NARAYANA IIT ACADEMY INDIA

43 YEARS OF EXCELLENCE

**JR. IIT CO-SPARK** **DATE: 08-08-2022**
**Time: 3:00 Hrs** **WTA-1** **Max Marks: 180**

# 2014-P1_ADV MODEL

**IMPORTANT INSTRUCTIONS**

## PHYSICS:

| Section | Question Type | +Ve Marks | - Ve Marks | No.of Qs | Total marks |
|---|---|---|---|---|---|
| Sec – I(Q.N : 21 – 30) | Questions with Multiple Correct Choice | 3 | 0 | 10 | 30 |
| Sec – II(Q.N : 31 – 40) | Questions with Integer Answer Type | 3 | 0 | 10 | 30 |
| **Total** | | | | **20** | **60** |

## CHEMISTRY:

| Section | Question Type | +Ve Marks | - Ve Marks | No.of Qs | Total marks |
|---|---|---|---|---|---|
| Sec – I(Q.N : 21 – 30) | Questions with Multiple Correct Choice | 3 | 0 | 10 | 30 |
| Sec – II(Q.N : 31 – 40) | Questions with Integer Answer Type | 3 | 0 | 10 | 30 |
| **Total** | | | | **20** | **60** |

## MATHS:

| Section | Question Type | +Ve Marks | - Ve Marks | No.of Qs | Total marks |
|---|---|---|---|---|---|
| Sec – I(Q.N : 21 – 30) | Questions with Multiple Correct Choice | 3 | 0 | 10 | 30 |
| Sec – II(Q.N : 31 – 40) | Questions with Integer Answer Type | 3 | 0 | 10 | 30 |
| **Total** | | | | **20** | **60** |

## SECTION-1
## (ONE OR MORE OPTIONS CORRECT TYPE)

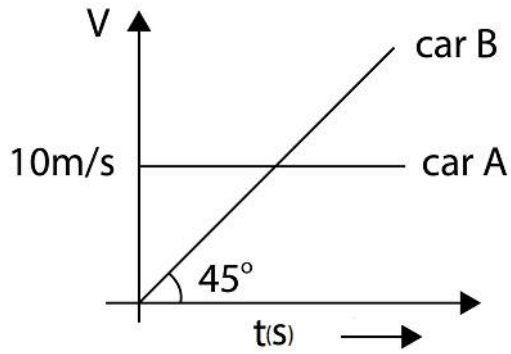
This section contains 10 multiple choice equations. Each question has four choices (**A)** (**B)**,(**C)** and (**D)** out of which **ONE** or **MORE THAN ONE** are correct.

**Marking scheme: +3 for correct answer, 0 if not attempted and 0 in all other cases.**

1. A body is thrown vertically upwards from A, the top of a tower. It reaches the ground in time '$t_1$'. If it is thrown vertically downward from A with same speed, it reaches the ground in time '$t_2$'. If it is allowed to fall freely from A, then time it takes to reach the ground is given by

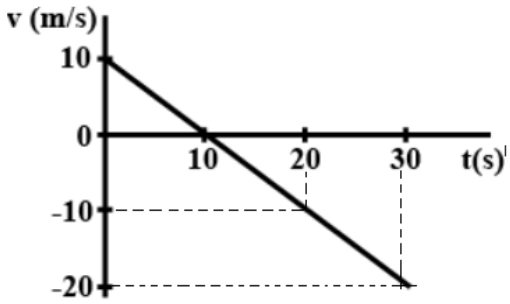
A) $t = \frac{t_1 + t_2}{2}$ B) $t = \frac{t_1 - t_2}{2}$ C) $t = \sqrt{t_1 t_2}$ D) $t = \frac{t_1}{t_2}$

2. Initially car A is 10.5 m ahead of car B. Both start moving at time t = 0 in the same direction along a straight line. The velocity time graph of two cars is shown in figure. The time when the car B will catch the car 'A' is




