ENGINEERING

(SAMPLE PAPER)

SESSION: 2024-2025

IMPORTANT INSTRUCTIONS

A. GENERAL INSTRUCTIONS

1. The Test is of **2 hours duration.**
2. The Test Paper contains 60 Questions. **The Maximum Marks are 240.**
3. The Test Paper consists of Four Parts - **Part I (Aptitude), Part II (Physics), Part III (Chemistry) and Part IV (Mathematics).**
4. Each Part contains 15 Questions. Part I (Aptitude) consists of 15 Multiple Choice Type Questions.
5. Part II (Physics), Part III (Chemistry) and Part IV (Mathematics) are further divided into Two Sections i.e. **Section A** and **Section B**. Section A consists of 10 Multiple Choice Type Questions.
6. Section B consists of 5 Integer Type Questions and an internal choice has been provided in each question. The answer to each of the question is a double digit integer ranging from 00 to 99.
7. +4 marks will be given for each correct answer and –1mark for each wrong answer in Multiple choice type questions only. There is no negative marking for Integer type questions. In all other cases, no marks will be given.
8. There is only one correct response for each question. Filling up more than one response in each question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 7 above.

B. HOW TO ANSWER THE QUESTION

1. **Use HB pencil/ Ball Pen (Blue or Black) only to mark your answer in the ORS sheet.**
2. For each question in **Part I (Aptitude) and Section A of Part II (Physics), Part III (Chemistry) and Part IV (Mathematics)** there are multiple choices. One of them is the correct answer.
3. Fill appropriate bubble like this ⬤ wherever and not like this ⊘⊗◖.
4. Mark your response by filling correct option.
5. For each question in section B of each Part there are two columns in the ORS Sheet as shown in the figure 1. The answer to each of the question is a double digit integer ranging from 00 to 99. Darken the bubble for digit at ten's place of the integer in the left column and for the digit at unit's place of the integer in the right column. For example, if answer is 50, it should be marked as shown in figure 2.
6. Please ensure that you fill answer against the correct question number.
7. Use the rough area provided for rough work.
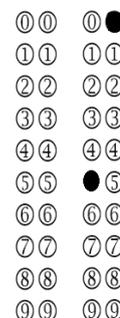
C. RESTRICTIONS DURING THE TEST

1. Calculators are not allowed in this test.
2. Use of mobile phones in the examination hall is strictly prohibited.
3. Log tables and electronic gadgets in any form are not allowed.
4. No additional sheets will be provided for rough work.

D. HELPFUL HINTS

1. Work quickly and accurately.
2. If you are not sure of an answer, mark your best choice and avoid wild guessing.

E. ON COMPLETION OF THE TEST

1. Please ensure your details are properly filled.
2. Handover the test booklet to the invigilator.
3. Ensure that your details are properly filled in the ORS sheet.

SAMPLE TEST PAPER

APTITUDE (SECTION - I)

1. In a certain code language, the word NUMERICAL is written as LMUIREACN. How will the word PUBLISHED be written in that language?

   (a) DBUSLIHEP   (b) DBUSILEHP
   (c) DUBSLIEHP   (d) DUBILSEHP

2. The area of the greatest circle, which can be inscribed in a square whose perimeter is 120 cm.

   (a) $\frac{22}{7} \times (15)^2$ sq. cm   (b) $\frac{22}{7} \times \left(\frac{7}{2}\right)^2$ sq. cm

   (c) $\frac{22}{7} \times \left(\frac{15}{2}\right)^2$ sq. cm   (d) $\frac{22}{7} \times \left(\frac{9}{2}\right)^2$ sq. cm

3. The average of 5 consecutive integers starting with "n" is m. What is the average of 6 consecutive integers starting with $(n + 2)$?

   (a) $\frac{2m + 5}{2}$ (b) $m + 2$

   (c) $m + 3$ (d) None of these

4. Sachin is five times as old as his daughter Teena and Sachin's wife Anjali's age is 26 years more than Teena. The difference between thrice age of Sachin ten years ago and twice the age of Angali ten years ago was 42 years. What will be the respective ratio of Angali's age 12 years hence and Sachin's age 12 years hence?

   (a) 23 : 26   (b) 24 : 29
   (c) 19 : 23   (d) 21 : 25

5. A watch is 1 minute slow at 1 pm on Tuesday and 2 minutes fast at 1 pm on Thursday. When did it show it show the correct time?

