



**UNIFIED COUNCIL**

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## NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION - 2011

### SOLUTIONS FOR CLASS : 10

#### Mathematics

1. (B)  $(2k - 1)x^2 - 8x + 6 = 0$

$$\Delta = 64 - 4(2k - 1)(6) = 88 - 48k = 8(11 - 6k) < 0$$

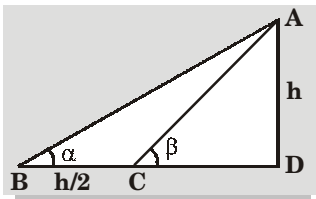
i.e.,  $11 - 6k = 0$

$$\Rightarrow k > \frac{11}{6}$$

Hence the smallest integral value of  $k$  is 2.

2. (A)  $\tan \beta = \frac{h}{CD} \Rightarrow CD = h \cdot \cot \beta$

$$\tan \alpha = \frac{h}{\frac{h}{2} + CD} \Rightarrow \frac{h}{2} + CD = h \cdot \cot \alpha$$



$$\therefore \frac{h}{2} + h \cot \beta = h \cot \alpha$$

$$\Rightarrow \cot \alpha - \cot \beta = \frac{1}{2}$$

3. (D)  $\sqrt{2}$  is an irrational number.  
i.e., a non-repeating decimal.

$$\sqrt{2} = 1.41421 \dots\dots\dots$$

4. (A)  $51 + 61 + 71 + \dots\dots\dots + 341$

$$a = 51, d = 10, l = 341$$

$$l = a + (n - 1)d$$

$$341 = 51 + (n - 1)(10)$$

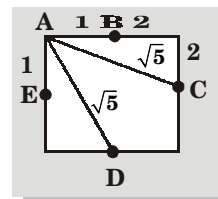
$$\Rightarrow n = 30$$

$\therefore$  Required sum

$$= \frac{n}{2}(a + l) = \frac{30}{2}(51 + 341) = 5880$$

5. (A) The highest powers of  $x$  in the factors  $(x^2 + 1)^4$  and  $(x^3 + 1)^3$  are 8 and 9, respectively. Hence the highest power of  $x$  in the product is  $8 + 9 = 17$ .

6. (C)



$$AB + AC + AD + AE$$

$$= 1 + \sqrt{5} + \sqrt{5} + 1 = 2 + 2\sqrt{5}$$

7. (A)  $\sin x + \cos x = \frac{1}{5} \Rightarrow \cos x = \frac{1}{5} - \sin x$

$$\cos^2 x = \left( \frac{1}{5} - \sin x \right)^2$$

$$\Rightarrow 25 \sin^2 x - 5 \sin x - 12 = 0$$

$$\sin x = \frac{4}{5} \text{ or } -\frac{3}{5}$$

$$\therefore 0 \leq x < \pi, \text{ we have } \sin x = \frac{4}{5}$$

$$\text{Hence } \tan x = -\frac{4}{3}.$$

8. (B) Total cases =  $6^2 = 36$

$$\begin{aligned} \text{Favourable cases} &= \{(5, 1), (5, 2), (5, 3), \\ &(5, 4), (5, 6), (1, 5), (2, 5), (3, 5), (4, 5), (6, 5)\} \\ &= 10 \end{aligned}$$

$$\therefore \text{Probability} = \frac{10}{36} = \frac{5}{18}$$

9. (D) Mean of P

$$= \frac{2 + 3 + 7 + 1 + 3 + 2 + 3}{7} = \frac{21}{7} = 3$$

$$\text{Median of P} = 1, 2, 2, 3, 3, 3, 7$$

$$\therefore \text{Median} = \frac{n+1}{2} = 4\text{th term}$$

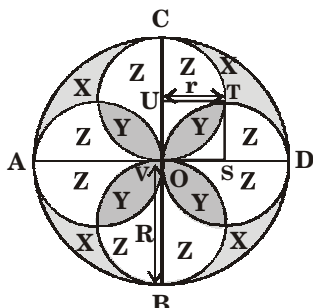
$$\text{mode} = 3$$

10. (A) Radius of smaller circle =  $r$   
 Radius of bigger circle =  $R$   
 Take square STUV, with side =  $r$

$$\text{Area of sector TUVT} = \frac{1}{4} \pi r^2$$

Area of unshaded portion of the square

$$= r^2 - \frac{1}{4} \pi r^2 = \frac{3}{14} r^2$$



$$\text{Area of Y} = r^2 - 2 \times \frac{3}{14} r^2 = \frac{4}{7} r^2$$

$$\begin{aligned} \text{Area of all X} &= \pi(2r^2) - 4\pi r^2 + 4 \times \frac{4}{7} r^2 \\ &= \frac{16}{7} r^2 \end{aligned}$$

$$\therefore \frac{x}{y} = \frac{\frac{16}{7} r^2}{4 \times \frac{4}{7} r^2} = 1$$

