NATIONAL STANDARD EXAMINATION IN JUNIOR SCIENCE (NSEJS)

DATE : 19-11-2017 **CODE : JS-533**

HINTS & SOLUTIONS

21. **(a)**

1008, 1109, ……….., 9997

a = 1008

d = 101

$a_n = 9997$

$a_n = a + (n – 1)d$

9997 = 1008 + (n – 1) 101

8989 = (n – 1) 101

89 = n – 1

n = 90.

22. **(c)**

$$1\frac{1}{2}+1\frac{1}{6}+1\frac{1}{12}+1\frac{1}{30}+.....1\frac{1}{380}$$

$$= 19+\frac{1}{2}+\frac{1}{6}+\frac{1}{12}+\frac{1}{30}+.....+\frac{1}{380}$$

$$= 19+\frac{1}{1\times 2}+\frac{1}{2\times 3}+\frac{1}{3\times 4}+\frac{1}{4\times 6}+\frac{1}{5\times 6}+.....+\frac{1}{19\times 20}$$

$$= 19+1-\frac{1}{2}+\frac{1}{2}-\frac{1}{3}+\frac{1}{3}-\frac{1}{4}+\frac{1}{19}-\frac{1}{20} = 19+1-\frac{1}{20}$$

$$= 20-\frac{1}{20} = \frac{400-1}{20} = \frac{399}{20} = 19.95.$$

23. **(c)**

Parallelogram

24. **(c)**

198396198

198396198 = 2 × 3 × 3 ×7 × 7 ×11 × 11 × 11 × 13 × 13

This number should be divided by 22.

So that result is perfect square.

25. **(b)**

x(x + y + z) = 135 ………(1)
y(x + y + z) = 315 ………(2)
z(z + x + y) = 243 ………(3)

Add (1) , (2) & (3)

$x^2 + y^2 + z^2 + 2(xy + yz + zx) = 729$

$(x + y + z)^2 = 729$

x + y + z = 27 ………(4)

From (1) , (2), (3) and (4)

x = 5 z = 9

y = 13

$x^2 + y^2 + z^2$

= 25 + 169 + 81 = 275

26. **(b)**

p + q + r = 2
$P^2 + q^2 + r^2 = 30$
pqr = 10
(1 – p) (1 – q) (1 – r)
(1 – r) (1 – q – p + pq)
1 – q – p + pq – r + rq + rp – rpq
1 – p – q – r + pq + rq + rp – rpq
1 – (p + q + r) + pq + rq + rp – rpq
$(p + q + r)^2 = p^2 + q^2 + r^2 + 2\,(pq + rq + rp)$ ……… (1)
4 = 30 + 2 (pq + rq + rp)
– 26 = 2 (pq + rq + rp)
pq + rq + rp = – 13 ………(2)
Put value of (2) in (1)
1 – 2 – 13 – 10 = – 24

27. **(c)**

$x+\frac{1}{x}=5$

$\left(x+\frac{1}{x}\right)^2=5^2$

$x^2+\frac{1}{x^2}=23$

$\left(x+\frac{1}{x}\right)^3 = x^3+\frac{1}{x^3}+3x\cdot\frac{1}{x}\left(x+\frac{1}{x}\right)$

$5^3 = x^3+\frac{1}{x^3}+3(5)$

$125 = x^3+\frac{1}{x^3}+15$

$x^3+\frac{1}{x^3}=110$

$\left(x^3+\frac{1}{x^3}\right)-5\left(x^2+\frac{1}{x^2}\right)+\left(x+\frac{1}{x}\right)$

= 110 – 5(23) + 5

= 110 – 115 + 5 = 0

28. **(b)**

$x = \sqrt{21}-\sqrt{20} = \left(\sqrt{21}-\sqrt{20}\right)\times\left(\frac{\sqrt{21}+\sqrt{20}}{\sqrt{21}+\sqrt{20}}\right) = \frac{1}{\sqrt{21}+\sqrt{20}}$

$y = \sqrt{18}-\sqrt{17} \times \frac{\sqrt{18}+\sqrt{17}}{\sqrt{18}+\sqrt{17}} = \frac{1}{\sqrt{18}+\sqrt{17}}$

Now x and y have same numerator but y denominator is less compare to x.

