



**UNIFIED COUNCIL**

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## NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION - 2011

### SOLUTIONS FOR CLASS : 11-PCB

#### Biology

1. (B) In the given flow chart P-Amylase, Q-Maltase, R-Invertase and S-lactase.
2. (B) Ventral nerve cord is common to leech, cockroach and scorpion.
3. (C) Lysosomes are rich in hydrolysing enzymes.
4. (C) Gastric juice secreted in the stomach of human digestive contain pepsin, rennin or lipase enzyme.
5. (D) Glossopharyngeal nerve controls the posterior part of mouth cavity.  
Epinephrine or norepinephrine (adrenaline) control the heart beat. Vagus control the increase heart beat.
6. (B) Taking milk before bedtime may induce sleep. As milk has a lot of amino acid and tryptophan, serotonin is synthesized. Serotonin may be the neurotransmitter of the sleep causing centres in the pons and medulla.
7. (B) Three amino acids participates in the ornithine cycle. They are ornithine, citrulline and arginine.
8. (C) At the time of stress or danger, the 4 stimulates the adrenal medulla to release adrenaline. It prepares the body to body to face stress or danger.
9. (A) Sweet pea, Cat's nail, Nepenthes, utricularia.
10. (A) Seeds can respire in the absence of oxygen.
11. (C) Sponges = porifera  
Scorpion & Crab = arthropods.
12. (B) Jelly fish – Coelenterate  
Cattle fish = Molluscan  
Devil fish – octopus molluscan  
Flying fish – Exocetus. Osteichthyes (Bony fish)
13. (C) Granulocytes are synthesized in red bone marrow.
14. (C) In the given flow chart W-single, X-Double, Y-Rabbit, Z-frog.
15. (D) Root hairs are tiny projections, that find their way between soil particles and absorb water and dissolved minerals through the cell membranes and then transported to the rest of the plant.
16. (D) Light energy is used to photolysis of water.
17. (B) Potassium is responsible for maintaining turgor pressure in guard cells thus it helps in opening and closing of stomata.
18. (D) Characteristic feature of stem is (protoxylem is towards the centre) endarch condition of xylem tissue and in root is exarch condition (Protoxylem is towards pericycle, of xylem tissue).
19. (B) The largest flower is Rafflesia of family onagraceae belong to total root parasite.
20. (C) Seed germination is regulated by gibberellins.
21. (B) Conversion of ADP to ATP in the presence of inorganic phosphate and light energy is called photophosphorylation.
22. (C) The chloroplasts in  $C_4$  are dimorphic the chloroplasts in bundle sheath are larger in size and arranged centripetally. They contain starch grains but lack grana the mesophyll cells contain normal type of chloroplasts.
23. (C) ABA promotes closing of stomata under condition of water stress. It plays significant inhibitory role in drought and water logging plants.
24. (A) The grafting technique is successful in two related plants having vascular cambium.
25. (C) Krebs's cycle enzymes occurs in the mitochondrial matrix.
26. (D) New plastids arise from proplastids by a fission like process.
27. (C) There are seven major (obligate) categories, which in hierarchical order are kingdom, phylum or division, class, order, family, genus and species.

28. (B) Takhtajan described taxonomy without phylogeny as bones without flesh.
29. (B) Algae are the smallest of all green plants. Many are made of only one cell or filamentous.
30. (D) The seeds of Monocots contain only one cotyledon, their leaves usually have parallel veins, and their flower petals come in multiples of three.
31. (B) Eosinophils represent only 1.5% of the total number of WBC's and an elevated number of these cells in a routine blood panel might support the diagnosis of asthma.
32. (D) Respiration in earthworm is cutaneous respiration (skin).
33. (A) Chloragogen cells are analogous to liver of higher vertebrates and are excretory in function.
34. (B) Parathormone regulate the calcium and phosphate balance between the blood and other tissue.
35. (D) The smaller the size of organism, the range of heart beat per minute is highest in the case of mouse.
36. (A) Chondrin is the protein present in the matrix of cartilage.
37. (A) Heart wood is the central non-functional xylem. It is generally dark and helps the stem in giving mechanical strength.
38. (C) Phellem → endodermis → pericycle → phloem.
39. (C) Rate of transpiration from the leaves contribute the most to increase the rate of water movement upward in the xylem.
40. (C) Otorhinolaryngology is related with the study of ENT i.e., ear, nose and tongue.

