SOLUTIONS

PROGRESS TEST-5

GZRM-1903-1904, GZR-1910-1912

GZRK-1903-1904 & GZBS-1902-1903

JEE ADVANCED PATTERN

Test Date: 03-12-2017

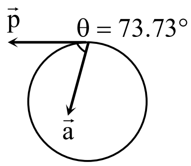
Mentors® Eduserv™

Corporate Office: Paruslok, Boring Road Crossing, Patna-01
Kankarbagh Office: A-10, 1st Floor, Patrakar Nagar, Patna-20
Bazar Samiti Office : Rainbow Tower, Sai Complex, Rampur Rd., Bazar Samiti Patna-06
Call : 9569668800 | 7544015993/4/6/7

PHYSICS

1. (B)

Angle between $\vec{a}$ and $\vec{p}$ is :



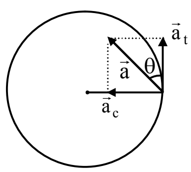
$\theta = \cos^{-1} \frac{\vec{a}.\vec{p}}{|\vec{a}||\vec{p}|}$

$= \cos^{-1} \left\{ \frac{32-18}{\sqrt{(16+9)}\sqrt{(64+36)}} \right\}$

$= \cos^{-1} \left(\frac{14}{50} \right)$

Clearly both are not perpendicular, hence accelerated circular motion

2. (C)



$\tan \theta = \frac{a_c}{a_t}$

$\therefore \quad \frac{a_c}{a_t} = \tan 30° = \frac{1}{\sqrt{3}}$

3. (D)

$$\frac{\Delta V}{V} \times 100 = 3\left(\frac{\Delta \ell}{\ell} \times 100\right)$$

4. (B)

$a_A = 6a_B$

$a_B = \frac{a_A}{6} = \frac{12 m/s^2}{6} = 2 m/s^2$

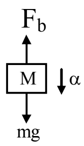
5. (B)

Work done depends upon frame of reference.

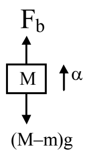
6. $a = -s$, $v\dfrac{dv}{ds} = -s$, $\int_{v_0}^{0} v\,dv = -\int_{0}^{s} s\,ds$, $\dfrac{v_0^2}{2} = \dfrac{s^2}{2}$ $\Rightarrow s = v_0$

$\therefore$ **(B)**

7. **(B)**



$Mg - F_b = M\alpha$ .....(1)



$F_b - (M-m)\,g = (M-m)\,\alpha$ ....(2)

Solving equation (1) and (2), we get $m = \dfrac{2\alpha}{\alpha + g}M$

8. For the dropped body, $h_1 = \dfrac{1}{2}gt^2$;

For the thrown body, $h_2 = 1 \times t \times \dfrac{1}{2}gt^2 = t + \dfrac{1}{2}gt^2$;

$h_2 - h_1 = t$; So, $t = 1.8$ second.

$\therefore$ **(C)**

9. Time to cross river (t) = $\dfrac{AB}{v_{mr}\sin\theta} = \dfrac{0.4}{5\sin\theta}$

$BC = (v_{mr}\cos\theta + v_r)t$

$\Rightarrow$ $0.4 = (5\cos\theta + 1) \times \dfrac{0.4}{5\sin\theta}$ $\Rightarrow$ $5\sin\theta - 5\cos\theta = 1$

$\Rightarrow$ $25\sin^2\theta + 25\cos^2\theta - 50\sin\theta\cos\theta = 1$ $\Rightarrow 25\sin 2\theta = 24$

$\Rightarrow$ $\sin 2\theta = \dfrac{24}{25}$ $\Rightarrow$ $\theta = 53°$

$\therefore$ **(C)**

10. **(B)**

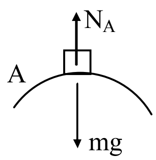
11. **(A,D)**

12. **(B,C,D)**

13. **(A,D)**

14. **(A,B,C)**

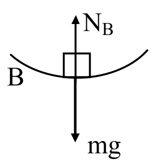
At A :



$$mg - N_A = \frac{mv^2}{r_A}$$

$$N_A = mg - \frac{mv^2}{r_A}$$

At B :



$$N_B - mg = \frac{mv^2}{r_B}$$

$$N_B = mg + \frac{mv^2}{r_B}$$

At C :

$$N_C = mg - \frac{mv^2}{r_C}$$

At D :

$$N_D = mg + \frac{mv^2}{r_D}$$

From figure $r_B < r_D$

hence $N_B > N_D$

Hence N_B is greatest

$r_C < r_A$

$N_C < N_A$

Hence N_C is least

At A & C ; $N_A < mg$

$N_C < mg$

At B & D ; $N_B > mg$

$N_D > mg$

15. (A,B,C,D)

$x = \alpha t^2 - \beta t^3$

for x = 0, $\alpha t^2 - \beta t^3 = 0$

$\therefore \quad t = \frac{\alpha}{\beta}$.

