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MATHEMATICS

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Latest Syllabus

(Issued by Department of PUE, Karnataka)

BLOW UP SYLLABUS

I PUC MATHEMATICS - Code No. 35

Column1	Column2	Column3	Column4	Column42	Column5	Column6
SUBJECT	**CLASS**	**CODE**	**DEPARTMENT OF P U EDUCATION**		**ACADEMIC PROGRAM FOR THE YEAR 2018-19**	
MATHE-MATICS	**I PUC**	**35**	*PUC (4 THEORY + 2 PROBLEM CLASSES A WEEK)*	***PRACTICE/PROBLEM SESSIONS***		
DAY	DATE	DAY				
DAY 1	14-May-18	MONDAY	REVISION ON REAL NUMBER SYSTEM			
DAY 2	15-May-18	TUESDAY	**CHAPTER 1: SETS :** Sets and their representations: Definitions, examples, Methods of Representation in roster and rule form, examples			
DAY 3	16-May-18	WEDNESDAY	TYPES OF SETS, EMPTY, FINITE, INFINITE, EQUAL SETS, SUBSETS			
DAY 4	17-May-18	THURSDAY	**Subsets of the set of real numbers** especially intervals (with notations). Power set. Number of elements in power set. Universal set. Examples			
DAY 5	18-May-18	FRIDAY	Operation on sets: Union and intersection of sets. Difference of sets. Complement of a set, Properties of Complement sets.			
DAY 6	19-May-18	SATURDAY		Practice session on Problems on sets		
	20-May-18	SUNDAY				
DAY 7	21-May-18	MONDAY	**Venn diagrams :** simple problems on Venn diagram representation of operation on sets			
DAY 8	22-May-18	TUESDAY		PRACTICAL PROBLEMS ON VENN DIAGRAMS		

DAY 9	23-May-18	WEDNESDAY	**Chapter 2: Relation and function :** Ordered pairs, Cartesian product of sets. Number of elements in the Cartesian product of two finite sets. Cartesian product of the reals with itself (upto R × R × R).			
DAY 10	24-May-18	THURSDAY	**Relation :** Definition of relation, pictorial diagrams, domain, co-domain and range of a relation and examples			
DAY 11	25-May-18	FRIDAY	**Function :** Function as a special kind of relation from one set to another. Pictorial representation of a function, domain, co-domain and range of a function. Real valued function of the real variable			
DAY 12	26-May-18	SATURDAY		Problem on Relation, Examples of functions		
	27-May-18	SUNDAY				
DAY 13	28-May-18	MONDAY	constant, identity, polynomial, rational function with their domain and range. Discussion on graphs of parabola y = x^2 and $y = x^3$, their domain and range.			
DAY 14	29-May-18	TUESDAY	modulus, signum and greatest integer functions with their graphs.			
DAY 15	30-May-18	WEDNESDAY	**Algebra of real valued functions :** Sum, difference, product and quotients of functions with examples.			
DAY 16	31-May-18	THURSDAY	Solving problems of Miscellaneous examples on Relation and functions			
DAY 17	01-Jun-18	FRIDAY		INTERACTIVE PRACTICE SESSION ON FINDING DOMAIN AND RANGE OF FUNCTIONS BY TAKING CERTAIN /ADDITIONAL EXAMPLES IN TEXT BOOK		
DAY 18	2-Jun-18	SATURDAY		SESSION MAY BE TAKEN FOR SOLVING PROBLEMS OF MISCELLANEOUS EXAMPLES GIVEN IN TEXT BOOK ON RELATION AND FUNCTIONS		

	03-Jun-18	SUNDAY				
DAY 19	4-Jun-18	MONDAY	**Chapter 3: TRIGONOMETRY:** **Angle :** Positive and negative angles. Degree Measure, Radian Measure, Getting expression for length of arc of circle. relationship between degree and radians, relationship between radian Measuring angles in radians and in degrees and conversion from one measure to another. Listing standard angles in radians and degrees.			
DAY 20	05-Jun-18	TUESDAY	Problems on conversion of radians and degrees and length of arc of circle			
DAY 21	6-Jun-18	WEDNESDAY	Definition of trigonometric functions with the help of unit circle. Truth of the identity $\sin^2 x + \cos^2 x = 1$ and Revision on Trigonometric identities. Defining other trigonometric functions in terms of sine and cosine functions, getting other trigonometric identities from $\sin^2 x + \cos^2 x = 1$			
DAY 22	07-Jun-18	THURSDAY	Trigonometric ratios of Quadrantal angles, 0°, 180°, 270°, 360° degrees. Deducting results for $\sin x=0$, $\cos x=0$, $\tan x=0$, $\sin(2n\pi+x) = \sin x$, $\cos(2n\pi+x)=\cos x$, concluding $\sin x$ and $\cos x$ repeats after interval of 2π			
DAY 23	8-Jun-18	FRIDAY		REVISION /PROBLEMS ON TRIGONOMETRY		
DAY 24	09-Jun-18	SATURDAY		REVISION /PROBLEMS ON TRIGONOMETRY		
	10-Jun-18	SUNDAY				
DAY 25	11-Jun-18	MONDAY	Revision on Trigonometric ratios of certain standard angles, Sign of Trigonometric functions,			
DAY 26	12-Jun-18	TUESDAY	Domain and range of trigonometric functions and their graphs			
DAY 27	13-Jun-18	WEDNESDAY	Given one trigonometric functions and expressing other trigonometric function in terms of it using right angled triangle.			

DAY 28	14-Jun-18	THURSDAY	**Trigonometric functions of sum and difference of two angles :** Deducing the formula for cos(x + y) using unit circle . Expressing sin (x + y) and cos (x + y) in terms of sin x, sin y, cos x and cos y. Deducing the identities like following and problems tan ($x \pm y$) = (tan x ± tan y) / (1 tan$x$. tan y) cot ($x \pm y$) = (cot x cot y 1) / (cot y ± cot x)			
DAY 29	15-Jun-18	FRIDAY		Practice session on Exercise 3.2 and Highligting the importance of drawing graphs of trigonometric functions		
	16-Jun-18	SATURDAY	RAMZAN			
	17-Jun-18	SUNDAY				
DAY 30	18-Jun-18	MONDAY	Getting the trigonometric functions of cos(π/2 – x), sin(π/2 – x), Definition of allied angles and obtaining their trigonometric ratios using compound angle formulae. Deducting trigonometric functions of allied angles cos(π/2+x)=–sin x, sin(π/2+x) = cos x etc , General rule to remember t ratios of allied angles			
DAY 31	19-Jun-18	TUESDAY	Trigonometric ratios of multiple angles : Identities related to sin2x, cos2x, tan2x, sin3x, cos3x and tan3x Deducting trigonometric ratios of half angles from above formulae			
DAY 32	20-Jun-18	WEDNESDAY	Deducing results of TRANSFORMATION FORMULAE, converting sum of t, functions into Product and product into sum sin$x$ +sin$y$ = 2 sin (x+y)/2 cos(x – y)/2; sin$x$ – sin$y$ = 2 cos (x+y)/2 sin (x – y)/2 cos$x$ + cos$y$ = 2 cos (x+y)/2 cos(x – y)/2; cos$x$ – cos$y$ = – 2 sin (x+y)/2 sin(x – y)/2 Deducting results of 2 cos$x$ cos$y$ = cos(x + y)+cos(x – y) etc			