11. (A) Empty space

$$= \pi \times (5)^2 \times 100 - \frac{4}{3} \times \pi \times 5^3 \times 10 = \frac{2500 \pi}{3} \text{ cm}^3$$

12. (B)  $-y_1 : y_2 = -4 : 6 = -2 : 3$

13. (A)  $4^{x+y} = 1 = 4^0$      $4^{x-y} = 4 = 4^1$

$$x + y = 0 \quad x - y = 1$$

$$x = -y \quad -y - y = 1$$

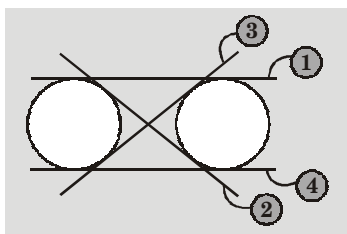
$$y = -\frac{1}{2}$$

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

14. (A)  $l = 5 \times 7 = 35 \text{ cm}$ ,  $b = 5 \text{ cm}$ ,  $h = 5 \text{ cm}$

$$\begin{aligned} \therefore \text{Surface area} &= 2(lb + bh + hl) \\ &= 2[35 \times 5 + 5 \times 5 + 35 \times 5] \\ &= 750 \text{ cm}^2 \end{aligned}$$

15. (C)



Four tangents

16. (B) Side of square =  $\sqrt{784} = 28 \text{ cm}$

$$\text{radius of each circle} = \frac{28}{4} = 7 \text{ cm}$$

$$\text{Radius of each circle} = 7 \text{ cm}$$

$$\therefore \text{circumference} = 2\pi r = 2 \times \frac{22}{7} \times 7 = 44 \text{ cm}$$

17. (A) 
$$\begin{aligned} &\frac{\sin \theta}{1 + \cos \theta} \times \frac{1 - \cos \theta}{1 - \cos \theta} + \frac{1 + \cos \theta}{\sin \theta} \\ &= \frac{1 - \cos \theta}{\sin \theta} + \frac{1 + \cos \theta}{\sin \theta} \\ &= \frac{2}{\sin \theta} \end{aligned}$$

18. (A) 
$$\frac{1}{2} \begin{vmatrix} 2\lambda - 1 & 2\lambda + 4 \\ 2 - 4\lambda & -4 \end{vmatrix} = 70$$

$$8\lambda^2 + 4\lambda - 144 = 0$$

$$2\lambda^2 + \lambda - 36 = 0$$

$$\lambda = -\frac{1 \pm \sqrt{1 + 288}}{4} = \frac{-1 \pm 17}{4} = 4 \text{ or } -\frac{9}{2}$$

$\therefore \lambda$  has only 1 integral value i.e., 4.

19. (D)

20. (C) Put  $3^x = y$

$$\text{Equation reduces to : } y^2 + 9 = 10y$$

$$\Rightarrow (y - 9)(y - 1) = 0$$

$$\text{or } y = 1, 9$$

$$\Rightarrow \begin{array}{l|l} 3^x = 3^0 & 3^x = 3^2 \\ x = 0 & x = 2 \end{array}$$

21. (C) Let the three sides be  $a - d$ ,  $a$ ,  $a + d$

$$\text{We have, } (a + d)^2 = (a - d)^2 + a^2$$

$$\Rightarrow a(a - 4d) = 0$$

$$\Rightarrow a = 4d$$

$$\text{Thus, the three sides are : } 3d, 4d, 5d$$

Since, the sides must be divisible by 3, 4, 5 only choice (C) could be the length of a side.

22. (D) The equations are :

$$ax + by - (2a^2 - 3b^2) = 0$$

$$x + 2y - (2a - 6b) = 0$$

$$\frac{a_1}{a_2} = \frac{a}{1} = a; \frac{b_1}{b_2} = \frac{b}{2} = \frac{2a}{2} = a;$$

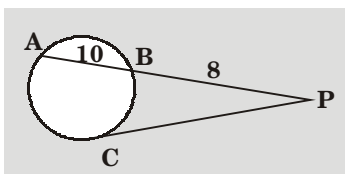
$$\frac{c_1}{c_2} = \frac{2a^2 - 3b^2}{2a - 6b} = \frac{-10a^2}{-10a} = a$$

$$\therefore \frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$$

Hence the equations possess an infinite number of solutions.