A) 21s B) 20s C) $2\sqrt{5}s$ D) 2s

3. The velocity-time plot of a particle moving along a straight line is shown in figure. Then



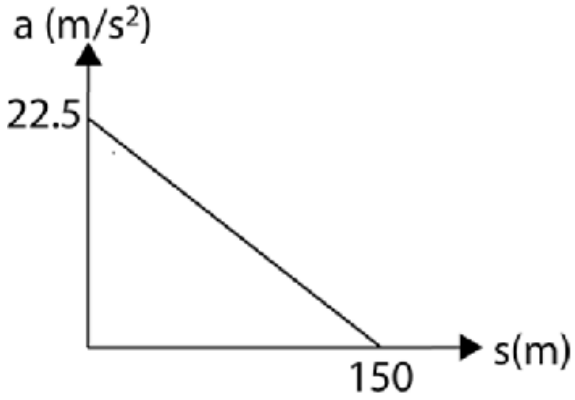

A) The particle has a constant acceleration

B) The particle has never turned around

C) The particle has zero displacement

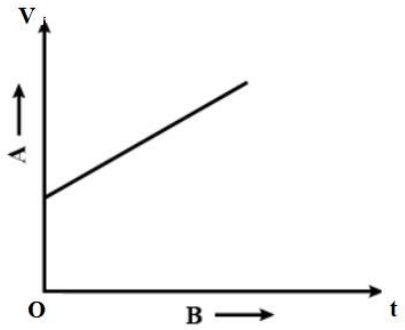
D) The average speed in the interval 0 to 10s is same the average speed in the interval 10s to 20s

4. A jet plane starts from rest at s=0 and is subjected to the acceleration as shown. The speed of the plane when it has travelled 60 m is




A) 46.47 m/s B) 36.47 m/s C) 26.47 m/s D) 16.47 m/s

5. The variation of quantity A with quantity B plotted in the figure describes the motion of a particle in a straight line. Then




a) quantity B may represent time

b) quantity A is velocity if motion is uniform

c) quantity A is displacement if motion is uniform

d) quantity A is velocity if motion is uniformly accelerated

A) a,c,d B) b,c,d C) a,b D) c,d

6. A particle is thrown vertically in upward direction and passes three equally spaced windows of equal heights then

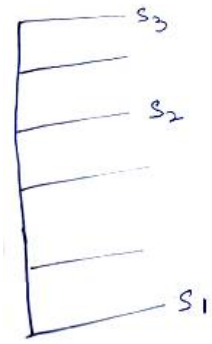
A) Average speed of the particle while passing the windows satisfies the relation $u_{av_1} > u_{av_2} > u_{av_3}$

B) The time taken by the particle to cross the windows satisfies the relation $t_1 < t_2 < t_3$

C) The magnitude of acceleration of the particle while crossing the windows satisfies the relation $a_1 = a_2 \neq a_3$

D) The change in the speed of the particle while crossing the windows would satisfy the relation $\Delta u_1 < \Delta u_2 < \Delta u_3$

7. $s_1, s_2$ *and* $s_3$ are the different sizes of windows 1,2 and 3 respectively, placed in a vertical plane. A particle is thrown up from $s_1$ in that vertical plane. Then the correct options are




A) average speed of the particle passing the windows may be equal if $s_1 < s_2 < s_3$ B) average speed of the particle passing windows may be equal if $s_1 > s_2 > s_3$

C) If $s_1 = s_2 = s_3$, that change in speed of the particle while crossing the windows will satisfy $\Delta v_1 < \Delta v_2 < \Delta v_3$

D) If $s_1 = s_2 = s_3$, the time taken by the particle to cross the windows will satisfy $t_1 < t_2 < t_3$

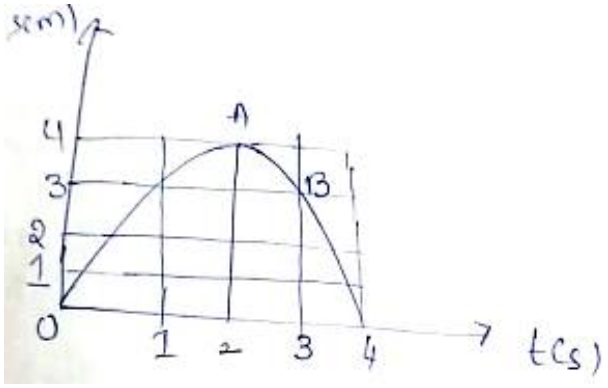
8. A body is thrown vertically upwards with an initial velocity 'u' reaches maximum height in 6 ses. The ratio of the distance travelled by the body in the first second to7th second is

A) 1 : 1 B) 11 : 1 C) 1 : 2 D) 1 : 11

9. A particle is thrown upwards from ground. It experiences a constant air resistance which can produce a retardation of 2 m/s$^2$ opposite to the direction of velocity of particle. The ratio of time of ascent to the time of descent is

