Sample Papers

JEE Mains

Time: 3 Hours ***Maximum Marks: 360***

Topics Covered:

Physics	:	*11th & 12th Complete Syllabus*
Chemistry	:	*11th & 12th Complete Syllabus*
Mathematics	:	*11th & 12th Complete Syllabus*

Important Instructions :

1. *The test is of **3 hours** duration.*
2. *The Test consists of 90 questions. The maximum marks are **360**.*
3. *There are three parts in the question paper A, B, C consisting of **Physics, Chemistry** and **Mathematics** having 30 questions in each part of equal weightage. Each question is allotted 4 (four) marks for each correct response.*
4. *Candidates will be awarded marks as stated above in Instructions No. 3 for correct response of each question. ¼ (one-fourth) marks of the total marks allotted to the question (i.e. 1 mark) will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.*
5. *There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instruction 4 above.*
6. *For writing particulars/marking responses on Answer Sheet use **only Black/Blue Ball Point Pen** provided in the examination hall.*
7. *No candidate is allowed to carry any textual material, printed or written, bits of papers, pager, mobile phone, any electronic device, etc. except the Admit Card inside the examination hall/room.*

Name of the Student : . . . . . Roll No.: . . . . . .

Father's Name : . . . . . Class : . . . . . Signature : . . . . . .

Centre Name : . . . . . Contact No : . . . . . .

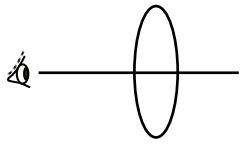
PART-A : PHYSICS

1. Statement-I : If two identical waves superimpose to form a stationary wave by free surface reflection, then antinode forms at surface of reflection.
Statement-II : Antinode of pressure wave forms at open end of closed pipe in stationary wave.
(A) If both Statement- I and Statement- II are true but Statement- II is not the correct explanation of Statement- I.
(B) If both Statement- I and Statement- II are true, and Statement - II is the correct explanation of Statement- I.
(C) If Statement - I is true but Statement - II is false.
(D) If Statement - I is false but Statement -II is true.

2. A sphere has only translational velocity $V_0 = 2r\omega$ when placed on rough horizontal surface with frictional coefficient μ. If r is radius then the time in which pure rolling starts is

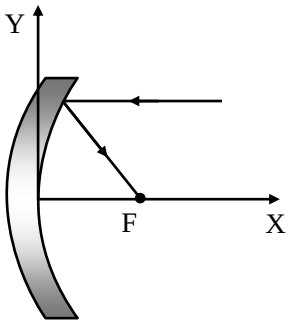
(A) $\frac{2r\omega}{7\mu g}$ (B) $\frac{4r\omega}{7\mu g}$ (C) $\frac{r\omega}{7\mu g}$ (D) $\frac{2\sqrt{2}r\omega}{7\mu g}$

3. A thin equiconvex lens of focal length f(in air) and refractive index μ has thickness t. How much thick it will appear to an observer as shown in figure?



(A) $\frac{t}{\mu}$ (B) $\frac{2ft}{2\mu f - t}$ (C) t (D) None

4. A parallel beam of light ray parallel to the X-axis is incident on a parabolic reflecting surface $x = 2by^2$ as shown in the figure. After reflecting it passes through focal point F. The focal length of the reflecting surface is :

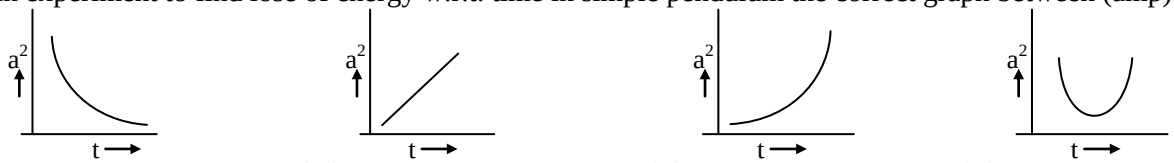


(A) $\frac{1}{8b}$ (B) $\frac{1}{4b}$ (C) $\frac{1}{b}$ (D) None

5. Which of the following is most accurate vernier callipers, whose least count is
(A) 0.5 cm (B) 0.05 cm (C) 0.005 cm (D) None