DAY 33	21-Jun-18	THURSDAY	**Trigonometric Equations :** General Solution of trigonometric equations of the type $\sin\theta = \sin\alpha$, $\cos\theta = \cos\alpha$ and $\tan\theta = \tan\alpha$ and problems			
DAY 34	22-Jun-18	FRIDAY		PROBLEMS ON TRIGONOMETRY		
DAY 35	23-Jun-18	SATURDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
	24-Jun-18	SUNDAY				
DAY 36	25-Jun-18	MONDAY	Proofs and simple applications of sine and cosine rule. Problems			
DAY 37	26-Jun-18	TUESDAY		Problems on Sine and cosine rule		
DAY 38	27-Jun-18	WEDNESDAY	**CHAPTER 4: Principle of Mathematical Induction:** Principle of mathematical Induction proofs of (a) $\Sigma \cong [n = (n(n+1)/2]$ (b) $\Sigma \cong [n \hat{} 2 = (n(n+1)(2n+1))/6]$ (c) $\Sigma \cong [n \hat{} 3 = (n \hat{} 2(n+1) \hat{} 2)/4]$ (d) $\Sigma \cong [2n - 1 = n \hat{} 2]$ by mathematical induction			
DAY 39	28-Jun-18	THURSDAY	Sample problems on mathematical induction			
DAY 40	29-Jun-18	FRIDAY	PROBLEMS ON MATHEMATICAL INDUCTION			
DAY 41	30-Jun-18	SATURDAY		5 Mark questions covered in Question bank		
	01-Jul-18	SUNDAY				
DAY 42	2-Jul-18	MONDAY	**CHAPTER 5 : Complex Numbers and Quadratic Equations:** Introducing complex numbers using $x^2+1=0$, Introducing symbol "I", Deducting the result for $I^{4n} = 1$, Solving problems of Exercise 5.1 , 1, 2 and 3			

DAY 43	03-Jul-18	TUESDAY	Algebraic properties of complex numbers and solving problems related			
DAY 44	4-Jul-18	WEDNESDAY	Square roots of negative real number, Identities,			
DAY 45	05-Jul-18	THURSDAY	Modulus and the conjugate of complex number and problems, Argand plane and polar representation of complex numbers and problems			
DAY 46	6-Jul-18	FRIDAY		Practice session on finding Modulus and conjugate of complex number		
DAY 47	07-Jul-18	SATURDAY		Problems on complex numbers		
	8-Jul-18	SUNDAY				
DAY 48	09-Jul-18	MONDAY	Finding argument and modulus of complex number and representing complex number into polar form,			
DAY 49	10-Jul-18	TUESDAY	solution of quadratic equations in the complex number system, Square-root of a Complex number given in supplement and problems.			
DAY 50	11-Jul-18	WEDNESDAY		Practice session on solving Miscellaneous problems / questions from question bank		
DAY 51	12-Jul-18	THURSDAY	**CHAPTER 6: LINEAR INEQUALITIES :** Rules related to linear inequalities and types of inequalities. , Algebraic solutions of linear inequalities in one variable and their representation on the number line and examples.			
DAY 52	13-Jul-18	FRIDAY	Solving problems related to Exercise 6.1			
DAY 53	14-Jul-18	SATURDAY		Practice session on word problems on Linear inequalties.		
	15-Jul-18	SUNDAY				
DAY 54	16-Jul-18	MONDAY	Graphical solution of linear inequalities in two variables and examples			

DAY 55	17-Jul-18	TUESDAY	Solution of system of linear inequalities in two variables -graphically and examples			
DAY 56	18-Jul-18	WEDNESDAY	problems from Miscelleneous exercises			
DAY 57	19-Jul-18	THURSDAY	1st test			
DAY 58	20-Jul-18	FRIDAY	1st test			1 TEST
DAY 59	21-Jul-18	SATURDAY	1st test			
	22-Jul-18	SUNDAY				
DAY 60	23-Jul-18	MONDAY	**CHAPTER 10: STRAIGHT LINES:** Brief recall of 2-D from earlier classes: mentioning formulae .			
DAY 61	24-Jul-18	TUESDAY	Inclination of a line, concept of slope, slope of line joining points			
DAY 62	25-Jul-18	WEDNESDAY	Problems on slope, Slope of parallel and perpendicular lines, collinearity of three points, problems			
DAY 63	26-Jul-18	THURSDAY	Angle between two lines: problems.			
DAY 64	27-Jul-18	FRIDAY		PROBLEMS OF STRAIGHT LINES		
DAY 65	28-Jul-18	SATURDAY		PROBLEMS OF EXERCISE 10.1		
	29-Jul-18	SUNDAY				
DAY 66	30-Jul-18	MONDAY	**Various forms of equations of a line:** Derivation of equation of lines parallel to axes, point-slope form, slope-intercept form, two-point form,			
DAY 67	31-Jul-18	TUESDAY	Various forms of equations of a line: Derivation of intercepts form and normal form and problems.			
DAY 68	1-Aug-18	WEDNESDAY	General equation of a line. Reducing $ax+by+c=0$ into other forms of equation of straight lines. Getting expression for slope, x intercept, y intercept of $ax+by+c=0$, sample problems			
DAY 69	02-Aug-18	THURSDAY	Condition for the two lines in general form to be parallel and perpendicular, Equation of family of lines passing through the point of intersection of two lines and problems			