A) 1 : 1 B) $\sqrt{\frac{2}{3}}$ C) $\frac{2}{3}$ D) $\sqrt{\frac{3}{2}}$

10. The figure shows the displacement time graph of a body subjected only force of gravity. This graph indicates that




A) the velocity is zero at 0 and c B) the velocity is zero at A

C) the velocity is maximum at 0 and c

D) the acceleration is constant throughout the motion

## SECTION-II
## INTEGER TYPE

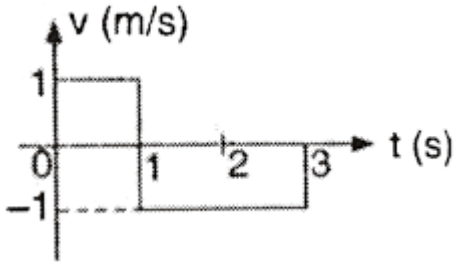
This section contains 10 questions. The answer to each question is a **single digit integer**, **ranging** from 0 to 9 (both inclusive).

**Marking scheme: +3 for correct answer, 0 if not attempted and 0 in all other cases.**

11. A body is dropped from a height h = 50 m. Another body is projected vertically up with a speed V= 10m/sec. After a time $t_o$=2 sec from the instant of release of the first body. Find the time of their meeting _____

12. A balloon starts from rest, moves vertically upwards with a acceleration g/8 $ms^{-2}$. A stone falls from the balloon after 8 sec from the start. Further time taken by the stone to reach the round is_____Sec

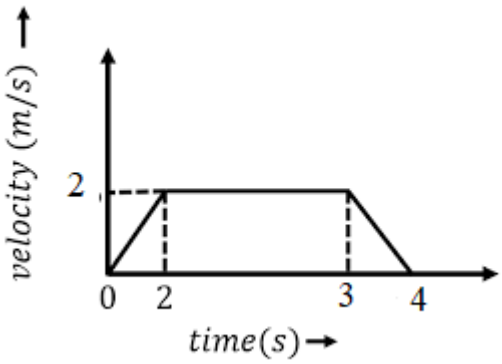
13. The v-t graph of a particle moving along x-axis is given below. Then the distance of the particle during two seconds from starting is (in meter) _____




14. A helicopter is ascending vertically with a speed of 8.0 m/s. At a height of 120 m above the earth, a package is dropped from window. How much time does it take for the package to reach the ground in (s)_____ (Round off to nearest integer)

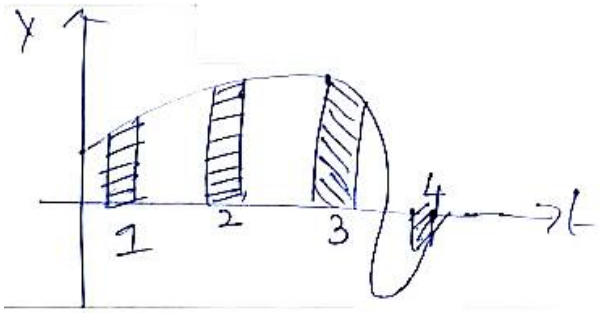
15. The distance travelled by a body projected upward during last second of journey is 9m. If velocity of projection is doubled, the distance travelled by the body during the last second of its upward journey is _____

16. An elevator is going up the variation in the velocity of elevator is as given in the graph. The height to which the elevator takes the passengers is



17. Form a lift moving upwards with a uniform acceleration a = 2 m/s$^2$, a man throws a ball vertically upwards with a velocity V= 12 m/s relative to the lift. The ball comes back to the man after a time‘t’. Then the value‘t’ is _____ in sec

18. In the x-plot of a particle in one dimensional motion, four different equal intervals of time are shown. In which interval, average speed is greatest _____




19. A girl is standing on the top edge of an 18 m high building. She tosses a coin upward with a speed of 7.0 $ms^{-1}$. How long does it take for the coin to hit the ground _____ in sec (Roundoff to nearest integer)

20. A body is thrown up with a velocity 40 m/s. At same time another body is dropped from a height 40 m. Their relative acceleration after 1.3 second is _____

## CHEMISTRY Max Marks: 60

### SECTION-1
### (ONE OR MORE OPTIONS CORRECT TYPE)

This section contains 10 multiple choice equations. Each question has four choices (**A)** (**B)**,(**C)** and (**D)** out of which **ONE** or **MORE THAN ONE** are correct.