So y > x.

29. **(b)**

s = 54 km/hr.

t = 20 sec

$\ell_t = \frac{54\times 5}{18}\times 20 = 300\text{ m}$

30. **(d)**

a + b + c + d = 4

$$\frac{1}{(1-a)(1-b)(1-c)}+\frac{1}{(1-b)(1-c)(1-d)}+\frac{1}{(1-c)(1-d)(1-a)}+\frac{1}{(1-a)(1-b)(1-d)}=?$$

$$\frac{1-d}{(1-a)(1-b)(1-c)(1-d)}+\frac{1-a}{(1-a)(1-b)(1-c)(1-d)}+\frac{1-b}{(1-a)(1-b)(1-c)(1-d)}+\frac{1-c}{(1-a)(1-b)(1-c)(1-d)}$$

$$=\frac{4-(a+b+c+d)}{(1-a)(1-b)(1-c)(1-d)}=\frac{4-4}{(1-a)(1-b)(1-c)(1-d)}=\frac{0}{(1-a)(1-b)(1-c)(1-d)}=0.$$

31. **(c)**

$$\frac{7^{2017}}{25}=\frac{7\cdot 7^{2016}}{25}=\frac{7(49)^{1008}}{25}=\frac{7(50-1)^{1008}}{25}$$

$$\frac{7\left(50k+(-1)^{1008}\right)}{25}=\frac{350k+7}{25}$$

Remainder = 7.

32. **(Bonus)**

$\Delta = \dfrac{abc}{4R}$

$s = \dfrac{30+36+30}{2} = 48$

$\Delta = \sqrt{48\times 18\times 18\times 12}$

= 18 × 12 × 2

= 432

$R = \dfrac{abc}{4\Delta} = \dfrac{30\times 36\times 30}{4\times 432} = \dfrac{32400}{1728} = 18.75.$

33. **(c)**

CI	f	CM(x)	f.x
0 – 10	4	5	20
10 – 20	6	15	90
20 – 30	8	25	200
30 – 40	10	35	350
40 – 50	12	45	540

$\Sigma f = 40$ $\quad \Sigma fx = 1200$

$\bar{x}=\dfrac{\Sigma fx}{\Sigma f}=\dfrac{1200}{40} = 30$

34. **(c)**

$x^2 - 3x + 2$

$x^2 - 2x - x + 2$

$x(x-2) - 1(x-1)$

$(x-2)(x-1)$

$(x-2)$ is factor of $x^4 - px^2 + q$

$(2)^4 - p(2)^2 + q = 0$

$16 - 4p + q = 0$

$4p - q = 16$ ……… (1)

$(x-1)$ is factor of $x^4 - px^2 + q$

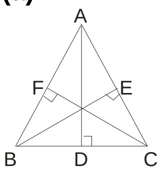
$(1)^4 - p + q = 0$

$p - q = 1$ ………(2)

Solving (1) & (2)
p = 5
q = 4

35. **(c)**
501, 503, 505,……………….., 599
a = 501
d = 2
$a_n = a + (n - 1)\, d$
599 = 501 + (n –1) 2
98 = (n – 1) 2
49 = n – 1
n = 50
$S = \frac{50}{2}\ (501 + 599)$
S = 27,500

36. **(a)**



Area of $\Delta = \frac{1}{2} AB \times CF = \frac{1}{2} AC \times BE$

Area of $\Delta^2 = \frac{1}{2} \times AB \times CF \times \frac{1}{2} AC \times BE$

$= \frac{1}{4} \times 172.8 \times 108.3$ = 4678.56

Area of Δ = 68.4

$\frac{1}{2} BC \times AD$ = 68.4

BC × AD = 68.4 × 2 = 136.8

37. **(d)**

a + b = 13

$a^3 + b^3 = 1066$

$a^3 + b^3 = (a + b)^3 - 3ab\,(a + b)$

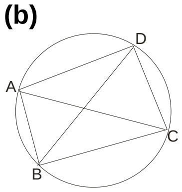
$1066 = 13^3 - 3ab\,(13)$

39 ab = 2197 – 1066

39ab = 1131

ab = 29.