Space for Rough Work

6. In an experiment to find lose of energy w.r.t. time in simple pendulum the correct graph between $(amp)^2$ and time is :



(A) (B) (C) (D)

7. The average degree of freedom of a gas is 6. Gas performs 50 J work when it expands at constant pressure. The heat absorbed by the gas is
(A) 100 J (B) 200 J (C) 50 J (D) 25 J

8. The mass of a planet is six times that of the earth. The radius of the planet is twice that of the earth. If the escape velocity from the earth is v, then the escape velocity from the planet is :
(A) $\sqrt{3}v$ (B) $\sqrt{2}v$ (C) v (D) $\sqrt{5}v$

9. A body of density D_1 and mass M is moving downward in glycerin of density D_2. What is the viscous force acting on it when it is moving with terminal velocity?
(A) $Mg\left(1-\frac{D_2}{D_1}\right)$ (B) $Mg\left(1-\frac{D_1}{D_2}\right)$ (C) MgD_1 (D) MgD_2

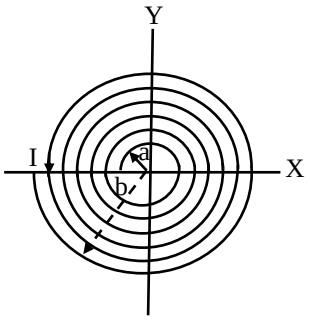
10. A particle moves in space along the path $z = ax^3 + by^2$ in such a way that $dx/dt = c = dy/dt$ where a, b and c are constants. The acceleration of the particle is :
(A) $(6ac^2x + 2bc^2)\hat{k}$ (B) $(2ax^2 + 6by^2)\hat{k}$
(C) $(4bc^2x + 3ac^2)\hat{k}$ (D) $(bc^2x + 2by)\hat{k}$

11. Find the number of photons emitted per second by a 24 W source of monochromatic light of wavelength 6600Å :
(A) 8×10^{19} (B) 4×10^{19} (C) 2×10^{19} (D) 1×10^{19}

12. Potential barrier developed in a junction diode opposes:
(A) minority charge carriers in both regions only (B) majority carriers only
(C) electrons in n-region (D) holes in p-region

13. The dominant mechanisms for the motion of charge carriers in forward and reverse biased germanium p-n junctions are :
(A) diffusion in both forward and reverse bias (B) diffusion in forward bias and drift in reverse bias
(C) drift in forward bias and diffusion in reverse bias (D) drift in both forward and reverse bias

14. A long insulated copper wire is closely wound as a spiral of 'N' turns. The spiral has inner radius 'a' and outer radius 'b'. The spiral lies in the XY plane and a steady current 'I' flows through the wire. The Z-component of the magnetic field at the centre of the spiral is :

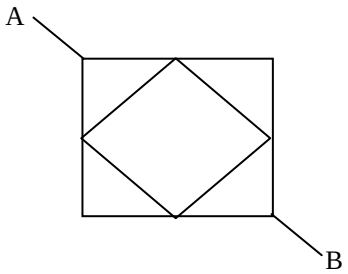


(A) $\frac{\mu_0 NI}{2(b-a)}\ell n\left(\frac{b}{a}\right)$ (B) $\frac{\mu_0 NI}{2(b-a)}\ell n\left(\frac{b+a}{b-a}\right)$ (C) $\frac{\mu_0 NI}{2b}\ell n\left(\frac{a}{b}\right)$ (D) $\frac{\mu_0 NI}{2b}\ell n\left(\frac{b+a}{b-a}\right)$

Space for Rough Work

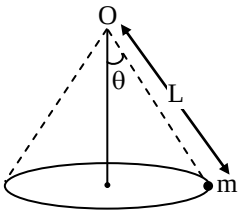
15. A capacitor, an inductor and an electric bulb are connected in series to an AC supply of variable frequency. As the frequency of the supply is increased gradually, then the electric bulb is found to:
(A) increase in brightness
(B) decrease in brightness
(C) increase, reach a maximum and then decrease in brightness
(D) show no change in brightness