**Marking scheme: +3 for correct answer, 0 if not attempted and 0 in all other cases.**

21. Correct statements regarding 3P, orbital is/are:

A) Angular part of wave function is independent of angles ($\theta$ *and* $\phi$)

B) No of maxima when a curve is plotted between $4\pi r^2 R^2(r) vs\ r'2'$

C) ‘xz’ plane acts as nodal plane

D) magnetic quantum number must be -1

22. Choose the correct statement(s)

A) For a particular orbital in hydrogen atom, the wave function may have negative value

B) Radial probability distribution function may have zero value but can never have negative value

C) $3d_{x^2-y^2}$ orbital has two angular nodes and one radial node

D) yz and xz planes are nodal planes for $d_{xy}$ orbital

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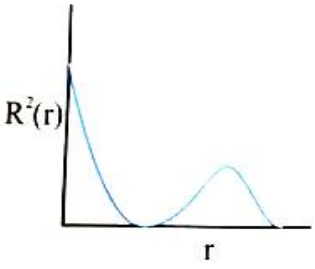
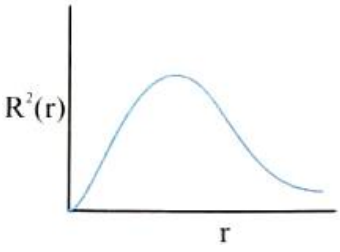
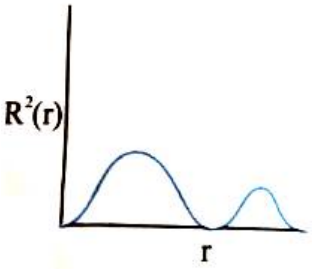
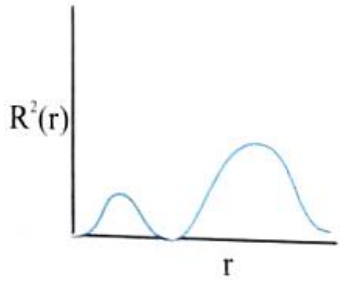
23. The variation of radial probability density $\psi^2(r)$ as a function distance are of the electron from the nucleus for 3p orbital

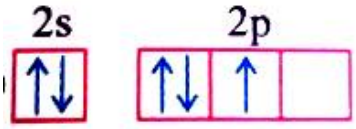
A) 

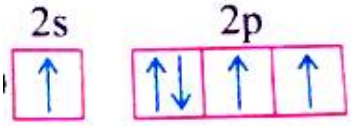

B) 

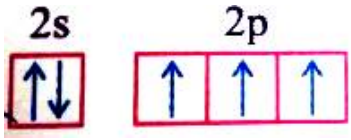

C) 

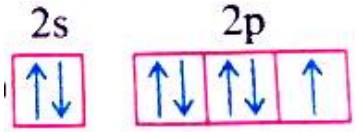

D) 


24. The orbital diagram in which the aufbau principle is violated is

A) 


B) 


C) 


D) 


25. Which of the following statements is/are correct?

A) The electronic configuration of Cr is $[Ar]3d^5 4s^1$. (Atomic number of Cr = 24)

B) The magnetic quantum number may have a negative value

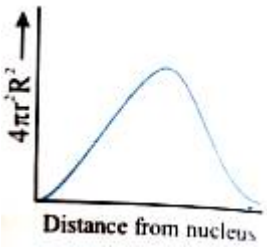
C) in silver atom, 23 electrons have a spin of one type and 24 of the opposite type (Atomic number of Ag = 47)

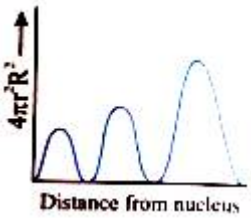
D) Number of angular nodes for $d_{z^2}$ is two

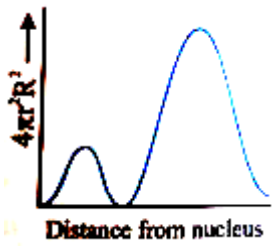
26. The value of the spin only magnetic moment of a particular ion is 2.83 Bohr magneton. The ion is

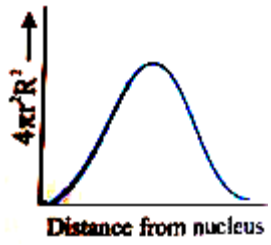
A) $Fe^{2+}$ B) $Ni^{2+}$ C) $Mn^{2+}$ D) $Co^{2+}$

27. **Column – I** **Column – II**

(A) 3S (P) 


(B)3P (Q) 

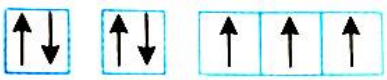

(C)3d (R) 

