements in electrical appliances need to have high melting point. Otherwise, they will melt when heated.

38. (D) At points b, f and h, the man drove his car at a constant speed.

39. (B) When an object is placed in front of a plane mirror or a concave lens, the image formed is always virtual and erect.

In the case of a plane mirror, the object size and the image size are the same. In the case of a concave lens, the image formed is virtual, erect but smaller in size than the object.

A convex lens forms a real and inverted image when the object is placed away from the lens.

When the object is placed very close to the convex lens, the image formed is virtual, erect and magnified.

The convex lens is called a magnifying glass or lens.

40. (B) An electric bell works on the principle of magnetic effects of electric current. In the given circuit, the bimetallic strip must be reversed such that the iron strip is in contact with the contact screw. When the current flows through the circuit, the iron strip acquires magnetism and gets attracted to the contact screw completing the circuit. Then the hammer strikes the gong producing sound for some time. The gap between the iron strip and the contact screw acts as a switch. Once the gap is more, it is in OFF position and the bell does not ring anymore.

41. (B) The quantity of liquids in all the bottles is same with identical thermometers placed in them. Thermometer in bottle (B) shows a decrease in the temperature of the liquid when compared with the thermometer readings in other bottles. Hence, the liquid in bottle (B) is the coolest.

42. (B) Statements (A), (C) and (D) are not correct. As the student walks with the same speed to both the places, we can conclude that his father's field is nearer than the place where his tuition is held.

43. (C) The temperature at which a liquid boils and changes rapidly into a gas at atmospheric pressure is called boiling point of the liquid. When water is heated to a temperature of 100°C , it boils rapidly to form a gas called steam. At t_3 minutes, water completely changes into steam as per the given heating graph.

At the temperature of 100°C , water boils and starts changing into steam. As more heat is supplied to water, more steam is formed but there is no rise in the temperature during the boiling of water. Once the water has begun to boil, the temperature remains constant at 100°C until all the water has changed into steam.

44. (D) A student while conducting an experiment to prove the suitability of material for making a heating coil has retained the length of the wire, number of batteries and number of bulbs constant in the circuit. She carried out the experiments by changing the material (coil) made of different metals.

45. (D) All the given statements are true of the image formed in a plane mirror.

46. (C) Among the four copper blocks, block 2 has more mass i.e., 800 g. A copper block of higher mass absorbs more heat than the copper block with the lower mass. Hence, copper block 2 has most of the heat followed by blocks 4, 3 and 1 respectively.

47. (D) (i) A reflecting telescope has a concave mirror that helps us to see distant objects clearly.

(ii) A simple and a compound microscope has a plane mirror fitted below the platform. The specimen to be viewed is placed on the platform. When light falls on the plane mirror, it gets reflected. This reflected light enables us to see the image of the specimen through the eye piece.

(iii) A periscope has two plane mirrors fixed at the two corners making an angle of 45° . It enables us to see the objects above the earth and in the water due to reflection. So, all the given instruments is different types of mirrors to reflect light.

48. (D) Batteries in the remote-controlled car have chemical energy that is converted to electrical energy in the electric circuit. The electrical energy is then converted to kinetic energy when the car moves, light energy when it lights up and sound energy when it makes sounds.

49. (C) The cooking utensils are made of metals which are good conductors of heat. Dark surfaces are good absorbers of heat. The base of cooking utensils are usually black and dull to absorb heat instantly from the heat source.

50. (B)
$$\text{Speed} = \frac{\text{Distance travelled}}{\text{Time}}$$

$$\text{Speed of runner(P)} = \frac{100}{13} = 7.69 \text{ m/s} \dots \text{III}$$

$$\text{Speed of runner(Q)} = \frac{100}{13.5} = 7.41 \text{ m/s} \dots \text{II}$$

$$\text{Speed of runner(R)} = \frac{100}{14} = 7.14 \text{ m/s} \dots \text{I}$$

$$\text{Speed of runner(S)} = \frac{100}{12} = 8.33 \text{ m/s} \dots \text{IV}$$

The correct arrangement of increasing speeds of runners is R, Q, P, S.