16. A wire has linear resistance ρ (in ohm/m). Find the resistance R between points A and B if the side of the ''big'' square is d :



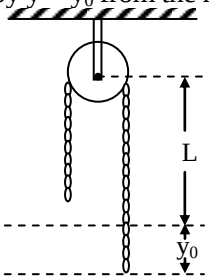
(A) $\frac{\rho d}{\sqrt{2}}$ (B) $\sqrt{2}\rho d$ (C) $2\rho d$ (D) None of these

17. The time period of a conical pendulum shown in figure is:



(A) $T = 2\pi\sqrt{(L/g)}$ (B) $T = 2\pi\sqrt{(L\cos\theta/g)}$ (C) $T = 2\pi\sqrt{(L\sin\theta/g)}$ (D) $T = 2\pi\sqrt{(L\tan\theta/g)}$

18. A frictionless pulley has radius r. A uniform chain of linear density d and total length (2L + πr) is released from rest over the pulley as shown. When R.H.S. end is lowered by $y = y_0$ from the mean position, speed of the chain is



(A) $\left[\frac{2gy^2}{2L+\pi r}\right]^{\frac{1}{2}}$ (B) $\left(\frac{1}{2}g\frac{y^2}{L}\right)^{\frac{1}{2}}$ (C) $\left[\frac{gy^2}{L+\pi r}\right]^{\frac{1}{2}}$ (D) None of these

19. The ratio of the dimensions of planck's constant and that of the moment of inertia has the dimensions of
(A) frequency (B) velocity (C) angular momentum (D) time

Space for Rough Work

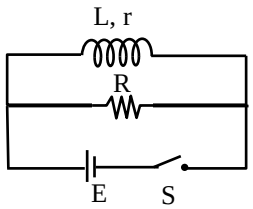
20. Charge 'q' is uniformly distributed over the surface of an annular-non-conducting disc of inner radius R_1 and outer radius R_2. The disc is made to rotate about an axis passing through its centre and perpendicular to its plane with a constant frequency *v* (rotations per second). Magnetic moment of the disc can be expressed as :

(A) $\frac{q\pi v(R_2^2 - R_1^2)}{2}$ (B) $\frac{q\pi v(R_2^2 + R_1^2)}{2}$ (C) $\frac{q\pi v R_2^2}{4}$ (D) $\frac{qv(R_2^2 - R_1^2)}{4}$

21. A dip circle is so set that the dip needle moves freely in the magnetic meridian. In this position the angle of dip is 39°. Now the dip circle is rotated so that the plane in which the needle moves, makes an angle of 30° with the magnetic meridian. In this position, the needle will dip by an angle :

(A) exactly 39° (B) 30° (C) more than 39° (D) less than 39°

22. For the circuit shown in the figure, initially the switch is closed for a long time so that steady state has been reached. Then at t = 0, the switch is opened, due to which current in the circuit decays to zero. The heat generated in the inductor is [L = self inductance of inductor, r = resistance of inductor] :

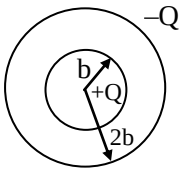


(A) zero (B) $\frac{E^2}{2(R+r)}$ (C) $\frac{E^2 L}{2r(R+r)}$ (D) $\frac{E^2 R}{2r(R+r)}$

23. In an a.c. circuit, the instantaneous values of e.m.f. and current are E = 200 sin 314 t (volt) and I = sin (314 t + π/3) A. The average power consumed in watts is

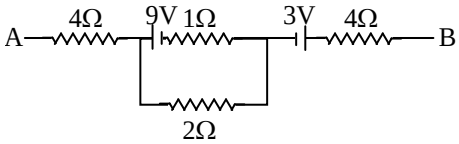
(A) 100 (B) 200 (C) 50 (D) 25

24. The accompanying figure shows two concentric spherical shells isolated from each other. The smaller shell has radius b and net charge +Q. The larger shell has radius 2b and net charge –Q. If R is the distance from the common center, which is wrong