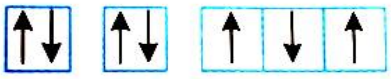

(D)2P (S) 


A) A-Q,B-R,C-P,D-S B) A-Q,B-R,C-S,D-P

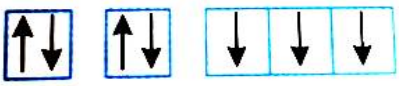
C) A-R,B-P,C-Q,D-S D) A-S,B-P,C-Q,D-RS

28. Ground state electronic configuration of nitrogen atom can be represented by

A) 

B) 

C) 

D) 

29. Which of the following is/are correct energy order for H-atom?

A) 1s < 2s < 2p < 3s < 3p B) 1s < 2s < 2p < 3s = 3p C) 1s < 2p < 3d < 4s D) 1s < 2s < 4s<3d

30. The spin magnetic momentum of electrons in an ion is c4.84 BM. Its total spin will be

A) $\pm 1$ B) $\pm 2$ C) $\geq \sqrt{\frac{h}{4\pi}}$ D) $\pm 2.5$

## SECTION-II
## INTEGER TYPE

This section contains 10 questions. The answer to each question is a **single digit integer**, **ranging** from 0 to 9 (both inclusive).

**Marking scheme: +3 for correct answer, 0 if not attempted and 0 in all other cases.**

31. The wave function of an orbital is represented as $\psi_{4,2,0}$. The azimuthal quantum number of that orbital is

32. How many d-electrons in $Cu^{+}(At.No = 29)$ can have the spin quantum $\left(-\frac{1}{2}\right)$

33. Magnetic moment of $M^{x+}$ is $\sqrt{24}$ BM. The number of unpaired electrons in $M^{x+}$ is

34. Not considering the electrons spin, the degeneracy of the second excited state (n=3) of atom is 9, while the degeneracy of the second excited state of $H^{-}$ is

35. How many of the following ions have the same magnetic moments $Fe^{+2}, Mn^{+2}, Cr^{+2}, Ni^{+2}$

36. The orbital angular momentum of an electron in 2s-orbitals is

37. The radial distribution curve of the orbital with double dumbbell shape in the 4th principle shell consists of 'n' nodes, n is

38. In an atom, the total no.of electrons having quantum number n = 4 $m_e = 1$ & $m_s = -\frac{1}{2}$ is

39. The maximum no. of electrons can have principle Q.no n =3 and spin Q.no : $m_s = -\frac{1}{2}$

40. The no.of radial nodes of 2d orbitals are respectively '0'

## MATHS — Max Marks: 60

## SECTION-1
## (ONE OR MORE OPTIONS CORRECT TYPE)

This section contains 10 multiple choice equations. Each question has four choices (**A)** (**B)**,(**C)** and (**D)** out of which **ONE** or **MORE THAN ONE** are correct.

**Marking scheme: +3 for correct answer, 0 if not attempted and 0 in all other cases.**

41. If $\sin\theta = \frac{-4}{5}$ and '$\theta$' lies in third quadrant then

A) $\cos\frac{\theta}{2} = \frac{-1}{\sqrt{5}}$ B) $\sin\frac{\theta}{2} = \frac{2}{\sqrt{5}}$ C) $\tan\frac{\theta}{2} = \frac{-1}{2}$ D) $\cot\theta = \frac{3}{4}$

42. If $\cos x + \cos y + \cos z = 0 = \sin x + \sin y + \sin z,$ then

A) $\cos^2\left(\frac{x-y}{2}\right) = \frac{1}{4}$ B) $\tan(x-y) = 2$ C) $\sin\left(\frac{x-y}{2}\right) = \frac{\sqrt{3}}{2}$ D) $\cos x + \cos y = \frac{1}{2}$

43. If $\cot\theta = \dfrac{2\tan 7\frac{1}{2}^{o}}{1-\tan^{2} 7\frac{1}{2}^{o}}$ *and* $\cos 3\theta = \dfrac{a}{\sqrt{b}}$, then

A) $a^2 + b^2 = 5$ B) $a - b = 1$ C) $2a + b = 0$ D) $\dfrac{b}{a} = -2$

44. If $Tan\theta + Tan(\theta + \dfrac{\pi}{3}) + Tan(\theta + \dfrac{2\pi}{3}) = x\ Tan\ y\theta$, then

A) $\dfrac{x}{y} = 3$ B) $\dfrac{x}{y} = Tan 45^{o}$ C) $x^2 + y^2 = 18$ D) $\sec 90^{o} = x$