$\frac{dx}{dt} = 2\alpha t - 3\beta t^2$

Particle at rest v = 0

$2\alpha t - 3\beta t^2 = 0$

$t = \frac{2}{3}\frac{\alpha}{\beta}$

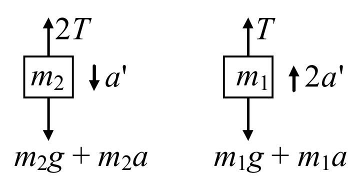
$\frac{d^2x}{dt^2} = 2\alpha - 6\beta t$

at t = 0 $\quad a = 2\alpha$, $\quad$ at t = 0, v = 0

for no net force, (a = 0)

$2\alpha - 6\beta t = 0, \quad t = \frac{\alpha}{3\beta}$.

16. (2)



Solving from the frame of the elevator

$m_2 g + m_2 a - 2T = 2m_2 a'$

$T - m_1 g - m_1 a = 2m_1 a'$

$a' = 0$

17. (2)

$av =$ constant

$\Rightarrow \quad \frac{dv}{dt}v = k$

$$\int_0^v v\,dv = \int_0^t k\,dt$$

$\Rightarrow \quad \frac{v^2}{2} = kt$

$\Rightarrow \quad v \propto \sqrt{t}$

18. (5)

$10 - v\cos 60^\circ = 0$

$\therefore H = \frac{v^2 \sin^2 60^\circ}{2g} = 15$ m

19. (5)

$R = \frac{v^2}{\mu g} = \frac{5 \times 5}{0.5 \times 10} = 5$ m

20. (4)

$F \propto v^a$

$\propto \rho^b$

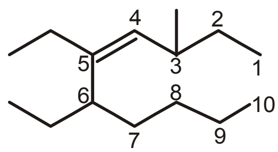
$\propto A^c$

$\Rightarrow F = k\, v^a \rho^b A^c$ k : dimensional constant.

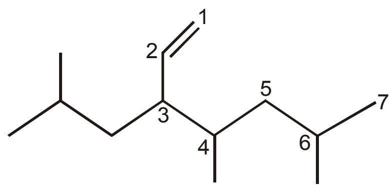
By dimension analysis $a = 2 \Rightarrow F \propto v^2$.

CHEMISTRY

21. (B)



22. (B)



23. (D)

$$\%\text{ of ionic character} = \frac{\mu_{exp.}}{\mu_{cal}} \times 100\,\%$$

$$\mu_{cal} = 9 \times d$$

$$= (4.8 \times 10^{-10}\,\text{e.s.u.}) \times 1.26 \times 10^{-8}\,\text{cm}$$

= 4.8 × 1.26 D

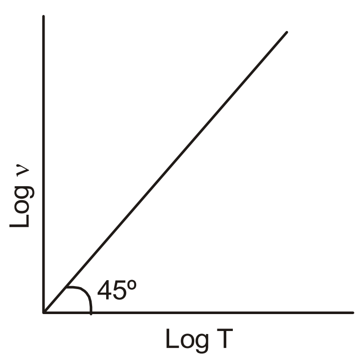
$$\%\text{ of I/C} = \frac{1.03\cancel{0}}{4.8 \times 1.26\cancel{0}} \times 100\%$$

$$= \frac{103}{6.048} \simeq 17\%$$

24. (A)

$$PV = nRT \Rightarrow \cancel{0.821} \times V = 10 \times \cancel{0.0821} \times T$$

$$V = T \Rightarrow \text{Log V} = \text{Log T}$$



25. (B)

$$\begin{array}{rcccc} & O_2, & O_{2,}^{+} & O_{2,}^{-} & O_2^{-2} \\ \text{Total V.E} = & 12, & 11, & 13, & 14 \\ \text{BiO} = & 2, & 2.5 & 1.5, & 1 \end{array}$$

so bond strength = $= O_2^{+} > O_2 > O_2^{-} > O_2^{-2}$

26. (A)