(A) the highest electric field magnitude E occurs immediately outside the smaller (R = b) shell
(B) the highest electric field magnitude E occurs immediately outside the larger (R = 2b) shell
(C) At R = b potential máximum
(D) At R = 0 potential is maximum

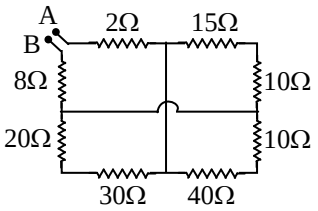
25. In the shown circuit, potential difference between points A and B is 16 V. The current passing through 2Ω resistor will be :



(A) 2.5 A (B) 3.5 A (C) 4 A (D) zero

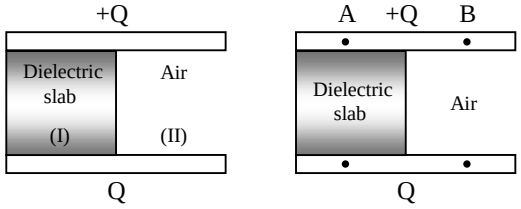
Space for Rough Work

26. The equivalent resistance between A and B is :



(A) 32.5 Ω (B) 22.5 Ω (C) 2.5 Ω (D) 42.5 Ω

27. **Statement-I :** A charged plane parallel plate capacitor has half interplanar region (I) filled with dielectric slab. The other half region II has air. Then, the magnitude of net electric field in region I is less than that in region II.
Statement-II : In a dielectric medium, induced (or polarized) charges tend to reduce the electric field.



(a) (b)

(A) If both Statement-I and Statement-II are true and the Statement-II is not correct explanation of the Statement-I.
(B) If both Statement-I and Statement-II are true but Statement-II is correct explanation of the Statement-I.
(C) If Statement-I is true but the Statement-II is false
(D) If Statement-I is false but Statement-II is true

28. At any instant, the ratio of the amount of radioactive substance is 2 : 1. If their half lives be respectively 12 and 16 hours, then after two days, what will be the ratio of the substance
(A) 1 : 1 (B) 2 : 1 (C) 1 : 2 (D) 1 : 4

29. In a fission reaction
$_{92}U^{236} \rightarrow X^{117} + Y^{117} + 2_0n^1 + \varepsilon$,
The binding energy per nucleon of X and Y is 8.5 MeV where as of U^{236} is 7.6 MeV. The total energy liberated will be about
(A) 200 KeV (B) 2 MeV (C) 200 MeV (D) 2000 MeV

30. YDSE is carried out with two thin sheets of thickness 10.5 μm each and refractive indices $\mu_1 = 1.5$ and $\mu_2 = 1.4$ covering the slits S_1 and S_2 respectively. If white light of range 4000 Å to 7800 Å is used then which wavelength will form minima exactly at the centre O of the screen
(A) 4200 Å only (B) 7000 Å only (C) 5250 Å only (D) 4200 Å and 7000Å

Space for Rough Work

PART-B : CHEMISTRY

31. When a lead storage battery is discharged
(A) SO_2 is evolved (B) Lead is formed
(C) Lead sulphate is consumed (D) Sulphuric acid is consumed

32. The freezing point (in°C) of solution containing 0.1g of $K_3[Fe(CN)_6]$(mol.wt. 329) in 100g of water ($K_f = 1.86 Kkgmol^{-1}$) is
(A) -2.3×10^{-2} (B) -5.7×10^{-2} (C) -5.7×10^{-3} (D) -1.2×10^{-2}

33. From the following statements regarding H_2O_2, choose the incorrect statement.
(A) It can act only as an oxidising agent
(B) It decomposed on exposure to light
(C) It has to be stored in plastic or wax lined glass bottles in dark
(D) It has to be kept away from dust

34. Which one is wrong if electrolysis of CH_3COONa (aq) is made using Pt electrodes?
(A) pH of solution increases. (B) Molar ratio of gases at anode and cathode is 3 : l.
(C) $[CH_3COO^{\ominus}]$ in solution decreases. (D) The molar ratio of gases at anode and cathode is 2 : l.