   (a) 1.00 am on Wednesday
   (b) 5.00 am on Wednesday
   (c) 1.00 pm on Wednesday
   (d) 5.00 pm on Wednesday

6. Saritha's expenditure and savings are in the ratio 3 : 2. Her income increases by 10% and her expenditure increases by 12%. By how much percent do her savings increase?

   (a) 7%   (b) 9%
   (c) 10%   (d) 13%

7. Two trains of equal length take 10 seconds and 15 seconds respectively to cross a telegraph post. If the length of each train be 120 metres, in what time will they cross each other traveling in opposite direction?

   (a) 16   (b) 15
   (c) 12   (d) 10

8. 8 litres are drawn from a container full of wine and is then filled with water. This operation is performed three more times. The ratio of the Quantity of wine now left in the cask to that of the water is 16:65. How much wine did the container hold originally?

   (a) 24 litres   (b) 18 litres
   (c) 32 litres   (d) 42 litres

Space for rough work

SAMPLE TEST PAPER

9. Pointing to a girl in the photograph, Ajay said, "Her mother's brother is the only son of my mother's father". How is the girl's mother related to Ajay?

(a) Mother   (b) Sister

(c) Aunt   (d) Grand Mother

10. How many squares on a chess board?

(a) 204   (b) 206

(c) 208   (d) 205

11. Insert the missing number in the series

3 6 24 29 174, _____

(a) 870   (b) 151

(c) 290   (d) 181

12. A publisher sells copies of books to a retail dealer a Rs 5 per copy but allows 25 copies to be counted as 24. If the retailer sells each of the 25 copies at Rs 6, his profit % is

(a) 20%   (b) 24%

(c) 25%   (d) 40%

13. How many squares are there in the given figures?
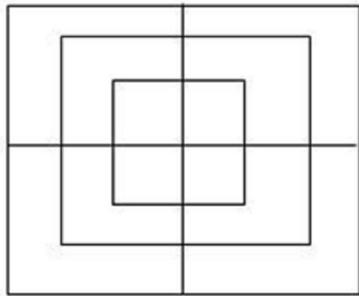
(a) 13   (b) 14

(c) 15   (d) 16

14. Three positions of a dice are given below. Identify the number on the face opposite to 6.
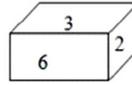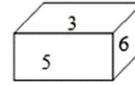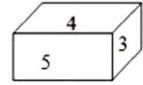
(a) 1   (b) 4

(c) 5   (d) 7

15. In a plane, a set of 8 parallel lines intersects a set of 'n' other parallel lines, giving rise to 420 parallelograms. Find the value of n.

(a) 8   (b) 7

(c) 6   (d) 5

*Space for rough work*

SAMPLE TEST PAPER

PHYSICS (PART - II)

SECTION - A

16.
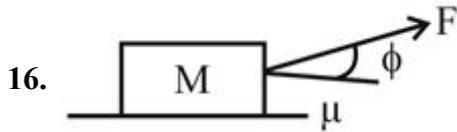
If Coefficient of kinetic friction = μ, then acceleration of block is

(a) $\dfrac{F}{M}(\cos\phi - \mu\sin\phi) - \mu g$

(b) $\dfrac{\mu F}{M}\cos\phi$

(c) $\dfrac{F}{M}(\cos\phi + \mu\sin\phi) - \mu g$

(d) $\dfrac{F}{M}\sin\phi$

17. One mole of an ideal monoatomic gas is taken along the process in which $PV^x = Constant$. The graph shown represents the variation of molar heat capacity of such a gas with respect to 'x'. The values of c' and c respectively are given by
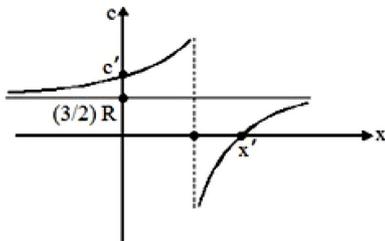
(a) $\dfrac{5}{2}R, \dfrac{5}{2}$

(b) $\dfrac{5}{2}R, \dfrac{5}{3}$

(c) $\dfrac{7}{2}R, \dfrac{7}{2}$

(d) $\dfrac{5}{2}R, \dfrac{5}{7}$

18. A certain simple harmonic vibrator of mass 0.1 kg has a total energy of 10 J. Its displacement from the mean position is 1 cm when it has equal kinetic and potential energies. The amplitude A and frequency v of vibration of the vibrator are

(a) $A = 0.0141\,\text{m}, v = 159.13\,\text{Hz}$

(b) $A = 0.0141\,\text{m}, v = 318.26\,\text{Hz}$

(c) $A = 0.007\,\text{m}, v = 159.13\,\text{Hz}$

(d) $A = 0.007\,\text{m}, v = 318.26\,\text{Hz}$

19. A parallel plate air capacitor of capacitance C is connected to a cell of emf V and then disconnected from it. A dielectric slab of dielectric constant K, which can just fill the air gap of the capacitor, is now inserted in it. Which of the following is incorrect?

