NATIONAL STANDARD EXAMINATION IN JUNIOR SCIENCE

NSEJS_STAGE-I (2012-13)

CODE : 578

HINTS & SOLUTIONS

ANSWER KEY

Ques.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans	d	c	c	a	b	a	a, d	c	d	d	d	b	c	d	a	a	c	a	c	d
Ques.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans	Bonus	a	d	a	a	b	c	d	a	c	a	b	d	b	c	d	c	a,b	c	a
Ques.	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Ans	b	a	b	d	c	b	d	c	a	a	d	a	d	b	c	c	b	b	c	d
Ques.	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Ans	a	a	Bonus	c	b	b	a	a	b	d	b	d	a	a	c	d	a	b	b,c	a

1. $C_{12}H_{22}O_{11} \xrightarrow{Con.H_2SO_4} \underset{Charcoal}{12C} + H_2O$
(dehydration)

2. $\ell_1 = \ell$, $\ell_2 = 2\ell$
$\rho_1 = \rho$, $\rho_2 = \rho$
$m_1 = m$, $m_2 = m$

$$\frac{R_1}{R_2} = \frac{\frac{\rho\ell_1}{A_1}}{\frac{\rho\ell_2}{A_2}} = \frac{\ell_1}{A_1} \times \frac{A_2}{\ell_2}$$

$$\frac{R_1}{R_2} = \frac{\ell_1}{\ell_2} \times \left(\frac{A_2}{A_1} \cdot \frac{\ell_2}{\ell_1}\right) \cdot \frac{\ell_1}{\ell 2}$$

$$\frac{R_1}{R_2} = \left(\frac{\ell_1}{\ell_2}\right)^2 \cdot \left(\frac{A_2}{A_1} \cdot \frac{\ell_2}{\ell_1}\right)$$

density of both wire will be same
then volume will be same
then,

$$\frac{R_1}{R_2} = \left(\frac{\ell_1}{\ell_2}\right)^2 = \frac{1}{4}$$

3. Given :
$x^2 + xy + xz = 135$ .....(1)
$y^2 + yz + yx = 351$ .....(2)
$z^2 + zx + zy = 243$ .....(3)
On adding (1) (2) and (3)
$x^2 + y^2 + z^2 + 2(xy + yz + zx)$
$= 729$ ..... (4)
$x + y + z = 27$
Eq (4) – Eq (1)
$y^2 + z^2 + 2yz + xy + zx = 594$
$(y + z)^2 + x(y + z) = 594$
$(y + z)(x + y + z) = 594$

$$y + z = \frac{594}{x + y + z}$$

$$y + z = \frac{594}{27}$$

$y + z = 22$
Similarly
$x + z = 14$ and $x + y = 18$
Solving above equations
$x = 5$, $y = 13$, $z = 9$
So $x^2 + y^2 + z^2 = 275$
Ans. (c)

4. $I' = 1.2\, I$
$R' = 1.2\, R$

$$\frac{\Delta P'}{P} = \frac{(I')^2 R' - (I)^2 R}{I^2 R} \times 100$$

$= \frac{[(1.2)^2(1.2)-1]}{1} \times 100$

$= 72.8\ \%$

5. Let the number is in base x.

$3x^2 + 6x + 3 + x^3 + 5x + 6 = x^3 + 4x^2 + 5x + 2$

$x^3 + 3x^2 + 11x + 9 = x^3 + 4x^2 + 5x + 2$

$x^2 - 6x - 7 = 0$

$(x - 7)(x + 1) = 0$

$x = 7$ or $x = -1$

So, number is in base 7

Subtraction in base 7 : $654 - 456 = 165$

Ans. (b)

6. $^{232}_{90}R \xrightarrow{-\alpha} {}^{228}_{88}X \xrightarrow{-2\beta} {}^{228}_{90}Y$

9. $\because$ 2 mole $\equiv$ K

$\therefore$ 1 mole $\equiv \sqrt{K}$

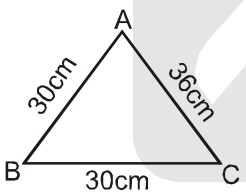
10. $M = m\ell$

$m' = 2m$

$M' = m\ell$

M.F. Lines will be double $\rightarrow$ 2n

11.



a = 30 cm, b = 36 cm, c = 30 cm

$S = \frac{30+36+30}{2} = \frac{96}{2} = 48$ cm

$\Delta = \sqrt{48 \times (48-30) \times (48-36) \times (48-30)}$

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

$= 18 \times 4 \times 6$

$= 432$ sq. cm.