### Physics

41. (B) Distance travelled in last 3 seconds  
 $= \text{area of } \Delta BEC$   
 $= \frac{1}{2} \times EC \times BE$   
 $= \frac{1}{2} \times 3 \times 24$   
 $= 36 \text{ m}$   
 Distance travelled in 8 s = area of  $\Delta OAD$   
 $+ \text{area rectangle } \Delta ABED + \text{area of } \Delta BEC$   
 $= \left( \frac{1}{2} \times 3 \times 24 \right) + (24 \times 2) + (36)$   
 $= 36 + 48 + 36 = 120 \text{ m}$   
 Ratio = 36 : 120 = 3 : 10
42. (B) As area = length  $\times$  breadth  
 $= 4.321 \times 4.055$   
 Area = 17.521655

43. (B) Mass of a particle = m  
 Force = p  
 Time = t  
 Here, initial velocity  $u = 0$   
 $p = ma$  where  $a$  is the acceleration

$$\text{or } a = \frac{p}{m}$$

$$\text{using, } s = ut + \frac{1}{2}at^2$$

$$s = 0 \times t + \frac{1}{2} \left( \frac{p}{m} \right) t^2$$

$$s = \frac{1}{2} \frac{pt^2}{m}$$

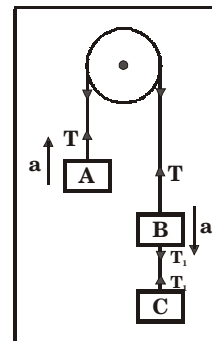
According to work energy theorem,

Kinetic energy =  $p \times S$

$$= p \left( \frac{1}{2} \frac{pt^2}{m} \right)$$

$$= \frac{p^2 t^2}{2m}$$

44. (B) Let  $T$  the tension in the string. Let the bodies B and C accelerate downwards with acceleration  $a$ . Then the body A move upwards with acceleration  $a$ .



Therefore, For motion of body A,

$$T - mg = ma \dots\dots\dots (i)$$

For motion of body B and C,

$$1 \text{ mg} - T = 2 \text{ m} \times a \dots\dots\dots (ii)$$

Adding (i) and (ii), we get

$$2 \text{ mg} - mg = 3 \text{ ma} \text{ or } a = g/3$$

For motion of body C,  $mg - T_1 = ma$

$$\text{or } T_1 = m(g - a) = m(g - g/3)$$

$$T_1 = 2 \text{ mg}/3 = 2 \times 2 \times 9.8/3$$

$$T_1 = 39.2/3 = 13 \text{ N}$$

45. (C) The  $g$  decreases both when we go below or above the surface of the earth. Hence,  $g$  value is maximum on the surface of the earth.
46. (A)  $L = mr^2 \omega$ . For given  $m$  and  $\omega$ ,  $L \propto r^2$ . If  $r$  is halved, the angular momentum  $L$  becomes one-fourth.

47. (A) Heat supplied  $dQ = nC_p dT$   
 Heat used for work  $= dW = nRdT$   

$$\frac{dW}{dQ} = \frac{R}{C_p} = \frac{C_p - C_v}{C_p} = 1 - \frac{C_v}{C_p}$$

$$= \left(1 - \frac{1}{\gamma}\right) = \left(1 - \frac{3}{4}\right) = \frac{1}{4} \times 100 = 25\%$$

48. (B) Displacement equation of S.H.M is  $y = a \sin \omega t$ .  
 Therefore velocity is obtained by differentiating it.

$$(v) = \frac{dv}{dt} = a\omega \cos \omega t = a\omega \sqrt{1 - \sin^2 \omega t}$$

$$= a\omega \sqrt{1 - \frac{y^2}{a^2}} = \omega \sqrt{a^2 - y^2}$$

49. (D) Let  $a$  be the radius of sphere.

$$\text{Mass of sphere} = \frac{4\pi}{3} a^3 \rho$$

$$\text{Weight} = \frac{4\pi}{3} a^3 \rho g$$

$$\text{Upward thrust due to liquid } w = \frac{4}{3} \pi a^3 \rho g$$

$$\text{Resultant weight} = \frac{4}{3} \pi a^3 g (d - \rho)$$

$$\therefore \text{Resultant acceleration} = \frac{\text{force}}{\text{mass}}$$

$$= \frac{\frac{4}{3} \pi a^3 g (d - \rho)}{\frac{4}{3} \pi a^3 d}$$

$$= \frac{g(d - \rho)}{d}$$

50. (A) Energy stored per unit volume

$$= \frac{1}{2} \times \text{stress} \times \text{strain} = \frac{1}{2} \times \text{stress} \times \frac{\text{stress}}{Y} = \frac{1}{2} \frac{S^2}{Y}$$

51. (A)  $P = \frac{2S}{r} = \frac{4S}{D} = \frac{4 \times 0.072}{1.2 \times 10^{-3}} = 240 \text{ N m}^{-2}$