(a) The change in energy stored is $\dfrac{1}{2}CV^2\left(\dfrac{1}{K} - 1\right)$

(b) The charge on the capacitor is not conserved

(c) The potential difference between the plates increases K times.

(d) The energy stored in the capacitor decreases K times.

20. A point Q lies on the perpendicular bisector of an electrical dipole of dipole moment p. If the distance of Q from the dipole is r (much larger than the size of the dipole) then the electric field at Q is proportional to

(a) p^2 and r^{-3}

(b) p and r^{-2}

(c) p^{-1} and r^{-2}

(d) p and r^{-3}

Space for rough work

SAMPLE TEST PAPER

21. A charge Q is enclosed by a Gaussian spherical surface of radius R. If the radius is doubled, then the outward electric flux will

(a) Increase four times
(b) Be reduced to half
(c) Remain the same
(d) be doubled

22. A clear transparent glass sphere (m = 1.5) of radius R immersed in a liquid of refractive index 1.25. A parallel beam of light incident on it will converge to a point. The distance of this point from the center will be

(a) –3 R   (b) +3 R
(c) – R   (d) None of these

23. An electron is projected with uniform velocity along the axis of a current carrying long solenoid. Which of the following is true?

(a) The electron will be accelerated along the axis.

(b) The electron path will be circular about the axis.

(c) The electron will experience a force at 45° to the axis and hence execute a helical path.

(d) The electron will continue to move with uniform velocity along the axis of the solenoid.

24. An inductor of reactance 1 Ω and a resistor of 2 Ω are connected in series to the terminals of a 6 V (rms) a.c. source. The power dissipated in the circuit is

(a) 8 W   (b) 12 W
(c) 14.4 W   (d) 18 W

25. A passenger is standing 'd' m away from a bus. The bus begins to move with constant acceleration 'a' away from him. To catch the bus the passenger runs at a constant speed v towards the bus. The minimum speed of the passenger so that he may catch the bus will be

(a) $2ad$ (b) $\sqrt{ad}$
(c) $\sqrt{2ad}$ (d) ad

Space for rough work

SAMPLE TEST PAPER

SECTION - B

26. If a body loses half of its velocity on penetrating 30 cm in a wooden block, then how much will it penetrate more before coming to rest (in cm)?

OR

To a man moving due north with a speed 6 m s^{-1}, the rain appears to fall vertically. When the man doubles his speed, the rain appears to fall at an angle of $60°$ with the horizontal. Find the actual speed of the rain in m/s.

27. The drift speed of the conduction electrons in a copper wire with radius $r = 900 \text{ µm}$ when it has a uniform current $i = 17 \text{ mA}$ is $x \times 10^{-7}$ m/s. Find the approximate integral value of $5x$. Assume that each copper atom contributes one conduction electron to the current and that the current density is uniform across the wire's cross section.

OR

A galvanometer of resistance $228 \ \Omega$ measures 1 A. How much shunt should be used, so that it can be used to measure 20 A?

28. Bulb B_1 (100 W–250 V) and bulb B_2 (100 W–200 V) are connected across 250 V. What is potential drop across B_2?
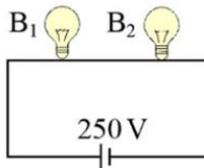
OR

An inductor of reactance $1 \ \Omega$ and a resistor of 2 Ω are connected in series to the terminals of a 15 V (rms) a.c. source. The power dissipated in the circuit is

29. In a meter bridge experiment, the ratio of the left gap resistance to right gap resistance is 2 : 3, the balance point from left is:

OR

A 10 µF capacitor is fully charged across a 12 volt battery. The capacitor is then disconnected from the battery and connected across an initially uncharged capacitor, C. The voltage across each capacitor is now 3 volts. What is the unknown capacitance C (in µF)?