Circumradius $= \frac{abc}{4\Delta}$

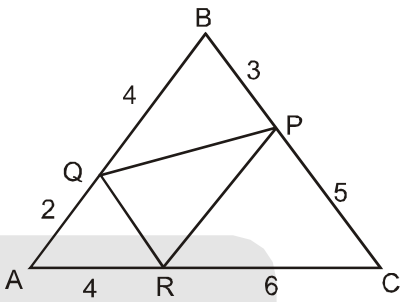
$= \frac{30 \times 36 \times 30}{4 \times 432}$

$= 18.75$ cm

Ans. (d)

12. Direction of magnetic filed will be given by right hand thumb rule. According to this rule magetic field will be out of the plane of paper.

13. Area of $\Delta ABC = \frac{1}{2} \times 6 \times 8 = 24$ sq. unit



Area of $\Delta AQR = \frac{2}{6}$ of area of ΔABR

$= \frac{1}{3}$ of $\frac{4}{10}$ of area of ΔABC

$= \frac{1}{3} \times \frac{2}{5} \times 24 = \frac{16}{5}$ sq. unit.

area of $\Delta CRP = \frac{5}{8}$ of area of ΔBRC

$= \frac{5}{8}$ of $\frac{6}{10}$ of area of ΔABC

$= \frac{5}{8} \times \frac{6}{10} \times 24 = 9$ sq. unit.

area of $\Delta BQP = \frac{4}{6}$ or area or ΔAPB

$= \frac{4}{6} \times \frac{3}{8} \times 24$

$= 6$ sq. unit.

area of ΔPQR = area of ΔABC – (area of ΔAQR + area of ΔPRC + area of ΔBQP)

$= 24 - (6 + 9 + 3.2)$

$= 24 - 18.2 = 5.8$ sq. unit.

Ans. (c)

14. $B_2D_3 \rightleftharpoons 2B^{3+} + 3D^{2-}$

Let solubility = s

2s 3s

$K_{sp} = [B^{3+}]^2[D^{2-}]^3$

$= [2s]^2[3s]^3$

$= 4s^2 \times 27s^3$

$= 108s^5$

16. $n = \frac{8}{32}$

$= \frac{1}{4}$

$\because$ 1 mole $= 6.023 \times 10^{23}$ molecule

$\therefore$ 1/4 mole = $6.023 \times 10^{23} \times \frac{1}{4}$

$= 1.5 \times 10^{23}$ molecules

17. Energy = 200 meV

$= 200 \times 10^6 \times 1.6 \times 10^{-19}$ Joule

According to Einstein energy mass relation

$E = mc^2$

(m is reduced mass, c is speed of light)

$$m = \frac{E}{c^2} = \frac{200 \times 10^6 \times 1.6 \times 10^{-19}}{\left(3 \times 10^8\right)^2} \text{ kg}$$

$m = 0.355 \times 10^{-27}$ kg

$m = 3.55 \times 10^{-28}$ kg

18. $\sin x + \sin y = a$ ... (1)

$\cos x - \cos y = b$ ... (2)

Adding the square of (1) & (2)

$\sin^2 x + \sin^2 y + 2 \sin x \sin y + \cos^2 x + \cos^2 y - 2 \cos x \cos y = a^2 + b^2$

$(\sin^2 x + \cos^2 x) + (\sin^2 y + \cos^2 y) + 2(\sin x \sin y - \cos x \cos y) = a^2 + b^2$

$1 + 1 - 2\cos(x + y) = a^2 + b^2$

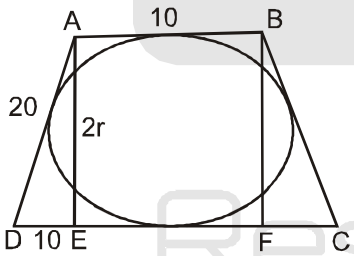
$2 - a^2 - b^2 = 2\cos(x + y)$

$\frac{1}{2}(2 - a^2 - b^2) = \cos(x + y)$ Ans. (a)

19. Projectile motion

so, parabolic path (C)

20.