DAY 70	3-Aug-18	FRIDAY		Practice session on Derivation of various forms of straight lines		
DAY 71	04-Aug-18	SATURDAY		Problems on straight lines		
	5-Aug-18	SUNDAY				
DAY 72	06-Aug-18	MONDAY	Distance of a point from a line , distance between two parallel lines and problems.			
DAY 73	7-Aug-18	TUESDAY	concurrent lines , Equation of line passing through point of intersection of two lines(given in supplement), problems , Solving Miscellaneous problems on straight lines.			
DAY 74	08-Aug-18	WEDNESDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
DAY 75	9-Aug-18	THURSDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
DAY 76	10-Aug-18	FRIDAY		REVISION TEST/SOLVING MISCELLANEOUS PROBLEMS ON STRAIGHT LINES		
DAY 77	11-Aug-18	SATURDAY	**CONIC SECTION :** Introduction, section of cone, degenerated conic sections,			
	12-Aug-18	SUNDAY				
DAY 78	13-Aug-18	MONDAY	**CIRCLE :** Definition, standard form of equation of circle, General form of equation of circle $x^2+y^2+2gx+2fy+c=0$, center and radius of circle, problems			
DAY 79	14-Aug-18	TUESDAY	problems on circles continued, **Parabola :** Definition, Derivation of standard equation of parabola, other forms of parabola, Latus rectum,			
	15-Aug-18	WEDNESDAY	INDEPENDENCE DAY			
DAY 80	16-Aug-18	THURSDAY	Problems on parabola			

DAY 81	17-Aug-18	FRIDAY	**Ellipse :** Definition, relationship between semi major axis, semi minor axis and distance of focus from the center of the ellipse. Special cases of an ellipse, eccentricity, Deriving standard equation of ellipse			
DAY 82	18-Aug-18	SATURDAY		PRACTICE SESSION ON DERIVATION OF ELLIPSE, PARABOLA		
	19-Aug-18	SUNDAY				
DAY 83	20-Aug-18	MONDAY	Properties of standard form of Ellipse, other form of ellipse having center at origin, Finding length of latus rectum of parabola, eccentricity, Problems			
DAY 84	21-Aug-18	TUESDAY	**Hyperbola:** Definition, Derivation, other form, properties			
	22-Aug-18	WEDNESDAY	BAKRID			
DAY 85	23-Aug-18	THURSDAY	Problems on Hyperbola			
DAY 86	24-Aug-18	FRIDAY		Solving Miscellaneous examples and problems		
DAY 87	25-Aug-18	SATURDAY		Practice session on Problems on conics		
	26-Aug-18	SUNDAY				
DAY 88	27-Aug-18	MONDAY	**LIMITS AND DERIVATIVES:** Limits: Indeterminate forms, existence of functional value, Meaning of $x \to a$, idea of limit, Left hand limit, Right hand limit, Existence of limit, definition of limit,			
DAY 89	28-Aug-18	TUESDAY	Algebra of limits , Proof of $\lim_{x \to a} f(x)$ for positive integers only, PROBLEMS			
DAY 90	29-Aug-18	WEDNESDAY	**Limits of Trigonometric functions:** Sandwich theorem, Proof $\lim_{x \to a} f(x)$ getting result for $\lim_{x \to a} f(x)$ and problems			

DAY 91	30-Aug-18	THURSDAY	PROBLEMS ON LIMITS			
DAY 92	31-Aug-18	FRIDAY		PROBLEMS ON FINDING LEFT HAND LIMIT AND RIGHT HAND LIMIT FOR A FUNCTION		
DAY 93	01-Sep-18	SATURDAY		Conducting Test/MCQ/practice session on Miscellaneous problems		
	2-Sep-18	SUNDAY				
DAY 94	03-Sep-18	MONDAY	**Derivative :** Definition and geometrical meaning of derivative *i.e.*, definition of derivative related to slope of tangent of the curve, Mentioning of Rules of differentiation , problems			
DAY 95	4-Sep-18	TUESDAY	Derivative of x^n, sin$x$, cos$x$, tan$x$, constant functions from first principles problems			
DAY 96	05-Sep-18	WEDNESDAY	Problems on Limits and derivatives			
DAY 97	6-Sep-18	THURSDAY	Limits involving exponential and logarithmic functions, Mentioning of standard limits $\lim_{x\to 0}\left[\frac{\log(f+x)}{x}\right]$ $\lim_{x\to 0}\left[\frac{e^x-1}{x}\right]$			
DAY 98	07-Sep-18	FRIDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
DAY 99	8-Sep-18	SATURDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
	09-Sep-18	SUNDAY				
DAY 100	10-Sep-18	MONDAY	MID TERM EXAMINATION			
DAY 101	11-Sep-18	TUESDAY	MID TERM EXAMINATION			
DAY 102	12-Sep-18	WEDNESDAY	MID TERM EXAMINATION			
	13-Sep-18	THURSDAY	GANESH CHATURTHI			

DAY 103	14-Sep-18	FRIDAY	MID TERM EXAMINATION			
DAY 104	15-Sep-18	SATURDAY	MID TERM EXAMINATION			MID TERM
	16-Sep-18	SUNDAY				
DAY 105	17-Sep-18	MONDAY	MID TERM EXAMINATION			
DAY 106	18-Sep-18	TUESDAY	MID TERM EXAMINATION			
DAY 107	19-Sep-18	WEDNESDAY	MID TERM EXAMINATION			
DAY 108	20-Sep-18	THURSDAY	MID TERM EXAMINATION			
	21-Sep-18	FRIDAY	LAST DAY OF MOHARRUM			
DAY 109	22-Sep-18	SATURDAY	REVISION			
	23-Sep-18	SUNDAY				
DAY 110	24-Sep-18	MONDAY	**PERMUTATION AND COMBINATION** : Fundamental principle of counting. Factorial n , PROBLEMS			
DAY 111	25-Sep-18	TUESDAY	Permulations : Definition, examples, derivation of formulae ${}^nP_r$. Permutation when all the objects are not distinct, problems			
DAY 112	26-Sep-18	WEDNESDAY	Problems on Permutations			
DAY 113	27-Sep-18	THURSDAY	Problems on Permutations			
DAY 114	28-Sep-18	FRIDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
DAY 115	29-Sep-18	SATURDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
	30-Sep-18	SUNDAY				
DAY 116	01-Oct-18	MONDAY	Combination: Definition, examples Prov-ing ${}^nC_r={}^nC_r r!$, ${}^nC_r = {}^nC_{n-r}$ Problems based on above formulae.			
	2-Oct-18	TUESDAY	MAHATHMA GANDHI JAYANTHI			
DAY 117	03-Oct-18	WEDNESDAY	Problems on Combination			
DAY 118	4-Oct-18	THURSDAY	Problems on Combination			
DAY 119	05-Oct-18	FRIDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		