30. A train starts from rest from a station and comes to a stop at the next station. Variation in acceleration is as shown in the graph. Find the time (Δt) for which the brakes is applied.
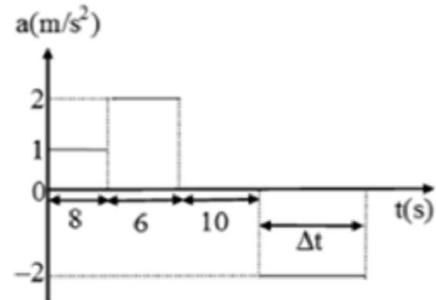
OR

A light string passing over a smooth light pulley connects two blocks of masses m_1 and m_2 (vertically). If the acceleration of the system is g/8 then the ratio of the masses is x/y. Find the $x + y$.

Space for rough work

SAMPLE TEST PAPER

SECTION - A

31. In the dichromate ion $Cr_2O_7^{2-}$

(a) 4 Cr–O bonds are equivalent

(b) 6 Cr–O bonds are equivalent

(c) All Cr–O bonds are equivalent

(d) None of Cr–O bonds are equivalent

32. When two liquids A and B are mixed, the boiling point of the mixture become greater than the boiling points of pure liquid A and liquid B. The mixture is:

(a) Ideal solution

(b) Non ideal solution with negative deviation from Raoult's Law

(c) Non ideal solution with positive deviation from Raoult's Law

(d) Normal solution

33. The first, second and third ionization potentials (E_1, E_2 and E_3) for an element are 7 eV, 12.5 eV and 142.3 eV respectively. The most stable oxidation state of the element will be

(a) 1   (b) 2

(c) 3   (d) 4

34. At 500 K, the half life period of a gaseous reaction at an initial pressure of 80 kPa is 350 s. When the pressure is 40 kPa, the half life period is 175 sec; the order of the reaction is :

(a) zero   (b) one

(c) two   (d) three

**35.** The IUPAC name of the following compound, is
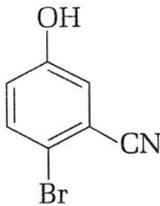
(a) 4-bromo-3-cyanophenol

(b) 2-bromo-5-hydroxybenzonitrile

(c) 2-cyano-4-hydroxybromobenzene

(d) 6-bromo-3-hydroxybenzonitrile

36. In the following reaction,

$$R_2CuLi \xrightarrow{R'X} R - R' + RCu + LiX$$

Nature of R and R' should be

(a) any alkyl, 2° alkyl

(b) any alkyl, methyl / l° alkyl / 2° cycloalkyl

(c) 1° alkyl, methyl / 1° alkyl / 2° cycloalkyl

(d) 2° alkyl, any alkyl

37. The increasing order of acidity among **phenol, p-methylphenol, m-nitrophenol and p-nitrophenol** is:

(a) m-nitrophenol, p-nitrophenol, phenol, p-methylphenol

(b) p-methylphenol, m-nitrophenol, phenol, p-nitrophenol

(c) p-methylphenol, phenol, m-nitrophenol, p-nitrophenol

(d) Phenol, p-methylphenol, p-nitrophenol, m-nitrophenol

Space for rough work

SAMPLE TEST PAPER

38. Phenol on distillation with zinc dust gives

(a) C_6H_6 (b) C_6H_{12}

(c) $C_6H_5OC_6H_5$ (d) $C_6H_5 - C_6H_5$

39. Which of the following is not a double salt but is a complex salt?

(a) $KCl.MgCl_2.6H_2O$

(b) $FeSO_4.(NH_4)_2SO_4.6H_2O$

(c) $K_2SO_4.Al_2(SO_4)_3.24H_2O$

(d) $4KCN.Fe(CN)_2$

40. For the reaction, along with C_6H_5Br, how many different acids are required to complete the following reaction at the place of '**?**'
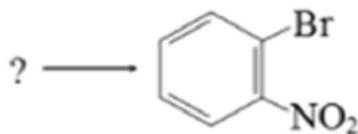
(a) 1

(b) 2

(c) 3

(d) Cannot be determined

Space for rough work

SAMPLE TEST PAPER

SECTION - B

41. The number of unpaired electrons in $[CoF_6]^{3-}$ are x. Find the value of 10x is

OR

The number of orbitals associated with quantum number $n = 4$, $m_s = +\dfrac{1}{2}$ is :

42. If S^o for H_2, Cl_2 and HCl are 0.13, 0.22 and $0.19\,kJ\,K^{-1}\,mol^{-1}$ respectively. The total change in standard entropy for the reaction, is $H_2 + Cl_2 \rightarrow 2HCl$:

OR

If the density of methanol is $0.793\ kg\ L^{-1}$, what is its volume (in integer) needed for making 2.5 L of its 0.25 M solution?