35. Which statement is not correct?
(A) Physical adsorption is due to van der Waals' forces
(B) Physical adsorption decreases at high temperature and low pressure
(C) Physical adsorption is reversible
(D) Adsorption energy for a chemical adsorption is generally lesser than that of physical adsorption

36. C_{60} contains
(A) 20 pentagons and 12 hexagons (B) 12 pentagons and 20 hexagons
(C) 30 pentagons and 30 hexagons (D) 24 pentagons and 36 hexagons

37. The synthesis of alkyl fluorides is best accomplished by
(A) Free radical fluorination (B) Sandmeyer's reaction (C) Finkelstein reaction (D) Swarts reaction

38. Which of the following is not an ore of iron?
(A) Magnetite (B) Haematite (C) Limonite (D) Cuprite

39. Which of the following is not an antacid?
(A) Aluminium hydroxide (B) Cimetidine (C) Phenelzine (D) Ranitidine

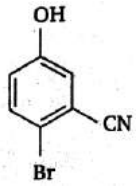
40. The metal that cannot be obtained by electrolysis of an aqueous solution of its salts is
(A) Ag (B) Ca (C) Cu (D) Cr

41. How many chiral compounds are possible on monochlorination of 2-Methyl butane?
(A) 2 (B) 4 (C) 6 (D) 8

Space for Rough Work

42. The electrons, identified by quantum numbers n and l
(i) n = 4, l = 1 (ii) n = 4, l = 0 (iii) n = 3, l = 2 (iv) n = 3, l = 1
can be placed in order of increasing energy, from the lowest to highest, as
(A) (iv) < (ii) < (iii) < (i) (B) (ii) < (iv) < (i) < (iii) (C) (i) < (iii) < (ii) < (iv) (D) (iii) < (i) < (iv) < (ii)

43. 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-3hydroxybenzonitrile

44. The best method to prepare cyclohexene from cyclohexanol is by using
(A) Conc. HCl + $ZnCl_2$ (B) Conc. H_3PO_4 (C) HBr (D) Conc. HCl

45. Which of the vitamins given below is water soluble?
(A) Vitamin C (B) Vitamin D (C) Vitamin E (D) Vitamin K

46. Which of the following pairs give positive Tollen's test?
(A) Glucose, sucrose (B) Glucose, fructose
(C) Hexanal, acetophenone (D) Fructose, sucrose

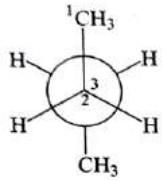
47. An aqueous solution of 6.3 g oxalic acid dihydrate is made up to 250 mL. The volume of 0.1 N NaOH required to completely neutralise 10 mL of this solution is
(A) 40mL (B) 20mL (C) 10mL (D) 4mL

48. The equilibrium constants for the reactions are:
$H_3PO_4 \xrightleftharpoons{K_1} H^+ + H_2PO_4^-$; K_1
$H_2PO_4^- \xrightleftharpoons{K_2} H^+ + HPO_4^{2-}$; K_2
$HPO_4^{2-} \xrightleftharpoons{K_3} H^+ + PO_4^{3-}$; K_3
The equilibrium constant for,
$H_3PO_4 \rightleftharpoons 3H^+ + PO_4^{3-}$ will be :
(A) K_1/K_2K_3 (B) $K_1 \times K_2 \times K_3$ (C) K_2 / K_1K_3 (D) $K_1 + K_2 + K_3$

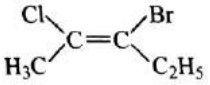
49. Identify the least stable ion amongst the following:
(A) Li^- (B) Be^- (C) B^- (D) C^-

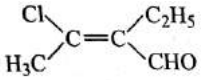
50. At a constant temperature what should be the percentage increase in pressure for a 5% decrease in the volume of gas?
(A) 5% (B) 10% (C) 5.26% (D) 4.26%

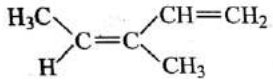
Space for Rough Work

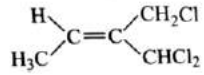
51. 

