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NATIONAL LEVEL SCIENCE TALENT SEARCH EXAMINATION

Paper Code: UN421

Solutions for Class : 11 (PCB)

Biology

1. **(D)** The given figure shows the predatory mode of nutrition.
2. **(A)** Iron is a trace mineral, forms a component of haemoglobin myoglobin and cytochromes. It is stored in our body in the form of ferritin or haemosiderin.
3. **(D)** Interferon stimulates the production of antiviral proteins (AVPs) which prevent viral multiplication.
4. **(B)** Herbivora is not a Taxon
5. **(A)** Nostoc fixes atmospheric nitrogen
6. **(C)** Ammonia is a nitrogenous excretory product of freshwater organisms.
7. **(B)** The movement of food in oesophagus is due to perstalsis.
8. **(C)** a - ii, b - iii, c - v, d - i, e - iv
9. **(D)** (ii), (i), (iv), (iii), (v)
10. **(C)** Hydrozoa are distinguished from other coelenterates by non-cellular mesoglea.
11. **(A)** Fungia, commonly known as mushroom belongs to the class anthozoa.
12. **(A)** Flatworms resemble to coelenterate in body plan.
13. **(C)** The second and third moulting of Ascaris occur in the lung of the host.
14. **(C)** Earthworm possesses two pairs of lateral hearts and two pairs of lateral oesophageal hearts (total 8, i.e.,4 pairs).
15. **(D)** Tick is an arachnid belonging to the subphylum chelicerata.
16. **(A)** Pluteus is a larval form of Echinodermata.
17. **(A)** The renal artery (P) supplies blood to the kidney, while the renal vein (Q) transports blood away from the kidney. S is the ureter that carries the urine formed in the kidney to the bladder.
18. **(B)** Dipleurula is a hypothitical ancestral larva of most deuterosomes comprising echinoderms, hemichordates and chordates.
19. **(C)** Sea horse (hippocampus) is a fish.
20. **(B)** Polypterus restricted to the rivers of Africa is the most primitive living actinopterygian. It is characterised by scales covered with an enamel-like ganoin and heterocercal caudal fin.
21. **(D)** Enhydrina valakadien is a poisonous sea snake. The back of this snake is olive or dark grey, with transverse bands. The underparts are white.
22. **(A)** In Ruscus, cladodes are appearing just like normal leaves but at the time of flowering, flower buds are produced at different nodes.
23. **(B)** The diagram shows a section of a dicot stem. The vascular bundles are located in a ring around the central pith, with the xylem closer to the central pith, and phloem further away. The narrow section of tissue between the xylem and phloem is the cambium.
24. **(C)** Plasma contains plasma proteins like albumin, globulins, immunoglobulins and fibrinogen. Platelets are formed elements in the blood and are not part of the plasma.
25. **(A)** Thin roof of cerebrum in frog is called pallium, This term is also used in reference to mantle of a mollusc of brachiopod.
26. **(D)** Acrosome, present at the tip of sperm head, develops from small Golgi-derived vesicles.
27. **(D)** Saccharine is an artificial sweetner, 375 times sweeter than sugar, no nutritive value and is excreted by body through urine. It is used by diabetic patients.
28. **(A)** It was thought that only proteins could act as biological catalysts, Recently Dr. Thomas Cech (1982) reported ribozymes which are catalytic RNAs.

29. **(B)** Prokaryotes and eukaryotes differ significantly in the organisation of their cell division.

30. **(B)** Saliva contains amylase and which breaks down the starch in bread to maltose, a disaccharide which tastes sweet.

31. **(B)** The statement 'Omnis cellula e cellula' 'All cells arise from pre-existing cells' was made by Rudolf Virchow (1821-1902), German professor of pathological anatomy at Berlin.

32. **(D)** Theophrastus is the father of botany.

33. **(B)** Arrow A indicates the process of pollination, the transfer of pollen grains from one flower to another. Pollen grains contain male gametes.

34. **(A)** Emerson effects explain the phenomenon of photosynthesis.

35. **(C)** In S. rupestris megaspores are retained till fertilization of archegonia and development of embryo and thus it produces rudimentary seeds.

36. **(B)** Number of microsporangia in monothecous anthers is only two.