Total number of spectral lines given by

$$\frac{1}{2}[n-1]\times n = 15; \quad \therefore \quad n = 6$$

Thus, electron is excited upto 6^{th} energy level from ground state. Therefore,

$$\frac{1}{\lambda} = R_H\left[\frac{1}{1^2} - \frac{1}{n^2}\right] = 109737 \times \frac{35}{36};$$

$$\lambda = 9.373 \times 10^{-6}\ \text{cm} = 937.3\ \text{Å}$$

27. (A)

$$E_n = \frac{I.E. + E_A}{2}$$ (Here I.E. & E_A in ev/atom)

$$E_n = \frac{I.E. + E_A}{540}\,KJ/mol$$

28. (D)

Let mole fraction of O2 is x

40 = 32 × x + 80 (1 – x)

or x = 5/6

a : b = x : (1 – x) = $\frac{5}{6} : \frac{1}{6}$

when ratio is changed

$$M_{mixture} = 32 \times \frac{1}{6} + 80 \times \frac{5}{6} = 72$$

29. (C)

30. (C)

$H_2O(\ell) \longrightarrow H_2O(g)$

0.0006 g/ml

$V = 1L = 1000\,mL$

$w = 0.6g$

$\frac{0.6}{18}$ mole

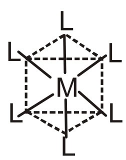
mole of $H_2O(\ell) = 0.6/18; w_{H_2O} = \frac{0.6}{18} \times 18 = 0.6\,g$

$\Rightarrow v_{H_2O} = 0.6\,mL$

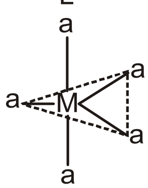
31. (A,B,D)

(A) Hybridisation is the mixing of atomic orbital prior to their combing into molecularorbital

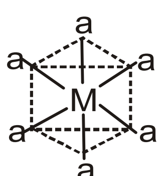
(B) Sp^3d^2 octahedral



Sp^3d^2
Q=90°

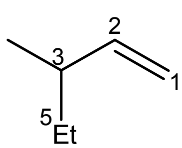
(C) 

Trigonal bipyramidal (Sp^3d)

(D) 

Regular octahedral Sp^3d^2

32. (A, B)

(A) 

3-Methylpent-1-ene

(B) $CH_3—\overset{4}{C}H—\overset{3}{C}H—CH_3$ with $\overset{2}{C}_2H_5$ on C-3 and $\overset{6}{C}_2H_5$ on C-4

3,4-Dimethylhexane

33. (A,D)

34. (A, C, D)

$V_{strength} = 28;$

$\therefore \quad M = \frac{28}{11.2} = 2.5$

$\therefore$ 1 L contain 2.5 moles of H_2O_2

or 2.5 × 34 = 85 g H_2O_2

Mass of 1 litre solution = 265g

$(\because \ d = 265\ g/L)$

$\therefore \quad w_{H_2O} = 180$ g or moles of H_2O = 10

$x_{H_2O_2} = \frac{2.5}{2.5+10} = 0.2$; $\quad \% \frac{w}{v} = \frac{2.5 \times 34}{1000} \times 100 = 8.5$

$m = \frac{2.5}{180} \times 1000 = 13.88$

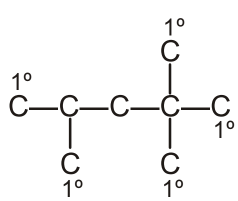
35. (A, B, C)

Option (d) is incorrect because the kinetic energy and potential energy of electrons are different.

36. (4)

No. of alkyl group = types of hydrogen.

37. (5)



38. (4)

Basic compound = CsOH, $Sr(OH)_2$

$Ca(OH)_2$, $Ba(OH)_2$, NaOH

—Acidic compound - $OC(OH)_2$ $SO_2(OH)_2$, BrOH,O_2NOH [Total 4 Nos]

39. (2)

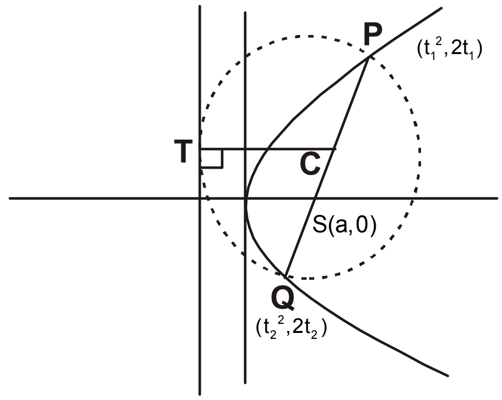
40. (5)

The n.factor of $KBrO_3$ in the reaction is 5

MATHEMATICS

41. (C)

The circle having focal chord PQ as diameter will touch the directrix.