C_2 is rotated anti-clockwise 120° about C_2-C_3 bond. The resulting conformer is
(A) Partially eclipsed (B) Eclipsed (C) Gauche (D) Anti

52. The E-isomer among the following is:
(A) 

(B) 

(C) 

(D) 

53. Which one of the following statements is not true?
(A) The pH of 10^{-8}N HCI is 8.
(B) 96500 coulomb of electricity is passed through a $CuSO_4$ solution to deposit l g equivalent of Cu at cathode.
(C) The conjugate base of $H_2PO_4^-$ is HPO_4^{2-}.
(D) pH + pOH = 14 for all aqueous solutions at 25°C.

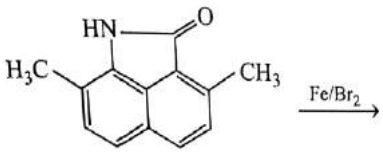
54. Which of the following element is isodiaphere of $^{235}_{92}U$?
(A) $^{209}_{83}Bi$ (B) $^{212}_{82}Pb$ (C) $^{231}_{90}Th$ (D) $^{231}_{91}Pa$

55. The colour of $KMnO_4$ is due to
(A) M $\rightarrow$ L charge transfer transition
(B) d $\rightarrow$ d transition
(C) L $\rightarrow$ M charge transfer transition
(D) $\sigma \rightarrow \overset{*}{\sigma}$ transition

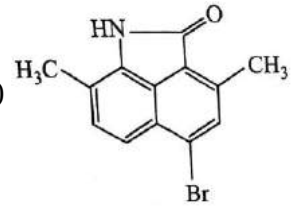
56. Which of the following will not be oxidised by O_3?
(A) KI (B) $FeSO_4$ (C) $KMnO_4$ (D) K_2MnO_4

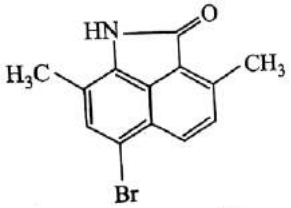
57. Among the following compounds, the most acidic is
(A) p- nitrophcnol (B) p-hydroxybenzoic acid
(C) o-hydroxybenzoic acid (D) p-toluic acid

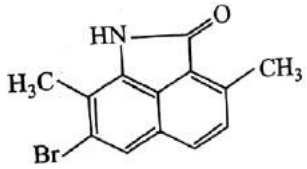
Space for Rough Work

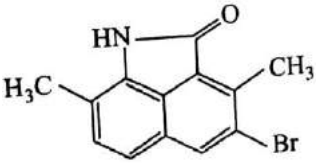
58. 

Product on monobromination of this compound is

(A) 

(B) 

(C) 

(D) 

59. The compound that does not liberate CO_2, on treatment with aqueous sodium bicarbonate solution, is
(A) Benzoic acid (B) Benzenesulphonic acid (C) Salicylic acid (D) Carbolic acid (Phenol)

60. For the elementary reaction, M $\rightarrow$ N, the rate of disappearance of M increases by a factor of 8 upon doubling the concentration of M. The order of the reaction with respect to M is
(A) 4 (B) 3 (C) 2 (D) 1

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PART-C : MATHEMATICS

61. In how many ways 'n' married couples be arranged around a table, so that men and women are alternate and each women is not adjacent to her husband?
(A) $(n-1)!(n!-2!)$ (B) $n!((n-1)!-2)$ (C) $(n-1)!$ (D) $(n-1)!\,n!$

62. If three distinct real numbers a, b and c satisfy $a^2(a + p) = b^2(b + p) = c^2(c + p)$ where $p \in R$, then value of ab + bc + ca is
(A) $-p$ (B) p (C) 0 (D) $\frac{p^2}{2}$

63. Negation of $p \to q$ is
(A) $p \wedge (\sim q)$ (B) $\sim p \vee q$
(C) $\sim q \to \sim p$ (D) $p \vee (\sim q)$

64. The sum of real solutions of the equation $\left(x^2+2\right)^2+8x^2=6x\left(x^2+2\right)$, given that $x \neq 0$, is
(A) 4 (B) 8 (C) 6 (D) 2

65. If total number of four digit numbers 'xyzt' such that x < y = z > t is K, then K is equal to
(A) 240 (B) 360 (C) 480 (D) 100