$\because$ AB + CD = BC + AD

10 + 30 = 2 AD $\because$ BC = AD

AD = 20 cm

In ΔADE

$AD^2 = AE^2 + DE^2$

$(20)^2 = 4r^2 + (10)^2$

$4r^2 = 400 - 100$

$4r^2 = 300$

$r^2 = \frac{300}{4}$

$r^2 = 75$

$\therefore$ Area of circle = $\pi r^2 = 75\pi$ Ans. (d)

21. $CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$

$\frac{1}{100}$ mol $\frac{50 \times 0.1}{1000}$ mol

$\because$ L.R. = HCl

$\because$ 2 mol HCl $\equiv$ 22.4 ℓ CO_2

$\therefore \frac{50 \times 0.1}{1000}$ mol $CaCO_3 \equiv \frac{50 \times 0.1}{1000} \times \frac{22.4}{2}$ ℓ CO_2

$= \mathbf{0.056}$ ℓ $= \mathbf{56}$ **m** ℓ

24. Heat required to convert in water of 60 g ice at 0ºC.

$= 60 \times 80$

$= 4800$

Heat given : 20 g water at 40º

$= 20 \times 1 \times 40$

$= 800$

since heat requied is more then neat given so ice will not melt completely. So final temperatue = 0ºC

25. Given

$y \alpha \frac{1}{x} \Rightarrow xy = k$ (constant)

Now x increased by 25%

So, $\frac{5}{4} x\, y' = k$

$\frac{5}{4} x\, y' = xy$

$y' = \frac{4}{5} y$

So, % change to y is 80%. Ans. (a)

27. $\frac{2}{15} + \frac{2}{35} + \frac{2}{63} + \frac{2}{99} + \frac{2}{9999}$

$=$

$$\left[\frac{1}{3} - \frac{1}{5} + \frac{1}{5} - \frac{1}{7} + \frac{1}{7} - \frac{1}{9} + \frac{1}{9} - \frac{1}{11} + \ldots\ldots \frac{1}{99} - \frac{1}{101}\right]$$

$= \frac{1}{3} - \frac{1}{101}$

$= \frac{101 - 3}{3 \times 101} = \frac{98}{303}$ Ans. (c)

28. $H_2SO_4 \rightleftharpoons 2H^+ + SO_4^{2-}$

$2H_2O \rightleftharpoons 2H^+ + 2OH^-$

discharge potential of OH^- is less

So OH^- discharge first

At positive electrode

$2OH^- \longrightarrow H_2O + \frac{1}{2} O_2 + 2e^-$

31. Into boy's hand since horizontal velocity will be same for both boy & ball.

32. $\sqrt[x]{75} = \sqrt[y]{45} = \sqrt[z]{15} = a$

$\sqrt[x]{75} = a$

$75^{\frac{1}{x}} = a$

$\frac{1}{x} \log 75 = \log a$

$x = \frac{\log 75}{\log a} = \log_a^{75}$

$= 2\log_a^5 + \log_a^3$ ... (1)

$\sqrt[y]{45} = a$

$45^{\frac{1}{y}} = a$

$\frac{1}{y}\log 45 = \log a$

$y = \log_a^{45} = 2\log_a^3 + \log_a^5$ .... (2)

$\sqrt[z]{15} = a$

$15^{\frac{1}{z}} = a$

$\frac{1}{z} \log 15 = \log a$

$z = \frac{\log 15}{\log a}$

$z = \log_a^{15} = \log_a^3 + \log_a^5$ ... (3)

Add (1) and (2)

$x + y = 3\log_a^5 + 3\log_a^3$

$= 3[\log_a^5 + \log_a^3]$

$x + y = 3z$ Ans. (b)

33. In all containers fluid is same so density is also same and height of liquid is same and pressure = dgh

then, $P_1 = P_2 = P_3 = P_4$

34. $x + y + z = 1$

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

Applying A.M. & H.M.