23. (A) Remainder  
 $= 3(2y)^3 - 2(2y)^2 \cdot y - 13(2y)y^2 + 10y^3$   
 $= 24y^3 - 8y^3 - 26y^3 + 10y^3 = 0$

24. (C)



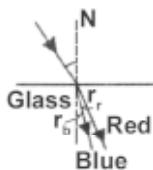
$$PC^2 = AP \times BP = 18 \times 8 = 144$$

$$PC = 12 \text{ cm}$$

25. (D) Let  $x = n^2$ ,  $n \geq 0$   
 then  $(n+1)^2 = n^2 + 2n + 1$   
 $= x + 2\sqrt{x} + 1$

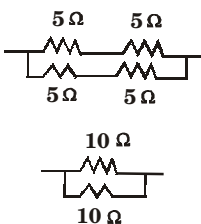
### Physics

26. (C) When we come out of a dark room into bright sunlight, then we feel the glare in our eyes. This is due to the fact that in a dark room, the pupil of our eye is large. So, when we go out in bright sunlight, a large amount of light enters our eyes and pupil of our eye becomes smaller, ciliary muscles contract there by iris also contracts.
27. (A) As a circular coil carrying a current  $I$  is taken. Directions of currents in X, Y and Z will be perpendicular to the plane of the loop and in inward direction. The direction of the field can be determined by using the right hand rule.
28. (C) A ray incident parallel to the principal axis of a concave mirror, after reflection, will pass through the principal focus obeying laws of reflection.
29. (A) Blue light is refracted more than red light because wave length of blue light is less than the wave length of red.



30. (B) Bio-gas is produced from biomass by the anaerobic degradation of animal wastes like animal dung or plant wastes in the presence of water. This degradation is carried out by anaerobic microorganisms in the absence of oxygen.

31. (C)



$$\frac{1}{R} = \frac{1}{10} + \frac{1}{10} = \frac{2}{10}$$

$$(\text{or}) R = 5 \Omega$$

32. (A) In Fleming's right hand rule, on stretching the thumb, fore finger and middle finger of right hand perpendicular to each other, the fore finger indicates the direction of magnetic field. The thumb indicates the direction of motion of the conductor and the middle the finger indicates the direction of induced current.
33. (B) A camera produces a real image.
34. (C) When light enters from a rarer to a denser medium, it always bends towards the normal.
35. (B) A concave mirror forms virtual and enlarged image when the object is placed within the focus.
36. (D) The glass covers as the top of a box type solar cooker allows the shorter wavelength infra red rays emitted by an extremely hot source like the sun to pass through but it does not allow the comparatively longer wavelength infra red rays emitted by less hot objects like a solar cooker to pass through it. This special property of a glass sheet of trapping heat causes reduction in heat loss by radiation.
37. (C) Alloys of manganin and nichrome have high melting points and low thermal expansion. Hence, can be used as heating elements.
38. (B) A diverging lens (concave lens) are virtual, erect images.  
 Hence  $m = +ve$ .

Give size of image ( $h_i$ ) =  $\frac{1}{3}$  size of the object ( $h_o$ )

$$\therefore m = \frac{h_i}{h_o} = \frac{1}{3} \quad (\text{or}) \quad m = \frac{v}{u} = \frac{1}{3} \Rightarrow v = \frac{u}{3}$$

$$\text{Now, } \frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{f} = \frac{3}{u} - \frac{1}{u} = \frac{3-1}{u} = \frac{2}{u} \quad (\text{or}) \quad u = 2f$$

39. (B) In human eye, the focussing is done by change in the convexity of the lens surface by the action of ciliary muscles.
40. (D) The lines of force are continuous inside a magnet. The magnetic lines of force always diverge at North-pole and converge towards South-pole.
41. (C) In order to generate hydro electricity a big water reservoir is made by constructing a high dam on the river. A vast variety of flora and fauna as well as human settlements get submerged in the water of a reservoir formed by the dam. Due to

this many plants trees are destroyed, animals get killed and many people are rendered homeless. The construction of dam on a river disturbs the ecological balance in the down stream area of the river.

42. (D) Even in absolutely clear water, a diver cannot see very clearly because the focal length of the eye lens in water gets changed and the image is no longer focused sharply on the retina.

43. (B) W is geothermal energy as it is energy obtained from the interior of the earth.