38. **(b)**



By Ptolemy Theorem
AD × BC + AB × DC = AC × BD
85 × 104 + 204 × 195 = AC × 221
8840 + 39780 = AC × 221
48,620 = AC × 221
AC = 220.

39. **(c)**

15 Aug 2017 $\longrightarrow$ Tuesday
} 1 odd day
15 Aug 2018
} 1 odd day
15 Aug 2019
} 2 odd day
15 Aug 2020
} 1 odd day
15 Aug 2021
} 1 odd day
15 Aug 2022
} 1 odd day
15 Aug 2023

15 Aug 2017 – Tuesday

15 Aug 2023 – Tuesday

So after 6 years Independence day will again come on Tuesday.

40. **(a)**

$(x^2 - bx)(m + 1) = (ax - c)(m - 1)$

$(m + 1)x^2 - b(m + 1)x = (m - 1)ax - c(m - 1)$

$(m + 1)x^2 - b(m + 1)x - (m - 1)ax + c(m - 1)$

$(m + 1)x^2 + (-bm - b - am + a)x + c(m - 1)$

for equal and opposite root coefficient of x should be zero.

$\therefore \quad -bm - b - am + a = 0$

$a - b = m(a + b)$

$m = \dfrac{a-b}{a+b}$.

42. (c)

Let the percentage abundance of isotope ${}^{79}_{35}X$ is x_1

and percentage abundance of isotope ${}^{82}_{35}X$ is $100 - x_1$

$\therefore$ Average atomic mass is 80 u

So $\quad 80 = \dfrac{79 \times x_1 + 82(100 - x_1)}{100}$

$\Rightarrow \quad {}^{79}_{35}X = 66 \cdot 67\%$

$\quad {}^{82}_{35}X = 33 \cdot 34\ \%$

43. (c)
Duralumin is an alloy of aluminium containing copper, manganese and magnesium.
It is used for making the parts of air crafts as it is light in weight.

44. (b)
Millimoles of HCl = 0·1 × 10 = 1
Millimoles of NaOH = 0·067 × 15 = 1· 005
So, concentration of OH^- = $\frac{1.005 - 1}{25}$

$\Rightarrow$ $[OH^-] = 2 \times 10^{-4}$
pOH = 4 – log 2 = 3· 7
pH + pOH = 14
pH = 14- pOH = 14-3·7 = 10.3
The pH range of 8-11 is of weak base & it gives pale blue colour.

45. (b)
Moles of HCl = $\frac{73}{36.5} = 2\,\text{mole}$
Molarity of HCl solution is 2M
$2Na + 2H_2O \rightarrow 2NaOH + H_2$
46 g Na metal gives 80g NaOH
$\therefore$ 0.46 g is gives 2×10^{-2} moles of NaOH
$M_{HCl} \times V_{HCl} = M_{NaOH} \times V_{NaOH}$
$2 \times V_{HCl} = 2 \times 10^{-2} \times 1000$ ml
$V_{HCl} = 10^{-2}$ L = 10 ml

46. (b)
Assume
Caustic soda (NaOH) is a monoacidic base
Calcium hydroxide $Ca(OH)_2$ is a diacidic base
Hydrated alumina $Al(OH)_3$ is a triacidic base
$\therefore$ For Neutralization with one equivalent of phosphoric acid (tribasic acid) each time
(Moles $_{base}$ × (Valnecy factor) base = Equivalent of acid)
The ratio of moles of bases required will be
NaOH : $Ca(OH)_2$: $Al(OH)_3$
1 : 0.5 : 0.33