DAY 120	6-Oct-18	SATURDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
	07-Oct-18	SUNDAY				
	8-Oct-18	MONDAY	MAHALAYA AMMAVASYA			
DAY 121	09-Oct-18	TUESDAY	Three dimensional Co ordinate goemetry: Introduction, Idea of co-ordinates, Octants etc			
DAY 122	10-Oct-18	WEDNESDAY	Distance formula, problems			
DAY 123	11-Oct-18	THURSDAY	Section formula ,Mid point formula, problems			
DAY 124	12-Oct-18	FRIDAY		PRACTICE SESSION ON DERIVATIONS ON 3D GEOMETRY		
DAY 125	13-Oct-18	SATURDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
	14-Oct-18	SUNDAY				
	15-Oct-18	MONDAY				
	16-Oct-18	TUESDAY				
	17-Oct-18	WEDNESDAY				
	18-Oct-18	THURSDAY	MAHANAVAMI			
	19-Oct-18	FRIDAY	VIJAYADASHMI			
	20-Oct-18	SATURDAY				
	21-Oct-18	SUNDAY				MID TERM
	22-Oct-18	MONDAY				
	23-Oct-18	TUESDAY				VACATION
	24-Oct-18	WEDNESDAY	VALMIKI JAYANTHI			
	25-Oct-18	THURSDAY				
	26-Oct-18	FRIDAY				
	27-Oct-18	SATURDAY				
	28-Oct-18	SUNDAY				
DAY 126	29-Oct-18	MONDAY	Recapitulation of concepts of permutation and combination, formula			

DAY 127	30-Oct-18	TUESDAY	**BINOMIAL THEOREM:** History, statement and proof of the binomial theorem for positive integral indices Pascal's triangle,			
DAY 128	31-Oct-18	WEDNESDAY	Statement and Proof of Binomial theorem, general and middle term in binomial expansion, some special cases of Binomial theorem			
	1-Nov-18	THURSDAY	KANNADA RAJYOTHSAVA			
DAY 129	02-Nov-18	FRIDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
DAY 130	3-Nov-18	SATURDAY		PRACTICE SESSION ON DERIVATIONS		
	04-Nov-18	SUNDAY				
DAY 131	5-Nov-18	MONDAY	Using binomial theorem , evaluating 98^5 etc, Problems			
	06-Nov-18	TUESDAY	NARAKA CHATURDASHI			
DAY 132	7-Nov-18	WEDNESDAY	Problems on Binomial theorem			
	08-Nov-18	THURSDAY	BALIPADYAMI DEEPAWALI			
DAY 133	9-Nov-18	FRIDAY	Problems on Binomial theorem			
DAY 134	10-Nov-18	SATURDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
	11-Nov-18	SUNDAY				
DAY 135	12-Nov-18	MONDAY	Recapitulation of Sequence and series			
DAY 136	13-Nov-18	TUESDAY	**Sequence and Series:** Definitions, Problems Arithmetic Progression (A.P.): Definition, examples, general term of AP, nth term of AP, sum to n term of AP, Problems			
DAY 137	14-Nov-18	WEDNESDAY	Problems on AP			
DAY 138	15-Nov-18	THURSDAY	Arithmetic Mean (A.M.) and problems. Geometric Progression (G.P.) : General term of a G.P., n^{th} term of GP, sum of n terms of a G.P. , and problems			

DAY 139	16-Nov-18	FRIDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
DAY 140	17-Nov-18	SATURDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
	18-Nov-18	SUNDAY				
DAY 141	19-Nov-18	MONDAY	Problems on GP,Infinite G.P and its sum, geometric mean (G.M.).			
DAY 142	20-Nov-18	TUESDAY	Problems on nth term and sum to n term of series			
	21-Nov-18	WEDNESDAY	EID MILAD			
DAY 143	22-Nov-18	THURSDAY	Relation between A.M. and G.M. and problems. Sum to n terms of the special series : Σn, Σn^2 and Σn^3			
DAY 144	23-Nov-18	FRIDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
DAY 145	24-Nov-18	SATURDAY		Solving Miscellaneous examples and problems		
	25-Nov-18	SUNDAY				
	26-Nov-18	MONDAY	KANAKADASA JAYANTHI			
DAY 146	27-Nov-18	TUESDAY	**Probability :** Random experiments: outcomes, sample spaces (set representation).			
DAY 147	28-Nov-18	WEDNESDAY	Problems on describing sample space for indicated experiment			
DAY 148	29-Nov-18	THURSDAY	**Types of Events :** Occurrence of events, simple event, compound event, impossible event, sure event, complimentary event, 'not', 'and' & 'or' events			
DAY 149	30-Nov-18	FRIDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
DAY 150	1-Dec-18	SATURDAY		REVISION ON PROBABILITY		

	02-Dec-18	SUNDAY				
DAY 151	3-Dec-18	MONDAY	Exhaustive events, mutually exclusive events. Problems			
DAY 152	04-Dec-18	TUESDAY	Problems on Mutually exclusive and Exhaustive events			
DAY 153	5-Dec-18	WEDNESDAY	Axiomatic (set theoretic) probability, examples			
DAY 154	06-Dec-18	THURSDAY	2nd test			
DAY 155	7-Dec-18	FRIDAY	2nd test			2 TEST
DAY 156	08-Dec-18	SATURDAY	2nd test			
	9-Dec-18	SUNDAY				
DAY 157	10-Dec-18	MONDAY	**Probability of an event**, Probability of equally likely outcomes, Probability of Event A or B, problems			
DAY 158	11-Dec-18	TUESDAY	Probability of event 'not A" problems, problems on probability			
DAY 159	12-Dec-18	WEDNESDAY	**STATISTICS :** Measures of dispersion, Mean deviation of ungrouped data and grouped data, Discrete frequency distribution,			
DAY 160	13-Dec-18	THURSDAY	Mean deviation about Mean, short cut method, Problems			
DAY 161	14-Dec-18	FRIDAY		SOLVING MISCELLANEOUS PROBLEMS ON PROBABILITY		
DAY 162	15-Dec-18	SATURDAY		MCQ/TEST/PRACTICE SESSIONS		
	16-Dec-18	SUNDAY				
DAY 163	17-Dec-18	MONDAY	Mean deviation about Median , problems			
DAY 164	18-Dec-18	TUESDAY	Variance and standard deviation			
DAY 164	19-Dec-18	WEDNESDAY	standard deviation of discrete frequency distribution, problems, Standard deviation of continuous frequency distribution , problems			
DAY 165	20-Dec-18	THURSDAY	short cut method to find variance and standard deviation, problems			