X is nuclear energy as it is obtained from the splitting of suitable atoms.

Y is biomass as it is the energy obtained from the decay of organic matter.

44. (B) On breaking wire into four equal parts, Area of cross section of each part of wire remains constant while length of each part changes to one fourth of its original length. Therefore resistance of each part of wire

is  $R/4$ . i.e.  $\frac{1}{4}^{\text{th}}$  resistance of  $\frac{R}{4}$  wire.

45. (C) As Arun uses spectacles containing converging lens or convex lens he suffers from hypermetropia. The main reason for the defect of the eyes is due to the low converging power of eye lens because the ciliary muscles attached to the eye lens become weak and cannot make eye lens fatter to increase its converging power. In other cases, the eye ball can be too short due to which the retina is at a smaller distance from the eye lens.

46. (A) The concave lens formula is  $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$  where no sign conventions are to be used.

Thus  $\frac{u}{v} - 1 = \frac{u}{f}$  or  $\frac{1}{n} - 1 = \frac{u}{f}$  (since  $\frac{v}{u} = n$ )

$$\text{or } u = \left( \frac{1-n}{n} \right) f.$$

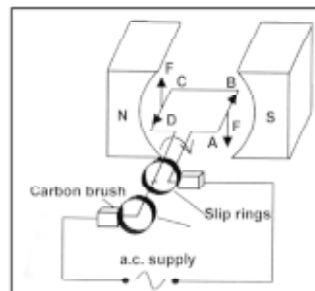
47. (C) Since the bulbs are joined in series, so when one bulb is removed from chain then the resistance of the chain is decreased, hence current flowing through each bulb is increased.

48. (A)  $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$  But,  $u = x$ ;  $v = y$ ;  $f = z$

$$\therefore \frac{1}{z} = \frac{1}{x} + \frac{1}{y}$$

$$\frac{1}{z} = \frac{y+x}{xy} \text{ (or) } z = \frac{xy}{y+x}$$

49. (D) In an ac motor, slip rings are connected at the end 'X' and 'Y' of the coils.

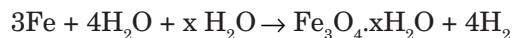


50. (B) In a series circuit, current remains same throughout the circuit and this circuit acts as a voltage divider circuit.

$$\therefore V = V_1 + V_2$$

### Chemistry

51. (A) Iron reacts with moist air and forms  $\text{Fe}_3\text{O}_4$  that is the formation of rust.



52. (C) Micelle contains both hydrophilic end that can remove grease / dirt from the clothes into water easily.

53. (D)  $4\text{KO}_{2(s)} + 2\text{H}_2\text{O}_{(g)} + 4\text{CO}_{2(g)} \rightarrow 4\text{KHCO}_{3(s)} + 3\text{O}_{2(g)}$

Hence,  $a = 4$ ,  $b = 2$ ,  $c = 4$

54. (D)  $\text{Na}_2\text{SO}_4 + \text{BaCl}_2 \rightarrow \text{BaSO}_4 + 2\text{NaCl}$

Hence the above reaction is a double displacement reaction.

55. (C) pH from 7.1 to 14 is called alkaline pH. Hence, the pH of blood is between 7 and 8 so it is slightly alkaline.

56. (A) I and II statements are correct. But in (III) plaster of paris contains  $1\frac{1}{2}\text{H}_2\text{O}$ .

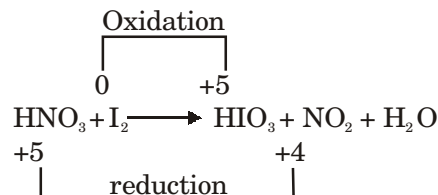
57. (D)  $\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$

When metal carbonate reacts with acid liberation of  $\text{CO}_2$  takes place.

58. (C)  $\text{NaCl}$  (Brine) undergo electrolysis i.e. P and give  $\text{Cl}_2$  (R) at anode and  $\text{NaOH}$  (Q) at cathode.

59. (B) Cu can displace Ag from  $\text{AgNO}_3$  because it is more reactive than silver.