47. (d)
In case (i) CO_2 – Acidic oxide, MgO – basic oxide, N_2O – neutral oxide
H_2O – Generally it is neutral but sometimes it shows amphoteric behaviour
So case (i) is correct
In case (ii) SO_2 – acidic oxide, NO – neutral oxide, CO – neutral oxide, Al_2O_3 – amphoteric oxide
So case (ii) is wrong

In case (iii) P_2O_5 – acidic oxide, ZnO – Amphoteric oxide, NO – neutral oxide, Al_2O_3 – Amphoteric oxide
So case (iii) is wrong
In case (iv) SO_3 – Acidic oxide, CaO – basic oxide, N_2O – Neutral oxide, PbO – Amphoteric oxide
So case (iv) is correct
So correct cases are (i) & (iv)

48. (a)
Weight of magnesium = 4g (Given)
Number of atom in magnesium = $\frac{4}{24} \times N_A$
Weight of sulphur = 4g (Given)
Number of atom in sulphur = $\frac{4}{32} \times N_A$
Ratio of atom in sulphur to magnesium
$= \frac{4N_A}{32} \times \frac{24}{4N_A} = \frac{3}{4}$

49. (c)
Biology specimens are preserved in formaline solution.
Formaline is (37 – 40%) aq. Solution of Formaldehyde or Methanal (HCHO)

50. (d)
Tooth decay starts when pH of mouth is lower than 5.5. Tooth enamel is made up of calcium phosphate which does not dissolve in water, but get corroded when pH in mouth tooth is below 5.5.

51. (c)
Case II Zinc is less reactive than aluminium so it will not displace aluminium.
(I) $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$
(II) $Zn + Al_2(SO_4)_3 \rightarrow$ No reaction
(III) $Zn + AgNO_3 \rightarrow Zn(NO_3) + Ag$
(IV) $Zn + PbNO_3 \rightarrow Zn(NO_3)_2 + Pb$
As per question reaction (III) will not occur, but as zinc is more reactive than silver so zinc can displace silver.

52. (c)
Last discovered element in halogens is astatine Z = 85 (it is a 6^{th} period element)
The difference between 6^{th} & 7^{th} period element is of 32.
So next halogen element will have atomic number (Z) = 117

53. (c)
As per Gay lussac's law :
At particular temperature & pressure both SO_2 & O_2 occupy same volume & having same number of molecules.
Suppose both contain same no. of moles 'x' then the ratio of their masses will be $SO_2 : O_2$
X × 64 g = x × 32 g
2 : 1
So the mass of SO_2 in flask will be twice that of oxygen.

54. (b)
During meteorite shower temperature of water body increases as a result pH decreases
$H_2O \rightleftharpoons H^+ + OH^-$
$K_w = [H^+][OH^-]$
as the temp increases, dissociation of water also increases. The value of K_w increases & pH decreases.

55. (a)
If Z =10
Electronic configuration will be = 2, 8
Outermost shell of the element is completely filled so its valency is zero.

56. (c)
Ketone is $R - \overset{\overset{\displaystyle O}{\|}}{C} - R$ [R = alkyl group]

(C_3H_6O) $CH_3 - \overset{\overset{\displaystyle O}{\|}}{C} - CH_3$ propan – 1 – one

57. (c)

(C) $Cu_{(s)} + AgNO_{3(aq)} \rightarrow Cu(NO_3)_{2(aq)} + Ag_{(s)}$

Colourless Bluish green

Final observation will be

(i) Solution turns blue

(ii) Silver deposite on the copper

58. (d)

As this is open vessel so pressure and Volume is constant.