45. If $4\sin 54^{o} + Tan\ 82\frac{1}{2}^{o} = \sqrt{n_1} + \sqrt{n_2} + \sqrt{n_3} + \sqrt{n_4} + \sqrt{n_5} + \sqrt{n_6}$, then

A) $\overset{6}{\underset{i=1}{\pi}} n_i^2 = 720$ B) $\overset{6}{\underset{i=1}{\sum}} n_i = 21$ C) $\overset{6}{\underset{i=1}{\sum}} n_i^2 = 91$ D) $\overset{6}{\underset{i=1}{\pi}} n_i^3 = 120$

46. If $Tan\dfrac{\pi}{7} + 2Tan\dfrac{2\pi}{7} + 4Tan\dfrac{4\pi}{7} + 8\cot\dfrac{8\pi}{7} = Tan\ \theta$, then

A) $\sin 21\theta = -1$ B) $\sin 7\theta = 1$ C) $\theta = \dfrac{\pi}{7}$ D) $\theta = \dfrac{5\pi}{14}$

47. If $\cos\theta\cos 2\theta\cos 4\theta.....\cos 2^{n}\theta = \dfrac{\sin 2^{n+k}\theta}{2^{n+l}\sin\theta}$, then

A) k = 1 B) $l = 3$ C) $k + l = 2$ D) $2k + l^2 = 3$

48. If $\cos^2 A + \cos^2 B - \cos A\cos B = \dfrac{3}{4}$, then

A) $A + B = 90^{o}$ B) $A - B = 60^{o}$ C) $A + B = 45^{o}$ D) $A + B = 60^{o}$

49. If $\cos^3 10^{o} + \cos^3 110^{o} + \cos^3 130^{o} = \sqrt{3}k$, then

A) 8k =3 B) $k = \dfrac{4}{3}$ C) $k^2 + 1 = 4$ D) $9k + 1 = 7$

50. If $Tan\dfrac{\alpha}{2}, Tan\dfrac{\beta}{2}$ are the roots of $8x^2 - 26x + 15 = 0$, then

A) $Tan\left(\dfrac{\alpha+\beta}{2}\right) = \dfrac{-26}{7}$ B) $\cot\left(\dfrac{\alpha+\beta}{2}\right) = \dfrac{7}{26}$

C) $Tan\dfrac{\alpha}{2}.Tan\dfrac{\beta}{2} = \dfrac{15}{8}$ D) $Tan\dfrac{\alpha}{2} + Tan\dfrac{\beta}{2} = \dfrac{13}{4}$

## SECTION-II
## INTEGER TYPE

This section contains 10 questions. The answer to each question is a **single digit integer**, **ranging** from 0 to 9 (both inclusive).

**Marking scheme: +3 for correct answer, 0 if not attempted and 0 in all other cases.**

51. If $Tan\ \alpha = \frac{1}{7}$ *and* $\cos 2\alpha = \frac{\lambda}{25}$, then $\frac{\lambda}{4} =$

52. If $4\cos^3 40^o - 3\sin 50^o = \frac{-a}{b}$, then $a^2 + b^3 =$

53. If $(1+\sec 20^o)(1+\sec 40^o)(1+\sec 80^o) = \cot^2(A^o)$, then $\frac{A}{5} + 3 =$

54. The value of $Tan\ 9^o - Tan\ 27^o - Tan 63^o + Tan 81^o$ is equal to

55. If $\alpha \in Q_4, \sin\frac{\alpha}{2} + \cos\frac{\alpha}{2} = \frac{-1}{2}$ *and* $\sin 2\alpha = \frac{-3\sqrt{b}}{a}$, then $\frac{a+b}{15}$ is equal to

56. If $\cos\frac{\pi}{2^2}\cos\frac{\pi}{2^3}.....\cos\frac{\pi}{2^{10}}\sin\frac{\pi}{2^{10}} = \frac{1}{\lambda}, then\ \frac{1024}{\lambda}$ is equal to

57. The value of $\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2+\sqrt{2}}}}}.\sec\frac{\pi}{64}$ is equal to

58. If A lies in the third quadrant and 3 Tan A = 4, then $5\sin 2A + 3\sin A + 4\cos A$ is equal to

59. The value of $\cot 15^o + \cot 75^o + \cot 315^o$ is equal to

60. The value of 16 sin 20º sin 40 º sin 60 º sin 80 º is equal to

**Paper Setters – HYD-DNI**

| Subject | Lecturer | Contact |
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