$\frac{x+y+z}{3} > \frac{3}{\frac{1}{x}+\frac{1}{y}+\frac{1}{z}}$

$\left(\frac{1}{x}+\frac{1}{y}+\frac{1}{z}\right)(x + y + z) > 9$

$m > 9$

So, m = 10 and m = 12 is possible. Ans. (b)

35. $\frac{v_1}{t_1} \times \frac{t_2}{v_2} = \sqrt{\frac{m_2}{m_1}}$

$\frac{2}{600} \times \frac{300}{0.6} = \sqrt{\frac{m_2}{32}}$

$\frac{10}{6} = \sqrt{\frac{m_2}{32}}$

$\frac{100}{36} = \frac{m_2}{32}$

$m_2 = \frac{100}{36} \times 32$

$= 88.88$

≈ 89

41. time before v = 0

$t = \frac{u}{g} = \frac{20}{10} = 2$ sec.

42. Sixty sixth independence day was on 15 Aug. 2012.
15 Aug. 2012 is wednesday.
Next wednesday on 15 Aug. will come in 2018
So after 6 years is the answer. Ans. (a)

43. Sound waves moves from air to water and we know that speed of sound in water is greater than in air. So water is rarer medium for sound than air then sound wave is moving from denser to rare medium then angle of refraction is greater than angle of incidence.

44. $\frac{7^{2012}}{25} = \frac{(7^2)^{1006}}{25}$

$= (50 - 1)^{1006}$

$\therefore$ Remainder = 1 Ans. (d)

45. $_{31}X \longrightarrow 2, 8, 18, 3$

$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^1$

n	l	m	S
4	1	–1	$\pm 1/2$

51. $K^+ \ ^-C \equiv N$

52. $v = 2 + 2 \times 9$

$\Rightarrow v = 20$ m/s

$w = \Delta k = \frac{1}{2}(0.5)[(20)^2 - 2^2]$

$= \frac{1}{4} \times 396 = 99$J Ans.

53. Let the three consecutive natural no. are $x, x + 1, x + 2$

Their average $= \frac{x + x + 1 + x + 2}{3}$

$= x + 1$

Now : $x(x+1)(x+2) = 124850054994$

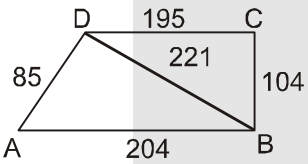
$= 4997 \times 4998 \times 4999$

$\therefore \quad x + 1 = 4998$

Ans. (d)

54. 2N

55.



By Ptolemy theorem

$AC \times BD = AB \times CD + BC \times AD$

$AC \times 221 = 204 \times 195 + 85 \times 104$

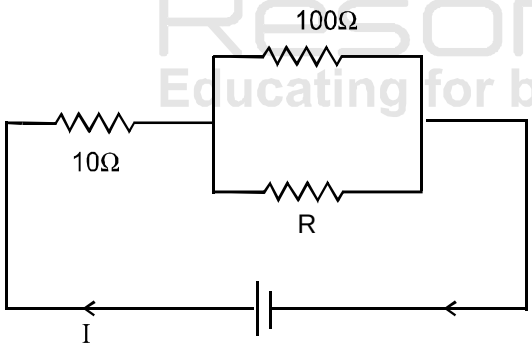
$AC = \frac{39780 + 8840}{221}$

$= \frac{48620}{221}$

$= 220$

Ans. (c)

60.



$I = \frac{10}{10 + \frac{100R}{100 + R}}$

Power consumed by 10Ω is $P_1 = I^2(10)$

Power consumed by parallel combination is

$P_2 = I^2 \times \frac{100R}{100 + R}$

Power is same, $P_1 = P_2$

$10 = \frac{100R}{100 + R}$

$100 + R = 10R$

$R = \frac{100}{9} = 11.11\Omega$

61. $x^2 - px + q = 0$

$\alpha + \beta = p$

$\alpha\beta = q$

Given : $\alpha = m\beta$

$m = \frac{\alpha}{\beta}$

To find :

$$\frac{m}{1+m^2}$$

$$= \frac{\frac{\alpha}{\beta}}{1+\frac{\alpha^2}{\beta^2}}$$

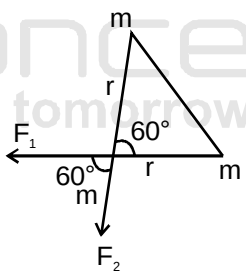
$$= \frac{\alpha\beta}{\alpha^2+\beta^2}$$

$$= \frac{\alpha\beta}{(\alpha+\beta)^2 - 2\alpha\beta}$$

$$= \frac{q}{p^2 - 2q}$$

Ans. (a)

62.