60. (D)



$\text{HNO}_3$  – oxidising agent or oxidant

$\text{I}_2$  – Reducing agent or reduced agent

61. (B) By addition of aqueous sodium hydroxide the nitric acid undergoes neutralisation without leaving an alkaline solution

62. (D)  $Z = 34$ ; E.C. = 2, 8, 18, 6. Therefore, the element belongs to VI A group or 16 group and since it has four shells it belongs to 4<sup>th</sup> period.
63. (D) Among the iso electronic species given,  $O^{2-}$  possess more ionic radius because the extra  $e^-$  added to the neutral oxygen atom experiences inter electronic repulsions. In the other case  $Mg^{+2}$  possess less ionic radius due to more nuclear charge.
64. (C) On roasting sulphide ore gives  $SO_2$  gas which escapes out.
65. (B) The number of hydrogen atoms in propane ( $C_3H_8$ ) = 8 H atoms.  
The number of hydrogen atoms in propyne ( $C_3H_4$ ) = 4 H atoms.  
Hence, ratio = 8 : 4 = 2 : 1
66. (C) Soap acts by forming micelles and trapping the fat within the micelles - is correct  
Soap molecules work as a bridge between polar water molecules and non-polar oil molecules - correct  
Soap is formed by saponification of oils.  
Soap is an emulsifier - is correct
67. (D) It is a gaint molecule that looks like foot ball and it is also called as Buckminster fullerene since it looked like geodesic dome designed by the architect Buckminster fuller. Graphite has structure formed by the hexagonal arrays.
68. (D) 1 mole of acetic acid is mixed with 1 mole of alcohol to give 1 mole of ester.
69. (B) In the presence of hot.conc.  $H_2SO_4$ , ethyl alcohol undergoes dehydration and give ethylene (p) i.e.,  $C_2H_4$ .
70. (A)  $HCl$  adds on ethylene and forms  $CH_3-CH_2-Cl$ . OH groups of NaOH substitutes  $Cl$  and gives  $CH_3-CH_2-OH$  which undergoes oxidation and finally gives  $CH_3COOH$ . Hence, X – addition, Y – substitution and Z – oxidation.

### **Biology**

71. (D) The given steps are followed to test the presence of starch in a leaf.
72. (C) Sometimes when there is a lack of oxygen in our muscle cells, another way for the breakdown of glucose to pyruvate and pyruvate is converted into lactic acid. This build up of lactic acid in our muscles during sudden activity causes cramps.
73. (C) The part labelled 'X' is cerebellum. It is responsible for precision of voluntary actions and maintaining the posture and balance of the body. It coordinate and give stability to the body.
74. (D) The saliva contains an enzyme called salivary amylase that breaks down starch which is a complex molecule to give sugar.
75. (A) The phenotypic ratio of the given cross  $Tt \times Tt$  is 3 tall and 1 dwarf.
76. (C) Due to girdling bark containing the cortex and phloem is removed. Due to the removal of the phloem, sugar and other food substances transported by the phloem could not pass through to the area below the ring. Food get accumulated above the ring, causing the swelling at the portion.
77. (B) In the given figure P – Zygote Q – Embryo and R – Foetus
78. (C) Forests are biodiversity hot spot. One of the main aims of conservation is to try and preserve the biodiversity we have inherited and replant trees that are cut down.
79. (D) According to Darwin's theory of natural selection:  
Those individuals who have favourable variations have better chances of living long enough to reproduce. They pass on their advantageous characters to the next generation.
80. (A) Adrenal glands are present on top of each kidney. Adrenal gland secretes cortisol, aldosterone and adrenaline. The hormone epinephrine or adrenaline controls glycogen phosphorylase which is an enzyme that breaks down glycogen into glucose. Deficiency of hormones of adrenal glands can cause Addison's disease.
81. (D) Sponges reproduces by gemmules, planaria by regeneration, Hydra by budding.
82. (D) In the given figure part labelled S is ovary. It produces female reproductive cells and part labelled 'Q' is anther. Anther produces male reproductive cells.
83. (A) Receptor is a cell or an organ that receives a stimulus and converts it into an electrical impulse.
84. (D) In the given flow chart P represents fertilisation and Q represent germination of seed to seedling.
85. (B) In the given figure P labelled is stomach, Q small intestine and R is large intestine.
86. (C) In any habitat the number of producers are more when compared to the number tertiary consumers.
87. (B) Plants show tropism in response to other stimuli as well. The roots of plants always grow downward in response to the pull of the earth and exhibit hydrotropism.
88. (B) The given figure is the fossil of trilobite. If a dead insect gets caught in hot mud, for example, it will not decompose quickly and the mud will eventually harden and retain the impression of the body parts of the insect.
89. (A) Reflex is a word we use very commonly when we talk about some sudden action in response to something in the environment.
90. (A) In the given figure, the gas liberated from the pulmonary artery P is carbon dioxide.