Also, $t_1 t_2 = -1$

Now, CT = 4 (C is mid point of PQ)

$$\left|\frac{t_1^2 + t_2^2}{2} + 1\right| = 4$$

$\Rightarrow t_1^2 + t_2^2 = 6$

$\Rightarrow (t_1 + t_2)^2 = 4$

$\Rightarrow t_1 + t_2 = \pm 2$

$\Rightarrow k = \pm 2$

42. (B)

six 3's & one 2's $= {}^7C_1 = 7$

five 3's & two 2's $= {}^6C_2 = 15$

four 3's & three 2's $= {}^5C_3 = 10$

three 3's & four 2's $= {}^4C_4 = 1$

Hence tatal number = 33

43. (A)

Since two parabola are symmetric about y = x

So, minimum distance is distance between tangents to parabola which are parallel to y = x

Now $\quad 2x - 8 - 4\frac{dy}{dx} = 0 \Rightarrow \quad \frac{dy}{dx} = \frac{x-4}{2} = 1 \Rightarrow x = 6$ and $y = 7$

Corresponding point on other parabola is (7,6)

So minimum distance $= \sqrt{2}$

44. (C)

45. (B)

Given that,

$f(\theta) = \sin^2\theta + \sin^2\left(\theta+\frac{2\pi}{3}\right) + \sin^2\left(\theta+\frac{4\pi}{3}\right)$

$= 1 + \sin^2\theta - [\cos^2\left(\theta+\frac{2\pi}{3}\right) - \sin^2\left(\theta+\frac{\pi}{3}\right)]$

$= 1 + \sin^2\theta - \cos(2\theta+\pi)\cos\frac{\pi}{3} = 1 + \sin^2\theta + \frac{\cos 2\theta}{2}$

$= 1 + \sin^2\theta + \frac{1}{2} - \sin^2\theta = \frac{3}{2}$

Hence, $f\left(\frac{\pi}{15}\right) = \frac{3}{2}$

46. (B)

Any second degree curve passing through the intersection of the given curves is

$ax^2 + 4xy + 2y^2 + x + y + 5 + \lambda(ax^2 + 6xy + 5y^2 + 2x + 3y + 8) = 0$

If it is a circle, then coefficient of x^2 = coefficient of y^2 and coefficient of $xy = 0$

$a(1+\lambda) = 2 + 5\lambda$ and $4 + 6\lambda = 0$

$\Rightarrow\ a = \frac{2+5\lambda}{1+\lambda}$ and $\lambda = -\frac{2}{3} \Rightarrow a = \frac{2-\frac{10}{3}}{1-\frac{2}{3}} = -4.$

47. (A)

Let d be the distance between the centres of two circles of radii r_1 and r_2.

These circle intersect at two distinct points if $|r_1 - r_2| < d < r_1 + r_2$

Here, the radii of the two circles are r and 3 and distance between the centres is 5.

Thus, $|r - 3| < 5 < r + 3 \Rightarrow -2 < r < 8$ and $r > 2 \Rightarrow 2 < r < 8$.

48. (A)

49. (B)

$3, A_1, A_2, \ldots, A_n, 54$ are in AP with common difference d

& $\frac{A_8}{A_{n-2}} = \frac{3}{5}$

$d = \frac{54-3}{n+1} = \frac{51}{n+1}$

$A_8 = 3 + 8d$ & $A_{n-2} = 3 + (n-2)d$

$$\frac{A_8}{A_{n-2}} = \frac{3+8d}{3+(n-2)d} = \frac{3}{5}$$

$$\Rightarrow \frac{3+8\left(\frac{51}{n+1}\right)}{3+(n-2)\left(\frac{51}{n+1}\right)} = \frac{3}{5}$$

$$\Rightarrow \frac{n+1+136}{n+1+(n-2)17} = \frac{3}{5} \Rightarrow 5(n + 137) = 3\,(18n - 33) \Rightarrow 784 = 49n$$

$$\Rightarrow n = \frac{784}{49} = \frac{112}{7} \Rightarrow n = 16$$

50. (B)