Chemistry

51. (B) Sodium chloride is a neutral salt that dissolves to form a neutral salt solution. The concentration of hydrogen ions in aq. HCl remained constant. Hence, the pH is not affected.

52. (C) Distribution of water is uneven on the earth. Rain also plays an important role in maintaining the proper level of underground water at a place. Water already used for washing rice, fruits and vegetables can be reused again to water the plants. In places of scanty moderate rainfall and other areas, cemented pits can be constructed to store rain water. This water can be used for future use.

53. (C) (i) Potential energy is the energy possessed by an object by virtue of its position.

(ii) Light energy is the energy emitted by natural and artificial sources of light.

(iii) Chemical energy is the energy present in a chemical substance.

Uneven heating on the earth is the main cause of wind movements. Strong winds carrying water vapour may cause rain. High speed winds and air pressure difference can cause cyclones. Strong winds possess more energy that causes damage to life and property on the earth.

54. (A) When the candle is lit, the wick starts burning. The heat melts the wax, which rises up the wick by capillary action. When the liquid wax reaches the burning wick, it

is vaporised (changes to gaseous state). The vaporised wax burns to release heat and light energy. Carbon dioxide and water are produced. As a result, the amount of wax decreases as the candle burns.

55. (B) Process X is evaporation. It takes place only on the surface of a liquid or water bodies. Evaporation occurs all the time continuously irrespective of the temperature, time and location.

56. (B) An aeroplane wing is flat at the bottom, curved on the top, rounded in the front and sloping to a sharp edge at the back. This shape is called an aerofoil or air foil.

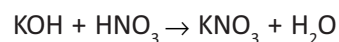
While the plane is in motion, the wing travels through the air and the air must travel either over or under the wing. The air passing over the top of the wing has a greater distance to travel than the air passing under the wing in the same period of time. Therefore, air must flow faster over the wing than the air flowing under the wing. The pressure of the faster moving air on the top decreases. Higher air pressure on the underside of the wing pushes the wing upwards, giving 'lift' to the plane and causing the plane to stay up in the air.

57. (C) P is $C_6H_{12}O_6$.

58. (C) When the pH of a solution drops below 7, it indicates the presence of an acidic substance (H^+ ions). Hence, the most likely cause of this change is that carbon dioxide from the air has dissolved into the water, forming a weak acid, carbonic acid.

59. (B) Wind is moving air. It produces a force that can change the direction and speed of the kite.

60. (A) Potassium hydroxide and nitric acid react to form potassium nitrate and water.



61. (B) Universal indicator is a mixture of solution of different indicators which give different colours at different pH values on the pH scale.

(i) Solution 'P' turned purple on testing with universal indicator solution. It is alkaline.

(ii) Solution 'Q' turned orange on testing with universal indicator solution. It is acidic.

(iii) Solution 'R' turned green on testing with universal indicator solution. It is neutral.

62. (C) Water from the sea gains heat from the sun or surroundings and evaporates into the air as water vapour. The water vapour loses

heat to the surroundings and condenses to form clouds.

63. (C) When a strip of zinc metal is placed in copper sulphate solution, a colourless zinc sulphate solution and copper are obtained. In this reaction, zinc displaces copper from copper sulphate compound and copper is set free (or liberated). A red brown deposit of copper metal is formed on the zinc strip. The blue colour of copper sulphate solution fades due to the formation of zinc sulphate (colourless solution). Zinc is more reactive than copper.
64. (C) Whenever the strong wind blows over tinned or straw roofs, the roofs are blown away. The reason for this is that the air pressure of the moving air over the roof decreases whereas the air pressure inside the house under the roof remains high as the air filling the house below the roof is calm (not in motion). Air from a zone of higher pressure gushes towards the zone of lower air pressure and causes the roof to lift up.
65. (B) Statements (A), (C) and (D) are true of water. Fresh water on the earth is limited. Global warming causes polar ice caps and glaciers of fresh water to melt and flow into the sea. This turns fresh water into sea water. Sea water increases and available fresh water decreases. As saline water cannot be used for irrigation, drinking, washing, bathing etc., the stored fresh water is used and causes a decrease in its level.
66. (A) The toxins in bee sting are acidic in nature. Its effect can be neutralised by a weak alkali such as bicarbonate of soda, NaHCO_3 made in the form of paste.
67. (D) Decomposition is the breakdown of a substance into its components. Fungi break down the compounds in wood to simpler substances. Yeast helps to break down the carbohydrates in wheat grain to form alcohol. The sugar in foods decomposes when heated, giving the characteristic smell, taste and colour of caramel. Decomposition does not occur in the baking of cookies.
68. (B) Carbon dioxide dissolves easily in cold water and forms a very weak organic acid called carbonic acid. It is used in soda or softdrinks.
69. (D) Runaway water flows away into drains and rivers and finally reaches the sea. To save this water embankments and dams should be constructed. If wells, ponds and lakes