66. If $\lim\limits_{x\to 0}\frac{x^a(\sin x)^b}{\sin(x^c)}$, where a, b, c $\in$ R – {0}, exists and have non-zero value, then
(A) a + c = b (B) b + c = a (C) a + b = c (D) $a+b+c=0$

67. Let g(x) = $2f\left(\frac{x}{2}\right)+f(2-x)$ and $f''(x)<0 \forall x \in (0, 2)$, then g(x) increases in
(A) $\left(\frac{1}{2}, 2\right)$ (B) $\left(\frac{4}{3}, 2\right)$ (C) (0, 2) (D) $\left(0, \frac{4}{3}\right)$

68. If $a^2x^4 + b^2y^4 = c^6$, then maximum value of xy is (a, b, c > 0)
(A) $\frac{c^2}{\sqrt{ab}}$ (B) $\frac{c^3}{ab}$ (C) $\frac{c^3}{\sqrt{2ab}}$ (D) $\frac{c^3}{2ab}$

69. If $I_1=\int_0^{n\pi} f(\sin^4 x)dx$ and $I_2=\int_0^{\pi} f(\sin^4 x)dx$, then value of $\frac{I_1}{I_2}$ equals to
(A) $\frac{\pi}{2}$ (B) n (C) $\frac{n}{2}$ (D) $\frac{3\pi}{2}$

70. If y = $\tan^{-1}\left(\frac{2^x}{1+2^{2x+1}}\right)$, then $\frac{dy}{dx}$ at x = 0 is
(A) 1 (B) 2 (C) ln 2 (D) $\frac{-1}{10}\ln 2$

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71. If $A^3 = O$, then $I + A + A^2$ equals (where A is a square matrix and I is a unit matrix of same order)
(A) $I - A$ (B) $(I + A)^{-1}$ (C) $(I - A)^{-1}$ (D) None of these

72. If period of function $f(x) = \cos(nx)\sin\left(\frac{5x}{n}\right)$ is 3π, then number of integral values of n must be
(A) 4 (B) 8 (C) 6 (D) 2

73. The points of discontinuity of the function $f(x) = \lim_{n\to\infty}\frac{(2\sin x)^{2n}}{3^n - (2\cos x)^{2n}}$ are given by
(A) $r\pi \pm \frac{\pi}{12}, r \in I$ (B) $r\pi \pm \frac{\pi}{6}, r \in I$ (C) $r\pi \pm \frac{\pi}{3}, r \in I$ (D) None of these

74. The value of $169\ e^{i\left(\pi+\sin^{-1}\left(\frac{12}{13}\right)+\cos^{-1}\left(\frac{5}{13}\right)\right)}$ is
(A) 119 – 120i (B) 120 +119i (C) 119 + 120i (D) None of these

75. If $\int_0^\infty \frac{x^2dx}{(x^2+a^2)(x^2+b^2)(x^2+c^2)} = \frac{\pi}{2(a+b)(b+c)(c+a)}$, then value of $\int_0^\infty \frac{dx}{(x^2+4)(x^2+9)}$ is
(A) $\frac{\pi}{60}$ (B) $\frac{\pi}{20}$ (C) $\frac{\pi}{40}$ (D) $\frac{\pi}{80}$

76. If f(x) = 0 is a quadratic equation such that $f(-\pi) = f(\pi) = 0$ and $f\left(\frac{\pi}{2}\right) = -\frac{3\pi^2}{4}$, then $\lim_{x\to-\pi}\frac{f(x)}{\sin(\sin x)}$ equals
(A) 0 (B) π (C) 2π (D) None of these

77. The equation $\sin^2\theta = \frac{x^2+y^2}{2xy}, x, y \neq 0$ is possible if
(A) x = y (B) x = –y (C) 2x = y (D) none of these

78. $\frac{d^n}{dx^n}(\log x)$ equals
(A) $\frac{(n-1)!}{x^n}$ (B) $\frac{n!}{x^n}$ (C) $\frac{(n-2)!}{x^n}$ (D) $(-1)^{n-1}\frac{(n-1)!}{x^n}$

79. The number of points where the function $f(x) = \begin{cases} 1+\left[\cos\frac{\pi x}{2}\right], & 1 < x \le 2 \\ 1-\{x\}, & 0 \le x < 1 \\ |\sin \pi x|, & -1 \le x < 0 \end{cases}$ and f(1) = 0 is continuous but non-differentiable is/are (where [.] and {.} represent greatest integer and fractional part functions, respectively)
(A) 0 (B) 1 (C) 2 (D) none of these

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80. If $1 + (1 + x) + (1 + x)^2 + (1 + x)^3 + \ldots\ldots + (1 + x)^n = \sum_{k=0}^{n} a_k x^k$, then which of the following is true?