Let a and b are first and 50th terms of the G.P, then

$$(a_3 \cdot a_{48}) \cdot (a_{13} \cdot a_{38}) \cdot (a_{23} \cdot a_{28}) = 343$$

$$\Rightarrow (ab)^3 = 343 \Rightarrow ab = 7$$

Product of first 50 terms $= \left(\sqrt{ab}\right)^{50} = 7^{25}$

51. (A, B, C, D)

Any point on the parabola is $P\left(at^2, 2at\right)$

$\therefore$ midpoint of S (a, 0) and P (at^2, 2at) is

$$R\left(\frac{a+at^2}{2}, at\right) \equiv (h,k) \qquad \therefore h = \frac{a+at^2}{2}, k = at$$

Eliminate t,

i.e. $2x = a\left(1+\frac{y^2}{a^2}\right) = a + \frac{y^2}{a}$

i.e. $2ax = a^2 + y^2$

i.e. $y^2 = 2a\left(x - \frac{a}{2}\right)$

Its a parabola with vertex at $\left(\frac{a}{2}, 0\right)$

latus rectum = 2a

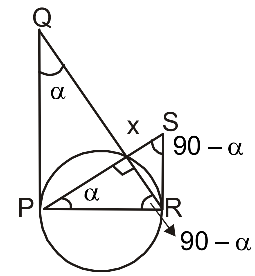
Directrix is $x - \frac{a}{2} = -\frac{a}{2}$ i.e. $x = 0$

focus is (a, 0)

52. (A) (C) (D)

In ΔPRS $\tan\alpha = \frac{RS}{2r}$ ----(1)

in ΔPRQ, $\cot\alpha = \frac{PQ}{2r}$ ----(2)



From (1) and (2) PQ, 2r, RS are in G.P.

in ΔPXQ, $\cos\alpha = \frac{QX}{PQ}$ -----(3)

in ΔXRS, $\cos\alpha = \frac{RX}{RS}$ -----(4)

From (3) and (4), $\frac{PQ}{RS} = \frac{QX}{RX}$

Now ΔPQX and ΔRSX

$PQ^2 = QX^2 + PX^2$, $RS^2 = SX^2 + RX^2$

Adding $(PQ)^2 + (RS)^2 = (QX)^2 + SX^2 + PX^2 + RX^2$

$\Rightarrow (PQ)^2 + (RS)^2 = (PR)^2 + (QS)^2$

53. (A,D)

54. (A, B)

55. (A,B,C,D)

We have

$b_3 > 4b_2 - 3b_1 \Rightarrow b_1 r^2 > 4b_1 r - 3b_1 \Rightarrow r^2 > 4r - 3$ [$\because b_1 > 0$]

$\Rightarrow r^2 - 4r + 3 > 0 \Rightarrow (r-3)(r-1) > 0 \Rightarrow r > 3$ or $r < 1$

Since r = 3.5 and r = 5.2 are both greater than 3, so (C) and (D) are true.

Hence (A), (B), (C) and (D) are the correct answers.

56. (1)

$x = \frac{1}{9}(999....9) = \frac{1}{9}\left(10^{20} - 1\right)$; $y = \frac{1}{3}(999....9) = \frac{1}{3}\left(10^{10} - 1\right)$; $z = \frac{2}{9}(999....9) = \frac{2}{9}\left(10^{10} - 1\right)$

57. (2)

58. (5)

$xy - 6x - 6y = 0$

$\Rightarrow (x - 6)(y - 6) = 36$

possibilities are

$x - 6 = 1; \quad y - 6 = 36$
$x - 6 = 2; \quad y - 6 = 18$
$x - 6 = 3; \quad y - 6 = 12$
$x - 6 = 4; \quad y - 6 = 9$
$x - 6 = 6; \quad y - 6 = 6$

i.e. there are 5 possible pairs

59. (1)

Let a and d be the first and common difference of corresponding A.P.

then $a + 9d = \frac{1}{21}$ and $a + 20d = \frac{1}{10}$

solve above two we get

$a = \frac{1}{210}$ & $d = \frac{1}{210}$

$\therefore t_{210}(A.P.) = a + 209d = 1 \Rightarrow t_{210}(H.P.) = 1$

60. (3)

Equation of tangent : $y = mx + \frac{1}{m}$

$\therefore \quad (-1) = m(-2) + \frac{1}{m} \quad \Rightarrow \quad 2m^2 - m - 1 = 0 \quad \therefore \quad m = -1/2, 1$

$\therefore \quad \tan\theta = \frac{1 + \frac{1}{2}}{1 - \frac{1}{2}} = 3.$