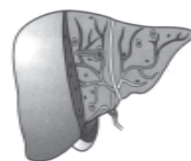
are dug at different places, this water instead of reaching the sea will get filled in them and can be used in future.

70. (A) The pH of a solution is inversely proportional to the concentration of hydrogen ions in it. A solution having a high concentration of hydrogen ions i.e., H_2SO_4 has a low pH value. On the other hand, a solution having low concentration of hydrogen ions has a high pH value i.e., HCl . The more basic a solution is, the higher will be its pH.

pH is a measure of the concentration of hydrogen ions in a solution. The lowest pH is the most acidic solution; the highest pH is the most alkaline solution. Sulphuric acid is a dibasic acid and will have twice the concentration of hydrogen ions than hydrochloric acid. Aqueous calcium hydroxide ($\text{Ca}(\text{OH})_2 \rightarrow \text{Ca}^{2+} + 2\text{OH}^-$) will also give twice the concentration of hydroxide ions than aqueous sodium hydroxide ($\text{NaOH} \rightarrow \text{Na}^+ + \text{OH}^-$) and is thus more alkaline.

Biology

71. (B) In the given figure pollination takes place at Y and Fertilisation in X.
72. (A) Arrows labelled as P and Q show the process of respiration in plants.
73. (C) The liver's bile is a yellowish brown fluid which helps to breakdown fatty acid in the small intestine. The bile is first stored in the gallbladder and is passed through the bile duct into the duodenum of the small intestine.



74. (C) Artery, Vein and Capillary are parts of the transport system.
75. (B) Microbes in the soil are decomposers. These breakdown the dead material on the forest floor to organic nutrients.
76. (C) Green plants give out oxygen only in the presence of sunlight during photo synthesis. In dark they respire and give out carbon dioxide. Hence when glowing splinter introduced in the test tube it put out.
77. (B) The cells in picture B are blood cells.
78. (D) In the given figure the dark patches are phloem. Phloem carry food to all parts of the plant.

79. (C) Autotrophs are organisms which are able to produce their own food. Plants are able to produce their own food through photosynthesis.
80. (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.
81. (D) Respiratory system and circulatory system function together to transport oxygen, so that the whole body can receive it.
82. (A) In the given aerobic respiration equation X = Oxygen, Y = Carbon dioxide, Z = Water
83. (D) The flower with the given characteristics can pollinate by insects.
84. (D) The hair and mucus in our nostrils help to filter out dust particles.
85. (D) Food carrying tubes in plants are called phloem and water carrying tubes are called xylem. The xylem and phloem function similar as blood vessels in human circulatory system.
86. (D) Insects transfer pollen from one flower to another and help to pollinate them, leading to fertilisation and the production of fruit. It is likely that the insecticide also killed the insects that helped in pollination.
87. (C) Soil is formed when rocks and stones are weathered by water, heat, wind, rain and pressure.
88. (B) Bending of some plants on plains due to flexible stems is a kind of adaptation in plants.
89. (A) Ginger is an underground stem. It reproduces from the buds present on underground stem. Bryophyllum reproduces by leaf buds.
90. (B) In the given figure X represents heart, Y represents lungs and Z represents other parts of the body.