37. **(A)** Potassium hydroxide solution is added to absorb carbon dioxide.

38. **(D)** The portuguese man-of-war, Physalia is a colonial coelenterate showing polymorphism. It is found floating in the surface of tropical seas.

39. **(D)** Flame cells of flatworms are also excretory in function.

40. **(C)** Tracheae are respiratory organ of silkworm, bedbug and sandfly, hence they belong to tracheate group.

Physics

41. **(C)** Centripetal acceleration is $R\ \omega^2$. R is more for the second.

42. **(C)** Due to surface tension, the surface of a liquid behaves like a stretched membrane.

43. **(B)** At constant speed, there is no acceleration, so the forces acting on the train are in equilibrium.

Therefore, F = R

$\therefore$ $F = 3\times 10^4$ N or P = Fv

We have, power $= 3\times 10^4 \times 40$

$= 1.2\times 10^6$ W

44. **(D)** $\frac{\Delta\rho}{\rho} = \frac{\Delta M}{M} + 3\times\frac{\Delta l}{l} = \frac{3}{100} + 3\times\frac{2}{100} = \frac{9}{100} = 9\%$

45. **(B)** Both, orbital speed of satellite $v = \sqrt{Gm/r}$ and time period of revolution of satellite, $T = \left[\frac{4\pi^2 r^3}{GM}\right]^{\frac{1}{2}}$ are independent of mass of satellite. Therefore orbital speed and time period of revolution of both the satellites are same.

The kinetic energy of a satellite, $K = \frac{GM\ m}{2\ r}$ and potential energy of a satellite, $U = -\frac{GM\ m}{r}$ both depend on mass of satellite, vary with mass of satellite.

46. **(D)** Velocity of ball on striking the roof of stationary lift $= \sqrt{2\ gh} = \sqrt{2\times 10\times 5}$

= 10 m/s. As lift is moving upwards with a velocity of 1 m/s ; relative velocity of ball on striking = 10 + 1 = 11 m/s.

The ball will rebound with this velocity if lift were stationary. As lift is moving upwards with a velocity of 1 m/s, therefore, ball will rebound with a velocity = 11 + 1 = 12 m/s upwards.

47. **(B)** Area under acceleration-time graph gives the change in velocity.

Hence, $v_{max} = \frac{1}{2}\times 10\times 11 = 55$ m/s

Therefore, the correct option is (B).

48. **(A)** The air through the horizontal tube will decreaase the pressure and more liquid will be pushed into the capillary tube.

49. **(B)** $a = \frac{v-u}{t} = \frac{3.5-2}{25} = 0.06\ m\ s^{-2}$

$F = ma = 6\times 0.06$

= 0.36 N in the direction of motion.

50. **(A)** As isothermal at T_1 is farther from the origin than the isothermal at T_2, therefore, $T_1 > T_2$.

51. **(D)** One second is defined as 9192631770 periods of cesium clock.

52. **(A)** The gravitational potential energy of a body on the surface of earth is $E_p = -\frac{GM\ m}{R}$.

Inside the earth, $E_p = -GM\frac{\left(3R^2 - r^2\right)}{2R^3}$.

Thus E_p is minimum on the surface of earth.

53. **(C)** Let the origin be at the C atom. Then :

$$R_{cm} = \frac{12\times 0 + 16\times 0.12 \text{ nm}}{12+16} \cong 0.07 \text{ nm.}$$

54. **(C)** 1 Pitch = least count × [No. of divisions on the head or circular scale]

= 0.005 mm × 200 = 1.00 mm.

55. **(B)** $F = \mu Mg \cos\theta = 0.7\times 2\times 9.8\times \frac{\sqrt{3}}{2}$

$= 0.7\times 9.8\times \sqrt{3}$ N

56. **(A)** As no external force is applied, therefore, according to the law of conservation of linear momentum, $\vec{P_s} = \vec{P_1} + \vec{P_2}$ = constant.

As both the blocks are initially at rest, therefore, $\vec{P_1} + \vec{P_2} = 0$ or $\vec{P_2} = -\vec{P_1}$

i.e., at any instant, the two blocks will have equal momentum (in magnitude), but opposite in direction.