DAY 166	21-Dec-18	FRIDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
DAY 167	22-Dec-18	SATURDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
	23-Dec-18	SUNDAY				
DAY 168	24-Dec-18	MONDAY	Analysis of frequency distribution, comparision of two frequency distribution with same mean but different variances, problems			
	25-Dec-18	TUESDAY	CHRISTMAS			
DAY 169	26-Dec-18	WEDNESDAY	Miscellaneous examples and problems			
DAY 170	27-Dec-18	THURSDAY		REVISION ON STATISTICS		
DAY 171	28-Dec-18	FRIDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
DAY 172	29-Dec-18	SATURDAY		Practice session on Miscellaneous examples and problems		
	30-Dec-18	SUNDAY				
DAY 173	31-Dec-18	MONDAY	**CHAPTER 14: MATHEMATICAL REASONING:** Definition of statement, examples, Negation of statement , examples			
DAY 174	01-Jan-19	TUESDAY	compound statement,Logical connectives " and", "OR",, problems,			
DAY 175	2-Jan-19	WEDNESDAY	Implication, converse and contrapostive of implication, problems			
DAY 176	03-Jan-19	THURSDAY	validating statements, Miscellaneous examples			
DAY 177	4-Jan-19	FRIDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		
DAY 178	05-Jan-19	SATURDAY		Selected questions of 1M, 2M, 3M & 5M of topics covered this week from question bank		

	6-Jan-19	SUNDAY				
DAY 179	07-Jan-19	MONDAY	REVISION CLASS / REMEDIAL GUIDANCE			
DAY 180	8-Jan-19	TUESDAY	REVISION CLASS / REMEDIAL GUIDANCE			
DAY 181	09-Jan-19	WEDNESDAY	REVISION CLASS / REMEDIAL GUIDANCE			
DAY 182	10-Jan-19	THURSDAY	REVISION CLASS / REMEDIAL GUIDANCE			2ND PUC PREPARA-TORY
DAY 183	11-Jan-19	FRIDAY	REVISION CLASS / REMEDIAL GUIDANCE			EXAM
DAY 184	12-Jan-19	SATURDAY	REVISION CLASS / REMEDIAL GUIDANCE			
	13-Jan-19	SUNDAY				
DAY 185	14-Jan-19	MONDAY	REVISION CLASS / REMEDIAL GUIDANCE			
	15-Jan-19	TUESDAY	MAKARASANKRANTI			
DAY 186	16-Jan-19	WEDNESDAY	REVISION CLASS / REMEDIAL GUIDANCE			
DAY 187	17-Jan-19	THURSDAY	REVISION CLASS / REMEDIAL GUIDANCE			
DAY 188	18-Jan-19	FRIDAY	REVISION CLASS / REMEDIAL GUIDANCE			
DAY 189	19-Jan-19	SATURDAY	REVISION CLASS / REMEDIAL GUIDANCE			

DESIGN OF THE QUESTION PAPER

Time: 3 Hours 15 Minutes **Maximum Marks: 100**

By "Total time for doing question paper shows 15 minutes out of which 15 minutes is for reading the question paper."

The weightage of the distribution of marks over different dimensions of the question paper shall be as follows :

I-WEIGHTAGE TO OBJECTIVES

Objective	Weightage	Marks
Knowledge	40%	60/150
Understanding	30%	45/150
Application	20%	30/150
HOTS	10%	15/150

II-WEIGHTAGE TO LEVEL OF DIFFICULTY

Level	Weightage	Marks
Easy	35%	53/150
Average	55%	82/150
Difficult	10%	15/150

II-WEIGHTAGE TO CONTENT

Chapter No.	Content	No. of teaching Hours	Marks
1	Sets	8	8
2	Relations and Functions	10	11
3	Trigonometric Functions	18	19
4	Principle of Mathematical Induction	4	5
5	Complex Numbers and Quadratic Equations	8	9
6	Linear Inequalities	8	7
7	Permutation and Combination	9	9
8	Binomial Theorem	7	8
9	Sequence and Series	9	11
10	Straight Lines	10	10
11	Conic Section	9	9
12	Introduction to 3D Geometry	5	7
13	Limits and Derivatives	14	15
14	Mathematical Reasoning	6	6
15	Statistics	7	7
16	Probability	8	9
	Total	**140**	**150**

IV-WEIGHTAGE OF THE QUESTION PAPER

Part	Type of Questions	Number of questions to be set	Number of questions to be answered	Remarks
A	1 mark questions	10	10	Compulsory part
B	2 marks questions	14	10	....
C	3 marks questions	14	10	....
D	5 marks questions	10	6	Questions must be asked from specific set of topics as mentioned below, under section V
E	10 marks questions (Each question with two sub divisions namely (a) 6 mark and (b) 4 mark).	2	1	

SAMPLE BLUE PRINT
I PUC : MATHEMATICS (35)

Time: 3 Hours 15 Minutes **Maximum Marks: 100**

	Content	Teaching Hours	Part A	Part B	Part C	Part D	Part E		Total Marks
			1 mark	2 mark	3 mark	5 mark	6 mark	4 mark	
1.	Sets	8	1	2	1				8
2.	Relations and Functions	10	1	1	1	1			11
3.	Trigonometric Functions	18	1	2	1	1	1		19
4.	Principle of Mathematical Induction	4				1			5
5.	Complex Numbers and Quadratic Equations	8	1	1	2				9
6.	Linear Inequalities	8		1		1			7
7.	Permutation and Combination	9	1		1	1			9
8.	Binomial Theorem	7			1	1			8
9.	Sequence and Series	9	1		2			1	11
10.	Straight Lines	10	1	2		1			10
11.	Conic Section	9			1		1		9
12.	Introduction to 3D Geometry	5		1		1			7
13.	Limits and Derivatives	14	1	1	1	1		1	15
14.	Mathematical Reasoning	6	1	1	1				6
15.	Statistics	7		1		1			7
16.	Probability	8	1	1	2				9
	Total	**140**	**10**	**14**	**14**	**10**	**2**	**2**	**150**

SOLVED PAPER	I PUC Annual Examination 2018	Mathematics Subject Code 35 (N)

Time : 3 Hours 15 minutes **Max. Marks : 100**

General Instructions :

1. *The question paper has five parts A, B, C, D and E. Answer all the parts.*
2. *Use the Graph Sheet for the question on Inequalities in Part D.*

PART-A

I. Answer All the following questions. **$10 \times 1 = 10$**

1. If $A = \phi$, the empty set, then write the number of elements in $P(A)$.
2. If $A = \{1, 2\}$ and $B = \{3, 4\}$, then write $A \times B$.
3. Convert 240° into radians.
4. Write the additive of the complex number $4 - 3i$.
5. If ${}^nC_8 = {}^nC_2$, then find 'n'.
6. If $a_n = \dfrac{n^2}{2^n}$, then find a_7.
7. Find the slope of the line joining the points (3, – 2) and (– 1, 4).
8. Evaluate : $\underset{x \to 0}{Lt}\left(\dfrac{ax+b}{cx+1}\right)$
9. Write the negation : "The number 2 is greater than 7".
10. A coin is tossed 3 times. Write the sample space.