52. (B) Using the relation,  $S = ut = \frac{1}{2} at^2$ ,

$$\text{we have, } h = u \cos \theta t_1 - \frac{1}{2} g t_1^2$$

$$\text{and } h = u \cos \theta t_2 - \frac{1}{2} g t_2^2$$

$$\text{or } u \cos \theta \times 1 - \frac{1}{2} \times 9.8 \times 1^2$$

$$= u \cos \theta \times 3 - \frac{1}{2} \times 9.8 \times 3^2$$

$$\text{or } u \cos \theta (3 - 1) = 4.9 \times 8$$

$$u \cos \theta = \frac{4.9 \times 8}{2} = 4.9 \times 4 = 19.6 \text{ m/s}$$

Maximum height

$$= \frac{u^2 \cos^2 \theta}{2g} = \frac{(19.6)^2}{2 \times 9.8} = 19.6 \text{ m}$$

53. (D)  $\omega t + \phi_0 = \frac{2\pi}{T} \times t$  (since  $\omega = \frac{2\pi}{T}$ )

both  $t$ ,  $T$  represent time.

Hence,  $\frac{2\pi t}{T}$  is dimensionless

$\phi_0$  - angle so, dimensionless

$\therefore \omega t + \phi_0$  has no dimensions but has certain magnitude or dimensionally it can be represented as  $M^0 L^0 T^0$ .

54. (C) Lengths of the two inclined planes are

$$l_1 = \frac{h}{\sin \theta_1} \text{ and } l_2 = \frac{h}{\sin \theta_2}$$

Acceleration of the block down the two planes are:

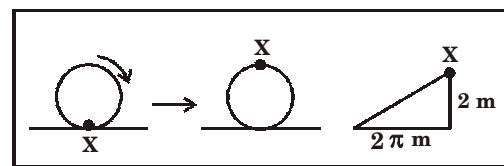
$$a_1 = g \sin \theta_1 \text{ and } a_2 = g \sin \theta_2$$

$$\text{As } l_1 = \frac{1}{2} a_1 t_1^2 \text{ and } l_2 = \frac{1}{2} a_2 t_2^2$$

$$\therefore \frac{l_1}{l_2} = \frac{a_1 t_1^2}{a_2 t_2^2} \text{ or } \frac{t_2^2}{t_1^2} = \frac{a_1 l_2}{a_2 l_1} = \frac{g \sin \theta_1}{g \sin \theta_2} \times \frac{\sin \theta_1}{\sin \theta_2}$$

$$\therefore \frac{t_2}{t_1} = \frac{\sin \theta_1}{\sin \theta_2}$$

55. (B)



In half rotation, point 'X' has moved horizontally  $\frac{\pi d}{2} = \pi r = \pi \times 2 = 2\pi \text{ m}$  (since  $r = 2 \text{ m}$ )

In the same time, it has moved vertically a distance which is equal to its diameter  $= 2r = 4 \text{ m}$

Therefore, displacement of

$$X = \sqrt{(2\pi)^2 + 4^2} = 2\sqrt{\pi^2 + 4} \text{ m}$$

56. (B) Work done =  $mg \times h$  = weight  $\times$  height
57. (A)  $T = \frac{2\pi R}{v_0} = \frac{2\pi R}{\sqrt{gR}} = 2\pi \sqrt{\frac{R}{g}}$   
It is independent of the mass of satellite.
58. (C) As velocities are exchanged on perfectly elastic collision, therefore, masses of two objects must be equal.
- Therefore  $\frac{m_a}{m_b} = 1$  (or)  $m_a = m_b$
59. (B) Applying theorem of parallel axes,  
 $I = I_0 + M(L/4)^2 = \frac{ML^2}{12} + \frac{ML^2}{16} = \frac{7}{48}ML^2$
60. (C) Because water level is higher on the surface exposed to atmosphere,  $P_1$  (pressure of confined air) is more than  $P_2$  (atmospheric pressure).
61. (C) The specific heat at constant pressure is more than that at constant volume because additional work is needed to be done for allowing expansion of gas at constant pressure.
62. (B) Terminal velocity  $v \propto r^2$ . since volume  $V = (4/3)\pi r^3$ . Therefore, when the volume becomes 8 times, the radius is doubled. Hence velocity becomes 4 times =  $4 \times 1 \text{ m s}^{-1} = 4 \text{ m s}^{-1}$
63. (A) Let mass of ice be  $x$   
Latent heat of ice =  $80 \text{ cal g}^{-1}$   
Heat required by ice to convert to water  
=  $x \times 80$   
Heat lost by water =  $160 \times 20$   
According to principle of calorimetry,  
Heat gained = Heat lost  
 $x \times 80 = 160 \times 20$   
 $x = \frac{160 \times 20}{80} = 40 \text{ g}$
64. (A) For adiabatic compression,  $PV^\gamma = \text{constant}$ ,  
Hence,  $dp = -\gamma P \frac{dV}{V} \dots (1)$   
For isothermal compression,  
 $PV = \text{constant}$ , hence  $dp = P \frac{dV}{V} \dots (2)$   
Ratio (1) to (2) =  $\gamma$
65. (B) Let the frequency of first tuning fork be  $f$ .  
The frequency of other tuning forks are  
( $f - 3$ ), ( $f - 2 \times 3$ ), ..... ( $f - 17 \times 3$ ),  
..... ( $f - 25 \times 3$ )  
As per given condition  
 $f = 2(f - 25 \times 3)$  or  $f = 25 \times 6 = 150 \text{ Hz}$   
The frequency of 18th fork  
 $= f - 17 \times 3 = 150 - 51 = 99 \text{ Hz}$ .