57. **(C)** Taking vertical upward motion of balloon for 8 sec.

v = u + at = 0 + 1.25 × 8 = 10 m/s.

$$s = \frac{1}{2}at^2 = \frac{1}{2}\times 1.25\times 8^2 = 40 \text{ m}$$

Taking vertical downward motion of stone released from balloon, we have

u = – 10 m/s, a = 10 m/s², s = 40 m ; t = ?

as $s = ut + \frac{1}{2}at^2$

$40 = -10 \times t + \frac{1}{2} \times 10 \times t^2$

or $5t^2 - 10t - 40 = 0$

On solving, t = 4 s.

58. **(B)** Escape velocity V_e = 11.2 km/s

Orbital velocity close to the earth

$$V_o = \frac{11.2}{\sqrt{2}} \text{ km/s}$$

∴ Additional velocity required to be given

$= V_e - V_o$

$$= \left(11.2 - \frac{11.2}{\sqrt{2}}\right) = 11.2 - 7.9 = 3.3 \text{ km/s.}$$

59. **(B)** Since, there is no loss of heat in an ideal flask, hence mechanical energy spent in shaking the flask is changed into heat energy resulting in the rise of temperature.

60. **(A)** The respective maximum errors in length, breadth and thickness are

$$\frac{0.1}{125.6}; \frac{0.1}{6.5}; \frac{0.01}{0.23}.$$

Hence, thickness measurement is least accurate.

61. **(C)** Excess of pressure in a bubble, p = 4 S / r

i.e., $p \propto \frac{1}{r}$

Therefore pressure in a smaller bubble is more than that of a bigger bubble. When two bubbles of different radii are in communication, then the air flows from higher pressure to lower pressure i.e., from smaller bubble into larger one.

62. **(C)** Here, m_1 = 1 kg, m_2 = 6 kg, and m_3 = 3 kg. If a is acceleration of the system to the right, then the equations of motion of the three bodies are

$m_1 a = T_1 - m_1 g$

$m_2 a = T_2 - T_1$

$m_3 a = m_3 g - T_2$

Adding the three equations, we get

$(m_1 + m_2 + m_3) a = (m_3 - m_1)g$

$$a = \frac{(m_3 - m_1)g}{m_1 + m_2 + m_3} = \frac{(3-1)10}{1+6+3} = 2 \text{ m/s}^2.$$

63. **(A)** dv = a dt

or change in velocity = area under a-t graph

Hence, $v_f - v_i = \frac{1}{2}$ (4) (4) = 8 m s^{-1}

∴ $v_f - v_i + 8 = (2 + 8) = 10$ m s^{-1}

64. **(B)** The velocity of rain drop measured by three observer's is found to be the same as the gravitational force on the rain drop is balanced by the force produced by the surrounding air.

65. **(C)** Solar system is an example of conservation of angular momentum, as all planets move around the sun in elliptical orbits and no torque is acting on them.

Chemistry

66. **(B)** Elements with Z = 4 (Be), 12 (Mg), 20 (Ca), 38 (Sr), 56 (Ba), 88 (Ra) belong to group 2 (alkaline earths) of the periodic table.

67. **(D)** Boric acid (H_3BO_3) contains BO_3 units which are planar and linked together by H- bonding to give layer structure.

68. **(B)** Ethyl alcohol undergoes combustion according to the reaction,

$$C_2H_5OH + 3O_2 \longrightarrow 2CO_2 + 3H_2O$$

$\Delta H = -1367$ kJ mol^{-1}

Then $\Delta_c H = \sum aH_{products} - \sum bH_{reactants}$

Since, the enthalpy of a compound is taken as equal to its heat of formation, and the enthalpy of an element is taken as zero, we can write,

$-1367 = [2\Delta_f H\ (CO_2) + 3\Delta_f H\ (H_2O)] - [\Delta_f H\ (C_2H_5OH) + 0]$

Therefore, $\Delta_f H\ (C_2H_5OH) = 2\ (-393.4) + 3\ (-285.9) + 1367 = -277.5$ kJ mol^{-1}

69. **(A)** In CH_3Cl melecule, the bond dipole moments due to C–Cl bond and C–H bonds are supportive. As a result, CH_3Cl has higher dipole moment as compared to other compounds.