(A) $a_{n-2} = \frac{n(n-1)}{2}$ (B) $a_9^2 - a_8^2 = {}^{n+1}C_{10}\left({}^{n+1}C_{10} - {}^{n+1}C_8\right)$

(C) $a_k = {}^nC_k$ (D) $\sum_{k=0}^{n} a_k = 2^{n+1} - 1$

81. If $A^2 = I$, then the value of det(A – I) is (where A has order 3)

(A) 1 (B) –1 (C) 0 (D) cannot say anything

82. In ΔABC, $a \geq b \geq c$, if $\frac{a^3 + b^3 + c^3}{\sin^3 A + \sin^3 B + \sin^3 C} = 8$, then the maximum value of a is

(A) $\frac{1}{2}$ (B) 2 (C) 8 (D) 64

83. If $\vec{b}$ is a vector whose initial point divides the join of $5\hat{i}$ and $5\hat{j}$ in the ratio k : 1 and whose terminal point is the origin and $|\vec{b}| \leq \sqrt{37}$, then k lies in the interval

(A) [–6, –1/6] (B) $(-\infty, -6] \cup [-1/6, \infty)$ (C) [0, 6] (D) none of these

84. A fair dice is tossed eight times, then the probability that on the eight throw, a third six is observed, is:

(A) ${}^7C_2\left(\frac{5^5}{6^6}\right)$ (B) ${}^7C_2\left(\frac{5^5}{6^7}\right)$ (C) ${}^7C_2\left(\frac{5}{6}\right)^7$ (D) ${}^7C_2\left(\frac{5^5}{6^8}\right)$

85. The asymptotes of the hyperbola xy = hx + ky are

(A) x – k = 0 and y – h = 0 (B) x + h = 0 and y + k = 0

(C) x – k = 0 and y + h = 0 (D) x + k = 0 and y – h = 0

86. If p, q, r are in A.P., then the value of determinant $\begin{vmatrix} a^2 + a^{2n+1} + 2p & b^2 + 2^{n+2} + 3q & c^2 + p \\ 2^n + p & 2^{n+1} + q & 2q \\ a^2 + 2^n + p & b^2 + 2^{n+1} + 2q & c^2 - r \end{vmatrix}$ is

(A) 1 (B) 0 (C) $a^2b^2c^2 - 2^n$ (D) $(a^2 + b^2 + c^2) - 2^nq$

87. The solution of differential equation $(1 - xy + x^2y^2)dx = x^2dy$ is

(A) tan xy = log |cx| (B) tan(y/x) = tan log |cx| (C) xy = tan log |cx| (D) none of these

88. In a triangle ABC, $\angle B = 90°$ and b + a = 4. The area of the triangle is maximum when $\angle C$ is

(A) $\frac{\pi}{4}$ (B) $\frac{\pi}{6}$ (C) $\frac{\pi}{3}$ (D) none of these

89. The radius of the base of a cone is increasing at the rate of 3 cm/min and the altitude is decreasing at the rate of 4 cm/min. The rate of change of lateral surface when the radius is 7 cm and altitude is 24 cm is

(A) 108π cm^2/min (B) 7π cm^2/min (C) 27π cm^2/min (D) none of these

90. Length of latus rectum of the parabola whose focus is at (2, 3) and directrix is the line x – 4y + 3 = 0 is

(A) $\frac{7}{\sqrt{17}}$ (B) $\frac{14}{\sqrt{17}}$ (C) $\frac{21}{\sqrt{17}}$ (D) None of these

Space for Rough Work