## Chemistry

66. (C) The melting and boiling points of alkali metals decrease down the group because increase in the atomic size in going from the top to the bottom in the group. Hence, the melting point of Cs is lower than that of Na and their salts too due to their difference in lattice arrangements.
67. (A) Molecular speeds :  
 $U_{\text{rms}}$  (root mean square speed) =  $\sqrt{\frac{3RT}{M}}$   
 $U_{\text{av}}$  (average speed) =  $\sqrt{\frac{8RT}{\pi M}}$   
 $U_{\text{mp}}$  (most probable speed) =  $\sqrt{\frac{2RT}{M}}$   
Thus,  $U_{\text{rms}} : U_{\text{av}} : U_{\text{mp}} = 1 : 0.92 : 0.82$   
 $\Rightarrow U_{\text{rms}} > U_{\text{av}} > U_{\text{mp}}$
68. (B) Let 2<sup>nd</sup> oxide be  $M_xO_y$ , At wt of M be  $M$ .  
**1<sup>st</sup> oxide** **2<sup>nd</sup> oxide**  
As in  $MO$ ; 50% is  $M$   $240 = \frac{16x}{16x + 16y} \times 100$   
At wt of  $M = \text{At wt of } O$   
 $\Rightarrow M = 16$   $2x + 2y = 5x$   
 $2y = 3x$   
 $\frac{x}{y} = 2 : 3$   
 $\therefore M_xO_y = M_2O_3$
69. (D) Temperature of the reaction, conditions like constant volume or constant pressure and the method by which change is brought about are the factors that influences the enthalpy of a reaction.
70. (D) On electrolysis of ionic hydride which contain  $H^-$  (hydride) ion, a very strong Bronsted base, it reacts with water, liberating  $H_2$  gas at anode which escapes out.  $H^-$  is an anion and moves towards anode.  
Eg:  $NaH + H_2O \rightarrow NaOH + H_2 \uparrow$
71. (D)  $\Delta E$  for  $Li^{+2}$  ion =  $E_2 - E_1$  is maximum as  $E_n Li^{+2} = E_n H \times Z^2$
72. (D) The oxidation number of the various elements involved in this reaction are as follows:  
 $Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$   
Here,  $Cl_2^{(0)} \rightarrow Cl^{(-1)}$ . So,  $Cl_2$  is the oxidant (oxidising agent) and  $Br^{(-1)} \rightarrow Br_2^{(0)}$ . So,  $Br^-$  is the reductant.
73. (C) Brine solution is taken in a saturation tower of the plant. Ammonia gas containing little amount of  $CO_2$  is passed into it, first ammonium reacts with  $CO_2$  to

form ammonium carbonate. This ammonium carbonate renders precipitation of impurities of magnesium, calcium and iron as carbonates.



74. (D) 
$$\begin{array}{ccccccc} & \text{OH} & & \text{C}_2\text{H}_5 & & & \\ & | & & | & & & \\ \text{CH}_3 - & \text{CH} & - & \text{CH}_2 & - & \text{CH} & = \text{CH} - \text{CH}_2 \end{array}$$
- Hence, IUPAC name of the compound is 4-ethyl hex-4-en-2-ol
75. (B) Aqueous solution of borax is basic as it turns red litmus paper blue.
76. (C) The product obtained is a mixture of butane ethane and ethane
77. (B)  $\text{CCl}_4$  has regular tetrahedral structure as the molecules have four bond pairs around its central atom. In  $\text{CCl}_4$ , the four bond dipoles are oriented tetrahedrally to neutralise each other. As a result, the net dipole moment of the molecule is zero.
78. (C) In pure water,  $[\text{H}^+] = [\text{OH}^-] = 10^{-7} \text{ mol lit}^{-1}$ . On addition of  $\text{NH}_3$  (a base) to pure water, the concentration of hydronium ion decreases because in pure water,  $2\text{H}_2\text{O} \rightarrow \text{H}_3\text{O}^+ + \text{OH}^-$ , on addition of  $\text{NH}_3$  it accepts hydronium ions from the solution or donates hydroxide ions to the solution. Thus, raises pH.