according to ideal gas equation

PV = nRT

$n \propto \frac{1}{\text{Temperature (Kelvin)}}$

$n_1T_1 = n_2T_2$

assume n_1 = 1 mole, n_2 = moles remain in vessel

then $n_2 = \frac{3}{5}$ mole ($\because$ as $\frac{2}{5}$ moles of air expelled out)

$T_1 = 27°C + 273 = 300$ K

$1 \times 300 = \frac{3}{5} \times T_2$

$T_2 = \frac{300 \times 5}{3} = 500$ K

59. (b)

$NaHCO_3 \xrightarrow{\Delta} Na_2CO_3 + CO_2\uparrow + H_2O$

white solid Residue

When residual white powder Na_2CO_3 dissolved in water it will give alkaline solution

$CO_3^{2-} + H_2O \longrightarrow HCO_3^- + OH^-$

When we add this solution in Alum Sol^n white gelatinous ppt of $Al(OH)_3$ is obtained.

60. (a)

Number of moles of cane sugar = $\frac{1.71}{342}$

Number of carbon atoms present in 1 mole cane sugar is 12 N_A

$\therefore$ Total number of carbon atoms consumed through sugar in the tea is

$12 \times \frac{1.71}{342} \times N_A = 3.66 \times 10^{22}$

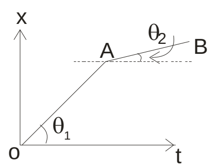
61. **(d)**

$\Delta t = 0.2$ ***sec.***

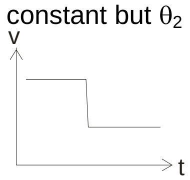
For block (a) displacement is same **i.e** = 4 unit, so acceleration is zero

For block (b) displacement is 6 unit same so acceleration is zero.

62. **(b)** I and III



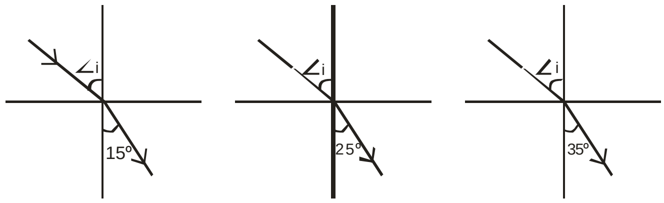
O to A velocity is constant i.e. V, also from A to B velocity is constant but $\theta_2 < \theta_1$ so velocity is less at AB



63. **(c)** From the definition of power of Accommodation.

64. **(d)** Constant downward force of gravity only.

65. **(b)**



$\therefore \mu = \frac{v_1}{v_2} = \frac{\sin i}{\sin r}$

μ_A is maximum and velocity is minimum.

66. **(c)**

$a_0 < a_t$, $b_0 < b_t$, density will decrease because its volume will increase.

67. **(d)**

By flemings left hand rule. α particle will turn towards left and electron will turn towards right.

68. **(d)**

It is evaporation of water from blanket by the heat of the box.

69. **(c)**

Time is 50 sec. and speed increases from 0 to 288 km/hr.

acceleration is a = $\frac{v - u}{t}$

= $\frac{288 \times \frac{5}{18} - 0}{50}$ = $\frac{80}{50}$ = $\frac{8}{5}$ m/sec^2

$v^2 = u^2 + 2as$

$80^2 = 0^2 + 2 \times \frac{8}{5} \times s$

$80 \times 80 = \frac{16}{5} s$

$s = \frac{80 \times 80 \times 5}{16} = 2000$ m

70. **(a)**

Electric Potential energy **=** $\frac{KQ_1Q_2}{R}$

As R decreases so electric potential energy increases.

71. **(d)**

According to newton's III law of motion for every action there is equal and opposite reaction

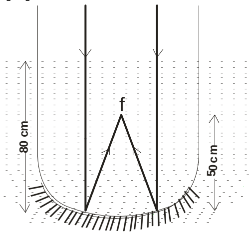
72. **(d)**

According to equation of continuity

av = constant

So, $a_1v_1 = a_2v_2$

73. **(c)**



Since the mirror is inside the water liquid image will be formed at focus i.e. 50 cm above mirror.