70. **(B)** The O.N. of O in H_2O_2 is – 1. It can either increase to zero in O_2 or decrease to – 2 in H_2O. Therefore, H_2O_2 can act both as an oxidising as well as a reducing agent.

71. **(B)** Given : Wavelength of electron (λ) = Velocity (v) of electron

From de Broglie equation, for a material particle (like electron) one can write,

$$\lambda = \frac{h}{mv} \text{ but, } \lambda = v$$

So, $v = \frac{h}{mv}$ or $v^2 = \frac{h}{m}$

This gives,

$$v = \sqrt{\frac{h}{m}} = \sqrt{\frac{6.6\times10^{-34}}{9.1\times10^{31}}} = \sqrt{7.25\times10^{-4}}$$

$= 2.7\times10^{-2}$ m s^{-1}

72. **(B)** Percentage of sulphur in the compound

$$= \frac{\text{Mass of } BaSO_4 \times 32}{233} \times \frac{100}{\text{Mass of compound}}$$

$$= \frac{0.668\times32\times100}{233\times0.468} = 19.6\ \%$$

73. **(C)** As NH_3 and HBr react, Dalton's law of partial pressures is not applicable.

74. **(B)** Relative formula mass of sodium silicate

$= 23\times2 + 28 + 16\times3 = 122$

% Mass of silicon in 100 g = $(28/122)\times100$

= 23.0 %

75. **(B)** Ice crystals have hollow hexagonal arrangement of H_2O molecules.

76. **(C)** Hydration enthalpy decreases with an increase in the size of the metal ion.

77. **(C)** Eqm. const. changes with change of temperature.

78. **(B)** Hydrazine (NH_2NH_2) does not contain C and hence on fusion with Na metal, it cannot form NaCN. Therefore, hydrazine does not show Lassaigne's test.

79. **(C)** N_1V_1 = N_2V_2

(H_2SO_4) ($NaOH$)

$\therefore N_1\times25 = 1\times20$ or $N_1 = 0.8$.

80. **(C)** The metal M is calcium.

81. **(D)** N_3H (hydrazoic acid) is the acidic hydride of nitrogen.

82. **(B)** $CuSO_4$ = Cu

(63.5 + 32 + 64) g 63.5 g

= 159.5 g

$$\text{Mass of copper obtained} = \frac{63.5\text{g}}{159.5\text{g}}\times40\text{g}$$

= 15.9 g

83. **(C)** 'a' is directly related to forces of attraction. Hence, greater the value of 'a', more easily the gas is liquefied.

84. **(A)** Both have normal tetrahedral angle of 109.5°.

85. **(C)** λ = 242 nm = 242 $\times10^{-9}$ m

c = 3 $\times10^8$ m s^{-1}

Then, the energy per mol of photons of this wavelength is equal to the ionisation energy. So, $E = N_A\ h\ v = N_A\ \frac{hc}{\lambda}$

$$= \frac{6.02\times10^{23}\ \text{mol}^{-1}\times6.62\times10^{-34}\ \text{J s}\times3\times10^8\ \text{m s}^{-1}}{242\times10^{-9}\ \text{m}}$$

E = 494 kJ mol^{-1}

86. **(C)** H_2PO_2 carries one negative charge. Balancing the charges on all the atoms in this ion,

$2\ (+1) + x + 2\ (-2) = -1$

This gives $x = +1$

87. **(B)** Both XeF_2 and CO_2 are linear molecules.

88. **(C)** Both $Al(OH)_3$ and $Be(OH)_2$ are amphoteric in character. They react with acids as well as alkalies forming salts.

89. **(A)** Mass of aluminium, m = 60.0 g

Rise in temperature, Δt = (55° C – 35° C)

= 20° C

Molar heat capacity, C = 24 J K^{-1} mol^{-1}

Heat required

$$= \frac{60.0\,g}{27\,g/mol} \times 24\,J\,K^{-1}\ mol^{-1} \times 20^{o}\,C$$

$$= \frac{60 \times 24 \times 20}{27}\,J = 1066.7\,J = 1.07\,kJ$$

90. **(C)** Six. Since DBE = 1, therefore, all the acyclic isomers are alkenes. These are : 1-pentene, cis-2-pentene, trans-2-pentene, 2-methyl- 1-butene, 3-methyl-1-butene, 2- methyl-2-butene.