79. (B) 
$$\frac{r_1}{r_2} = \frac{x/5}{x/t} = \sqrt{\frac{M_{\text{gas}}}{M_{\text{He}}}} = \sqrt{\frac{M_{\text{gas}}}{4}}$$

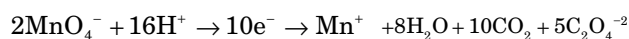
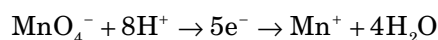
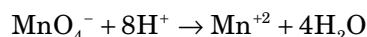
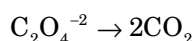
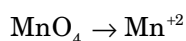
$$\frac{t}{5} = \sqrt{\frac{M_{\text{gas}}}{4}}$$

$$\text{If } t = 20 \text{ s}$$

$$\frac{20}{5} = \sqrt{\frac{M_{\text{gas}}}{4}} \Rightarrow 16 \times 4 = M_{\text{gas}}$$

$$M_{\text{gas}} = 64, \text{ Therefore } \text{SO}_2 \text{ gas.}$$

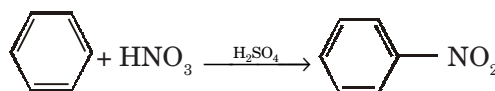
80. (D) For an adiabatic expansion of an ideal gas undergoing reversible process (i.e. no entropy generation) is:
- $$PV^\gamma = \text{constant or } P^{1-\gamma} T^\gamma = \text{constant}$$
- (or)  $TV^{\gamma-1} = \text{constant}$
81. (C) Gypsum is sparingly soluble in water on heating it carefully at  $100^\circ\text{C}$ , it partially loses water of crystallisation and becomes  $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$ .
82. (C) Silicate is a metal derivative of silicic acid which contains silicate as anion. Silicon is a synthetic organo-silicon polymer,  $\text{R}_2\text{SiO}$  as repeat unit.
83. (A)



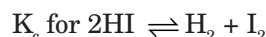
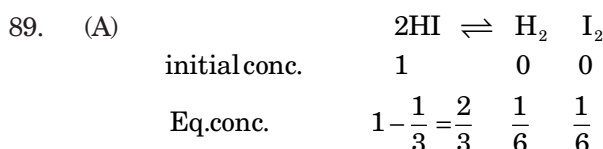
84. (D) Hydrogen bond is formed between the molecules in which hydrogen atoms are linked to an atom of highly electro negative element and atom of electronegative element should be small. In liquid  $\text{HCl}$ , chlorine is not highly electronegative to form H-bond.
85. (D) In 98 g of  $\text{H}_2\text{SO}_4$  there are 1 g atoms of S. In 4.9 g  $\text{H}_2\text{SO}_4$  has g atom of S

$$= \frac{4.9}{98} = 0.05 \text{ g atoms}$$

86. (A) Lithium carbonate is the least soluble alkali metal. As lithium carbonate is more covalent in nature than other carbonates of alkali metals down the group.
87. (A) In electrophilic (aromatic) nitration, aromatic organic compounds are nitrated via an electrophilic aromatic substitution mechanism involving the attack of the electron rich benzene ring by the nitronium ion.



88. (D) The orbitals described by the set of quantum numbers in given options is: 4s, 3p ; 3d, 3s
- Energy of these orbitals follows the order  $3d > 4s > 3p > 3s$
- $\therefore$  Subshell 3s has the least energy.



$$K_c = \frac{[\text{H}_2][\text{I}_2]}{[\text{HI}]^2}$$

$$\Rightarrow K_c = \frac{\left(\frac{1}{6}\right)\left(\frac{1}{6}\right)}{\left(\frac{2}{3}\right)^2} = \frac{1}{36} \times \frac{9}{4} = \frac{1}{16}$$

90. (B) Photo chemical fog is a yellowish colour of  $\text{NO}_2$  formed by burning of oil, coal, gas in vehicles and industries. The main cause for arise of this smog is due to oxides of nitrogen ( $\text{NO}$  and  $\text{NO}_2$ ).