PART-B

II. Answer any Ten questions **$10 \times 2 = 20$**

11. If $U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$ $A = \{1, 2, 3, 4\}$ and $B = \{2, 4, 6, 8\}$, then find $(A \cup B)'$.
12. If $A = \{1, 2, 3, 4, 5, 6\}$, $B = \{2, 4, 6, 8\}$, then find $A - B$ and $B - A$.
13. Let $A = \{1, 2, 3, 4, 5, 6\}$. Define a relation R from A to A by $R = \{(x, y) : y = x + 1\}$. Depict the relation using an arrow diagram.
14. Find the radius of a circle in which a central angle of 60° intercepts an arc of length 37.4 cm $\left(\text{given } \pi = \dfrac{22}{7}\right)$.
15. Find the value of $\sin\left(\dfrac{31\pi}{3}\right)$.
16. Find the modulus and the argument of the complex number $-\sqrt{3} + i$.
17. Solve $7x + 3 < 5x + 9$. Show the graph of the solution on the number line.
18. Find the equation of the line, which makes intercepts – 3 and 2 on X and Y axes respectively.
19. Find the distance of the point (3, – 5) from the line $3x - 4y - 26 = 0$.
20. The centroid of a triangle ABC is at the point (1, 1, 1). If the co-ordinates of A and B are (3, – 5, 7) and (– 1, 7, 6) respectively, find the co-ordinates of the point C.
21. Evaluate $\underset{x \to 0}{Lt}\left(\dfrac{\sin ax}{\sin bx}\right)$.
22. Write the converse and contrapositive of "If x is a prime number, then x is odd".

23. The coefficient of variation of a distribution is 60 and its standard deviation is 21. Find the arithmetic mean.
24. If A and B are two events such that $P(A) = 0.54$, $P(B) = 0.69$ and $P(A \cap B) = 0.35$, then find $P(A \cup B)$.

PART-C

III. Answer any TEN questions : **10 × 3 = 30**

25. In a class of 35 students, 24 like to play cricket and 16 to play football. Also each students like to play atleast one of the two games. How many students like to play both cricket and football ?
26. Let $f(x) = x^2$; $g(x) = 2x + 1$ be two real functions. Then find
    (i) $(f + g)(x)$ (ii) $(f - g)(x)$ (iii) $(fg)(x)$.
27. Find the general solution of the equation $2\cos^2 x + 3\sin x = 0$.
28. Solve : $\sqrt{2}\, x^2 + x + \sqrt{2} = 0$.
29. If $\left(\frac{1+i}{1-i}\right)^m = 1$, then find the least positive integral value of m.
30. Find r, if $5 \times {}^4P_r = 6 \times {}^5P_{r-1}$.
31. Find the middle term in the expansion of $\left(\frac{x}{3}+9y\right)^{10}$
32. In an AP, if m^{th} term is n and nth term is n, where $m \neq n$, find its p^{th} term.
33. Insert five numbers between 8 and 26 such that the resulting sequence is in AP.
34. Find the co-ordinates of the vertices, length of the latus rectum and eccentricity of the ellipse $\frac{x^2}{49} + \frac{y^2}{39} = 1$.
35. Find the derivation of sin x *w.r.t.* x, using first principle.
36. Verify by the method of contradiction :
    P : $\sqrt{7}$ is irrational
37. A die is thrown. Find the probability that
    (i) A prime number will appear
    (ii) A number greater than or equal to 3 will appear.
    (iii) A number more than 6 will appear.
38. Out of 100 students, two section of 40 and 60 are formed. If you and your friend are among the 100 students, what is the probability that you both enter the same class ?

PART-D

IV. Answer any Six questions **6 × 5 = 30**

39. Define Signum Function. Draw its graph. Write its domain and range.
40. Prove that $= \frac{\sin 5x - 2\sin 3x + \sin x}{\cos 5x - \cos x} = \tan x$.
41. Prove by mathematical induction
    $1.2 + 2.3 + 3.4 + ... + n(n+1) = \frac{n(n+1)(n+2)}{3}\ \forall\ n \in N$.
42. Solve the system of inequalities graphically : $2x + y \geq 4$; $x + y \leq 3$; $2x - 9y \leq 6$
43. What is the number of ways to choosing 4 cards from a pack of 52 cards ? In how many of these
    (1) Four cards are of same suit.
    (2) Four cards belong to four different suits.
    (3) Four face cards.
    (4) Two cards are red cards and two are black cards.
44. Prove the Binomial Theorem $(a + b)^n = {}^nC_0a^nb^o + {}^nC_1a^{n-1}b^1 + {}^nC_2a^{n-2}b^{n-2} + ... + {}^nC_na^{n-n}b^n$
45. Derive the formula to find the angle between two lines with slopes m_1 and m_2.

46. Derive the formula to find the co-ordinates of a point which divide the line joining the points $A(x_1, y_1, z_1)$ and $B(x_2, y_2, z_2)$ internally in the ratio $m : n$.

47. Prove Geometrically that $\underset{x \to 0}{Lt}\left(\frac{\sin x}{x}\right) = 1$, x is in radians.

48. Calculate the mean deviation about median form the following data :

Class	0-10	10-20	20-30	30-40	40-50	50-60
Frequency	6	7	15	16	4	2

PART-E

V. Answer any One questions $1 \times 10 = 10$

49. **(a)** Derive geometrically that $\cos(x + y) = \cos x \cos y - \sin x \sin y$. Hence deduce the value of $\cos 75°$ **6**

(b) Find the sum to 'n' terms of the series $\frac{1}{1 \times 2} + \frac{1}{2 \times 3} + \frac{1}{3 \times 4} + \dots\dots\dots\dots$ **4**

50. **(a)** Define Hyperbola. Derive the equation of the hyperbola in the form $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$ **6**

(b) Find the derivative of $\frac{x^5 - \cos x}{\sin x}$ w.r.t x. **4**

❑❑❑

SOLUTIONS
As Per Scheme of Valuation
(Issued by Department of PUE, Karnataka)