$F_1 = \frac{Gm^2}{r^2} = F_2$

$F_{net} = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos 60}$

$= \sqrt{2F^2 + 2F^2 \times \frac{1}{2}} = \sqrt{3}F = \sqrt{3}\,\frac{Gm^2}{r^2}\,(\alpha)$

63. **This question is *bonus* in CODE 578 but It is correct in code 514 (Q.71) and Code 556 (Q. 78).**

$a + b + c = 1$

$a^2 + b^2 + c^2 = 21$

$abc = 8$

$(1 - a)(1 - b)(1 - c)$

$= (1 - a - b + ab)(1 - c)$

$= 1 - a - b + ab - c + ac + bc - abc$

$= 1 - (a + b + c) + (ab + bc + ac) - abc$

$= 1 - 1 + ab + bc + ac - 8$

$= ab + bc + ac - 8$

$a + b + c = 1$

$= a^2 + b^2 + c^2 + 2(ab + bc + ca) = 1$

$= 21 + 2(ab + bc + ca) = 1$

$= 2(ab + bc + ca) = -20$

$ab + bc + ca = -10$

$\therefore (1 - a)(1 - b)(1 - c) = -10 - 8$

$= -18$

68. Distance = 75 km

Let speed of water current = x km/hr

ATP

$$\frac{75}{2x - x} + \frac{75}{3x} = 16$$

$$\frac{75}{x} + \frac{75}{3x} = 16$$

$$\frac{1}{x}[75 + 25] = 16$$

$$x = \frac{100}{16} = \frac{25}{4}$$

So, Speed of boat in still water = 2x

$$= 2 \times \frac{25}{4} = 12.$$

5 km/hr. Ans. (a)

70. Eq. of line parallel to $4x + 3y = 5$ is $4x + 3y = k$.

$$\frac{x}{k/4} + \frac{y}{k/3} = 1$$

Given : x intercept = – 3

$$\frac{k}{4} = -3$$

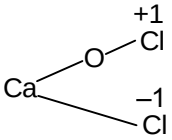
$k = -12$

Eq. is $4x + 3y = -12$ or $4x + 3y + 12 = 0$

Ans. (d)

71. $(NH_4)_2Cr_2O_7 \longrightarrow \underset{\text{green}}{Cr_2O_3} + N_2 + 4H_2O$

73.



Average O.S $= \frac{(+1) + (-1)}{2} = 0$

or

$CaOCl_2$

$2 - 2 + 2x = 0$

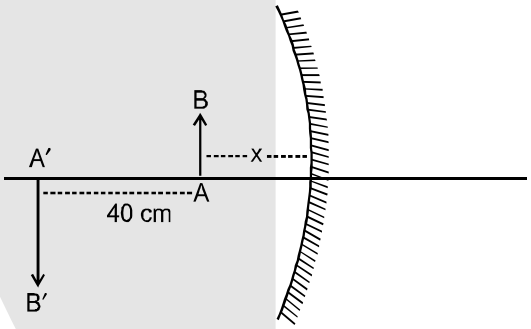
$2x = 0$

$x = 0$

74. $u = -x$

$v = -(40 + x)$

$$m = -\frac{v}{u} = -\frac{(40 + x)}{x}$$



$$m = -3 = -\frac{40 + x}{x}$$

$x = 20$

$\therefore u = -20, v = -60$

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$$

$$\frac{1}{-20} - \frac{1}{60} = \frac{1}{f}$$

$$\frac{-3 - 1}{60} = \frac{1}{f}$$

$f = -15$ cm

75. $\cot^2\theta(1 - 3\sec\theta + 2\sec 2\theta) = 1$

$\theta > 90^\circ$

This is true when $\theta = 300^\circ$

$\cot^2 300^\circ(1 - 3\sec 300 + 2\sec^2 300)$

$$= \left(\frac{-1}{\sqrt{3}}\right)^2 \left[1 - 3 \times (+2) + 2(+2)^2\right]$$

$$= \frac{1}{3}[1 - 6 + 8]$$

$$= \frac{3}{3} = 1$$ Ans. (c)

76. $$f = \frac{100}{1.25}$$

$= -80$ cm

$$\frac{1}{\infty} - \frac{1}{u} = \frac{1}{-80}$$

$u = 80$ cm