43. The formation of phosgene is represented as, $CO + Cl_2 \rightleftharpoons COCl_2$

The reaction is carried out in 500 mL flask. At equilibrium 0.3 mole of phosgene, 0.1 mole of CO and 0.1 mole of Cl_2 are present. The equilibrium constant of the reaction is

OR

The equivalent mass of H_3PO_4 in the following reaction is,

$H_3PO_4 + Ca(OH)_2 \rightarrow CaHPO_4 + 2H_2O$
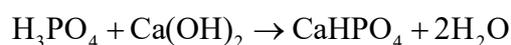
44. The cell, Zn/Zn^{2+}

$\left(1M\right)\|Cu^{2+}\left(1M\right)/Cu\left(E^0_{cell} = 1.10V\right)$ was allowed to be completely discharged at 298K. The relative concentration of Zn^{2+} to Cu^{2+} $\left(\dfrac{[Zn^{2+}]}{[Cu^{2+}]}\right)$ is 10^x. Integral the value of x is:

$\left(\textbf{Take}: \dfrac{2.303RT}{F} = 0.059 \right.$ Round off your answer up to one decimal)

OR

Hg_2Cl_2 is produced by the electrolytic reduction of Hg^{2+} ion in presence of Cl^- ion is $2Hg^{2+} + 2Cl^- + 2e^- \rightarrow Hg_2Cl_2$. If the current 'I' is required to have a rate production of 44 g per hour of Hg_2Cl_2. Then the value of 8I is [Atomic weight of Hg = 200.6] :-

45. Graph between log k and 1/T (k = rate constant in sec^{-1} and T is the temperature in k) is straight line. If $OX = 5$ and slope of line $= -\dfrac{1}{2.303}$ then $15E_a$ is
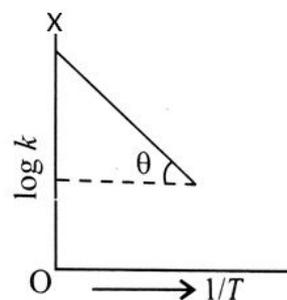
OR

The two solutions of NaOH having molarity $\dfrac{M}{10}$ and $\dfrac{M}{30}$ are mixed to prepare 1 L of NaOH solution in such a way that 300 ml of final solution is completely neutralized by 10 ml of 0.5 M H_3PO_4 solution. The volume (in ml) of $\dfrac{M}{10}$ NaOH solution used is V. Then V/10 = ?

[Assuming: 100% dissociation]

Space for rough work

SAMPLE TEST PAPER

MATHEMATICS (SECTION-IV)

SECTION - A

46. Two imaginary numbers α and β are such that $\alpha + \beta = 2$ and $\alpha^4 + \beta^4 = 272$, then the quadratic equation whose roots are α and β is

(a) $x^2 - 2x + 16 = 0$

(b) $x^2 - 2x + 12 = 0$

(c) $x^2 - 2x + 8 = 0$

(d) None of these

47. The value of $\int \tan^{-1} x \, dx$ is equal to

(a) $\dfrac{1}{1+x^2} + c$

(b) $x \tan^{-1} x + \dfrac{1}{2} \log |1 + x^2| + c$

(c) $x \tan^{-1} x + \dfrac{1}{2} \cdot \dfrac{\tan^{-1} x}{1 + x^2} + c$

(d) $x \tan^{-1} x - \dfrac{1}{2} \log |1 + x^2| + c$

48. The roots of the equation $x^3 - 2x^2 - x + 2 = 0$ are

(a) 1, 2, 3   (b) –1, 1, 2

(c) –1, 0, 1   (d) –1, –2, 3

49. The equation of the tangent to the curve $\left(\dfrac{x}{a}\right)^n + \left(\dfrac{y}{b}\right)^n = 2$ at (a, b) is

(a) $\dfrac{x}{a} + \dfrac{y}{b} = 2$ (b) $\dfrac{x}{a} + \dfrac{y}{b} = \dfrac{1}{2}$