PART - A

1. Getting $P(A) = 1$. **1**

2. Writing $A \times B = \{(1, 3), (1, 4), (2, 3), (2, 4)\}$. **1**

3. Getting $\frac{4\pi}{3}$ **[Scheme of Valuation, 2018] 1**

Detailed Answer :

$$240 = 240 \times \frac{\pi}{180}$$

$$= 24\frac{\pi}{18}$$

$$= \frac{4\pi}{3}$$ **1**

4. Writing $-4 + 3i$. **1**

5. Getting $n = 10$. **[Scheme of Valuation, 2018] 1**

Detailed Answer :

Given $\quad {}^nC_8 = {}^nC_2$

Since, $\quad {}^mC_x = {}^mC_y$

Then $\quad m = x + y$

So, $\quad {}^nC_8 = {}^nC_2$

or, $\quad n = 8 + 2 = 10.$ **1**

6. Writing $a_7 = \frac{7^2}{2^7}$ or $a_7 = \frac{49}{128}$ **1**

7. Getting $m = -\frac{3}{2}$ **[Scheme of Valuation, 2018] 1**

Detailed Answer :

$$(x_1, y_1) = (3, -2)$$
$$(x_2, y_2) = (-1, 4)$$

Slope $\quad m = \frac{y_2 - y_1}{x_2 - x_1}$

$$m = \frac{4-(-2)}{-1-3}$$

$$m = \frac{-3}{2}$$ **1**

8. Getting b. **[Scheme of Valuation, 2018] 1**

Detailed Answer :

$$\underset{x \to 0}{Lim}\left(\frac{ax+b}{cx+1}\right) = \left(\frac{a(0)+b}{c(0)+1}\right) = b.$$ **1**

9. The number 2 is not greater than 7. **1**

10. $S = \{HHH, HHT, HTH, THH, HTT, THT, TTH, TTT\}$. **1**

PART - B

11. $A \cup B = \{1, 2, 3, 4, 6, 8\}$ **1**

$(A \cup B)' = \{5, 7, 9\}$. **[Scheme of Valuation, 2018] 1**

Detailed Answer :

$$U = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$$
$$A = \{1, 2, 3, 4\}$$
$$B = \{2, 4, 6, 8\}$$
$$(A \cup B)' = U - (A \cup B)$$
$$A \cup B = \{1, 2, 3, 4, 6, 8\} \quad \mathbf{1}$$
$$(A \cup B)' = U - (A \cup B)$$
$$= \{1, 2, 3, 4, 5, 6, 7, 8, 9\} - \{1, 2, 3, 4, 6, 8\}$$
$$= \{5, 7, 9\}. \quad \mathbf{1}$$

12. $A - B = \{1, 3, 5\}$ **1**

$B - A = \{8\}$. **[Scheme of Valuation, 2018] 1**

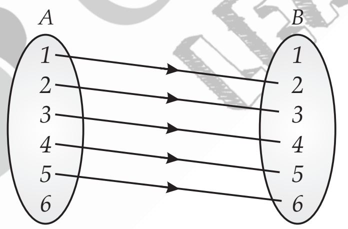
Detailed Answer :

$$A = \{1, 2, 3, 4, 5, 6\}$$
$$B = \{2, 4, 6, 8\}$$
$$A \cap B = \{2, 4, 6\}$$

(i)
$$A - B = A - (A \cap B)$$
$$= \{1, 2, 3, 4, 5, 6\} - \{2, 4, 6\}$$
$$= \{1, 3, 5\}. \quad \mathbf{1}$$

(ii)
$$B - A = B - (A \cap B)$$
$$= \{2, 4, 6, 8\} - \{2, 4, 6\}$$
$$= \{8\}. \quad \mathbf{1}$$

13. $R = \{(1, 2), (2, 3), (3, 4), (4, 5), (5, 6)\}$. **1**



1

14. $l = r\,\theta$ or $37.4 = r \times \dfrac{\pi}{3}$ $\left(\because 60° = \dfrac{\pi}{3}\right)$ **1**

Getting $r = 35.71$ $\left(\text{given } \pi = \dfrac{22}{7}\right)$ **1**

15. Writing $\sin \dfrac{31\pi}{3} = \sin\left(10\pi + \dfrac{\pi}{3}\right)$ **1**

Getting $\dfrac{\sqrt{3}}{2}$ **1**

16. Modulus = 2 **1**

Argument $= \dfrac{5\pi}{6}$ **[Scheme of Valuation, 2018] 1**

Detailed Answer :

$$Z = -\sqrt{3} + i$$

Modulus $|Z| = ?$

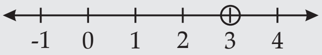
Argument $\theta = ?$

$$Z = a + bi$$
$$a = -\sqrt{3},\ b = 1$$

(i)
$$|Z| = \sqrt{a^2 + b^2}$$
$$= \sqrt{\left(-\sqrt{3}\right)^2 + (1)^2}$$
$$|Z| = 2 \quad \mathbf{1}$$

(ii)
$$\theta = \tan^{-1}\left(\frac{b}{a}\right)$$
$$= \tan^{-1}\left(\frac{1}{-\sqrt{3}}\right)$$
$$= \tan^{-1}(-\tan 30°)$$
$$= \tan^{-1}[\tan(180° - 30°)]$$
$$= \tan^{-1}(\tan 150°)$$
$$= 150° = \frac{5\pi}{6} \quad \mathbf{1}$$

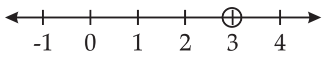
17. Getting $x < 3$. **1**



[Scheme of Valuation, 2018] 1

Detailed Answer :

$$7x + 3 < 5x + 9$$
$$7x - 5x < 9 - 3$$
$$2x < 6$$
$$x < 3. \quad \mathbf{1}$$



$(-\infty, 3)$ **1**

18. Writing $\dfrac{x}{-3} + \dfrac{y}{2} = 1$ **1**

$2x - 3y + 6 = 0$. **[Scheme of Valuation, 2018] 1**

Detailed Answer :

The equation of line has intercept a and b on x and y axes.

$$\frac{x}{a} + \frac{y}{b} = 1$$

Here, $a = -3, b = 2$

or, $\dfrac{x}{-3} + \dfrac{y}{2} = 1$ **1**

or, $2x - 3y + 6 = 0$ **1**

19. $d = \left|\dfrac{3 \times 3 - 4 \times -5 - 26}{\sqrt{3^2 + 4^2}}\right|$ **1**