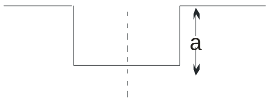
74. **(b)**

Resultant amplitude is given by

A = $\sqrt{a_1^2 + a_2^2 + 2a_1a_2\cos\delta}$

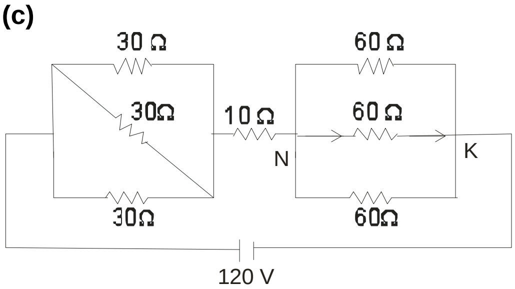
δ = 180°

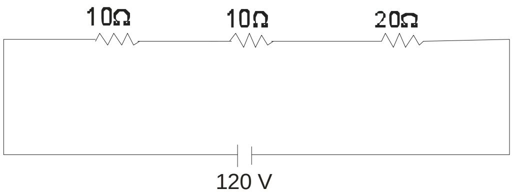
A = $\sqrt{a^2 + (2a)^2 + 2 \times a \times 2a\cos 180^\circ}$



= $\sqrt{a^2 + 4a^2 - 4a^2}$ = a

75. **(c)**





I = $\frac{120}{40}$ = 3A

Current flowing from N to K = I/3

Current flowing from N to K is 3 / 3 = 1A

76. **(b)**

On the chair there will be a downward force of gravity and an upward force exerted by the flow.

77. **(a)**

By lenz law

78. **(b)**

Let the volume of bulb of hydrometer is V and area of cross section of rod is A

For water (V + 20A) d_wg = mg ……(1)

For liquid 1

(V + 0A) 1.4 g = mg ……(2)

For liquid 2

(V + 10A) dg = mg ……(1)

From equation (1) and 2

(V + 20 A) = V × 1.4

20A = 0.4 V

V = 50A

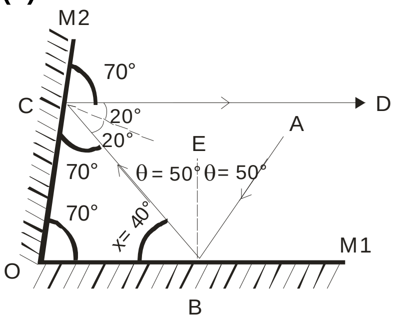
Equation in (1) and (3)

(V + 20A) ×1 = (V + 10A) d

50A + 20A = (50A + 10A)d

$d = \frac{70}{60} = \frac{7}{6} = 1.17\ g/cm^3$

79. **(b)**



In ΔCOB

$70 + 70 + x = 180°$

$x = 40°$

$\angle\theta = 90° - 40°$

So $\theta = 50°$

80. (b)

If R_1 & R_2 are connected in series then $S = R_1 + R_2$

If R_1 & R_2 are connected in parallel then $P = \frac{R_1R_2}{R_1 + R_2}$

$$\frac{S}{P} = \frac{R_1 + R_2}{\frac{R_1R_2}{R_1 + R_2}} = \frac{(R_1 + R_2)^2}{R_1R_2}$$

$$\frac{S}{P} = \frac{R_1^2 + R_2^2 + 2R_1R_2}{R_1R_2} = \frac{R_1}{R_1R_2} + \frac{R_2}{R_1R_2} + \frac{2R_1R_2}{R_1R_2} = \frac{R_1}{R_2} + \frac{R_2}{R_1} + 2$$

If n is minimum then $R_1 = R_2$

So, $(n)_{min} = \frac{S}{P} = 2 + 2 = 4$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