(c) $\dfrac{x}{b} - \dfrac{y}{a} = 2$ (d) $ax + by = 2$

50. If $f(x) = 2x^6 + 3x^4 + 4x^2$, then $f'(x)$ is

(a) Even function

(b) An odd function

(c) Neither even nor odd

(d) None of these

51. The function $f(x) = \{x\} \sin(\pi[x])$, where [.] denotes the greatest integer function and {.} is the fractional part function, is discontinuous at

(a) all x

(b) all integer points

(c) no x

(d) x which is not an integer

Space for rough work

SAMPLE TEST PAPER

52. If $\cos 3x \cos^3 x + \sin 3x \sin^3 x = 0,$ then x is equal to

(a) $(2n+1)\dfrac{\pi}{4},\ n \in I$

(b) $(2n+1)\dfrac{\pi}{2},\ n \in I$

(c) $\dfrac{n\pi}{5},\ n \in I$

(d) $n\pi,\ n \in I$

53. If a, b, and c are in A.P., then what is the value of the expression $(ab + bc - ac)$?

(a) $\dfrac{3a^2 + c^2}{2}$

(b) $\dfrac{a^2 + 3c^2}{2}$

(c) $\dfrac{a^2 + c^2}{2}$

(d) $\dfrac{a^2 - c^2}{2}$

54. $\displaystyle\int \dfrac{\ln\left(\dfrac{x-1}{x+1}\right)}{x^2 - 1}\,dx$ is equal to

(a) $\dfrac{1}{2}\left(\ln\left(\dfrac{x-1}{x+1}\right)\right)^2 + c$

(b) $\dfrac{1}{2}\left(\ln\left(\dfrac{x+1}{x-1}\right)\right)^2 + c$

(c) $\dfrac{1}{4}\left(\ln\left(\dfrac{x-1}{x+1}\right)\right)^2 + c$

(d) $\dfrac{1}{4}\left(\ln\left(\dfrac{x+1}{x-1}\right)\right) + c$

55. The matrix X, if $2X + \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix} = \begin{bmatrix} 3 & 8 \\ 7 & 2 \end{bmatrix}$, is

(a) $\begin{bmatrix} 1 & 3 \\ 2 & -1 \end{bmatrix}$

(b) $\begin{bmatrix} 1 & -3 \\ 2 & -1 \end{bmatrix}$

(c) $\begin{bmatrix} 2 & 6 \\ 4 & -2 \end{bmatrix}$

(d) $\begin{bmatrix} 2 & -6 \\ 4 & -2 \end{bmatrix}$

Space for rough work

SAMPLE TEST PAPER

SECTION - B

56. If area bounded by the curves $y = \sin(cx + d)$ (which lies above x-axis $\forall\, x \geq 1$), the x-axis and the ordinates $x = 1$ and $x = b$ is $[(b-1)\sin(3b+4)]$ sq. unit $(\forall\, b > 1)$. Find the value of $c \times d$.

OR

Number of divisors of the form $(4n + 2)$, $n \geq 0$ of the integer 240 is D. Find 4D.

57. $100 \times \lim\limits_{x \to 0} \dfrac{\sin\left(x^{1/3}\right)\ell n(1+3x)}{\left(\tan^{-1}\sqrt{x}\right)^2\left(e^{5x^{\frac{1}{3}}}-1\right)} =$

OR

The number of elements in the set $\{(a, b) : 2a^2 + 3b^2 = 35,\ a, b \in Z\}$, where Z is the set of all integers, is y. Then 8y equal to:

58. The value of $\dfrac{72}{\pi}\displaystyle\int_0^{\frac{\pi}{2}} \dfrac{dx}{1+\cot x}$ is

OR

If α and β are different complex numbers with $|\beta| = 1$, then $40 \times \left|\dfrac{\beta - \alpha}{1 - \overline{\alpha}\beta}\right|$ is equal to

59. How many different signals can be given using any number of flags from 4 flags of different colours?

OR

Let $\lim\limits_{x \to 0} \dfrac{\sin 2x}{\tan\left(\dfrac{x}{2}\right)} = L_1$ and $\lim\limits_{x \to 0} \dfrac{e^{2x}-1}{x} = L_2$, then the value of $7\, L_1 L_2$ is.

60. $\displaystyle\int \sec^2(3 - 2x)\,dx = \dfrac{1}{a}\tan(b - cx) +$ constant. Find the value of abc.

OR

The area of the region bounded by $y = x^2$ and $y = 4x$, for x between 0 and 9, is equal to

Space for rough work

SAMPLE TEST PAPER