$= \dfrac{3}{5}$ **[Scheme of Valuation, 2018] 1**

Detailed Answer :

$$(x_1, y_1) = (3, -5)$$
$$Ax + By + C = 0$$
$$3x - 4y - 26 = 0$$

On comparing $A = 3, B = -4, C = -26$

$$x_1 = 3, y_1 = -5$$

The distance from point (x_1, y_1) to the line $Ax + by + C = 0$

is given as, $d = \left|\dfrac{Ax_1 + By_1 + C}{\sqrt{A^2 + B^2}}\right|$ **1**

$$d = \left|\frac{(3)(3) + (-4)(-5) + (-26)}{\sqrt{(3)^2 + (-4)^2}}\right|$$

$d = \dfrac{3}{5}$ **1**

20. $\left(\dfrac{3 + (-1) + x}{3}, \dfrac{-5 + 7 + y}{3}, \dfrac{7 + 6 + z}{3}\right) = (1, 1, 1)$ **1**

Getting $(x, y, z) = (1, 1, -10)$. **1**

[Scheme of Valuation, 2018]

Detailed Answer :

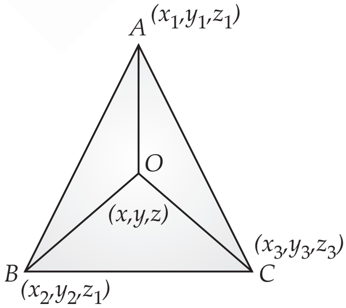
In ΔABC,

Given $\mathbf{O}\ (x, y, z) = (1, 1, 1)$

$A\ (x_1, y_1, z_1) = (3, -5, 7)$

$B\ (x_2, y_2, z_2) = (-1, 7, 6)$

$C\ (x_3, y_3, z_3) = ?$



$$x = \frac{x_1 + x_2 + x_3}{3}$$

or, $1 = \dfrac{(3) + (-1) + x_3}{3}$

or, $1 = \dfrac{2 + x_3}{3}$

or, $x_3 = 1$ **1**

Now,

$$y = \frac{y_1 + y_2 + y_3}{3}$$

or, $1 = \dfrac{(-5) + (7) + y_3}{3}$

or, $y_3 = 1$

Now,

$$z = \frac{z_1 + z_2 + z_3}{3}$$

or, $1 = \dfrac{(7) + (6) + z_3}{3}$

or, $z_3 = -10$

Hence, the centroid of triangle

$(x_3, y_3, z_3) = (1, 1, -10)$ **1**

21. Writing $\underset{x \to 0}{Lt}\left(\dfrac{\dfrac{\sin ax}{ax} \times ax}{\dfrac{\sin bx}{bx} \times bx}\right)$ **1**

$= \dfrac{a}{b}$ **[Scheme of Valuation, 2018] 1**

Detailed Answer :

$$= \lim_{x \to 0}\left(\frac{\sin ax}{\sin bx}\right)$$

$= \dfrac{\lim\limits_{x \to 0} \dfrac{\sin ax}{ax}}{\lim\limits_{x \to 0} \dfrac{\sin bx}{bx}} \times \dfrac{ax}{bx}$ **1**

$$\left[\because \lim_{x \to 0}\left(\frac{\sin ax}{ax}\right) = 1\right]$$

$$= \frac{1 \times ax}{1 \times bx}$$

$= \dfrac{a}{b}$ **1**

22. **Converse :** If x is an odd number, then x is prime. **1**

Contrapositive : If x is not an odd number then x is not prime. **1**

23. C V $= \dfrac{\sigma}{\bar{x}} \times 100$ or $60 = \dfrac{21}{\bar{x}} \times 100$ **1**

$\bar{x} = 35.$ **1**

24. $P(A \cup B) = P(A) + P(B) - P(A \cap B)$ **1**

$= 0.88.$ **1**

PART - C

25. $n(x) = 24, n(y) = 16, n(x \cup y) = 35$ **1**

$n(x \cap y) = n(x) + n(y) - n(x \cup y)$ **1**

$= 5$ **1**

26. $(f+g)(x) = x^2 + 2x + 1$ **1**

$(f-g)(x) = x^2 - 2x - 1$ **1**

$(fg)(x) = 2x^3 + x^2.$ **1**

[Scheme of Valuation, 2018]

Detailed Answer :

$f(x) = x^2, g(x) = 2x + 1$

(i) $(f+g)(x) = f(x) + g(x)$

$= x^2 + 2x + 1$ **1**

(ii) $(f-g)(x) = f(x) - g(x)$

$= (x^2) - (2x + 1)$

$= x^2 - 2x - 1$ **1**

(iii) $(fg)(x) = f(x)\,g(x)$

$= (x^2)(2x + 1)$

$= 2x^3 + x^2$ **1**

27. Getting $(\sin x - 2)(2\sin x + 1) = 0$ **1**

$\sin x = 2$ is not possible **1**

$\sin x = -\dfrac{1}{2}$ or $x = n\pi + (-1)^n \dfrac{7\pi}{6}, n \in I$ **1**

[Scheme of Valuation, 2018]

Detailed Answer :

$2\cos^2 x + 3\sin x = 0$

or, $2(1 - \sin^2 x) + 3\sin x = 0$

or, $2\sin^2 x - 3\sin x - 2 = 0$

or, $(\sin x - 2)(2\sin x + 1) = 0$ **1**

Either $\sin x = 2$ (not possible) or, $\sin x = \dfrac{-1}{2}$

$\sin x = \dfrac{-1}{2}$ **1**

$\sin x = \sin\left(\dfrac{7\pi}{6}\right)$

$x = n\pi + (-1)^n\left(\dfrac{7\pi}{6}\right), n \in I$ **1**

28. $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ **1**

$= \dfrac{-1 \pm \sqrt{(1)^2 - 4 \times \sqrt{2} \times \sqrt{2}}}{2 \times \sqrt{2}}$ **1**

$= \dfrac{-1 \pm i\sqrt{7}}{2\sqrt{2}}$ **1**

[Scheme of Valuation, 2018]

Detailed Answer :

$\sqrt{2}x^2 + x + \sqrt{2} = 0$

$a = \sqrt{2}, b = 1, c = \sqrt{2}$

$x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ **1**

$x = \dfrac{-1 \pm \sqrt{(1)^2 - (4)(\sqrt{2})(\sqrt{2})}}{2\sqrt{2}}$ **1**

or, $x = \dfrac{-1 \pm \sqrt{-7}}{2\sqrt{2}}$

or, $x = \dfrac{-1 \pm \sqrt{7}.\sqrt{-1}}{2\sqrt{2}}$

$x = \dfrac{-1 \pm \sqrt{7}i}{2\sqrt{2}}$ **1**

29. Getting $\left(\dfrac{1+i}{1-i}\right) = i$ **1**

Writing $i^m = 1$ **1**

Getting $m = 4$ **[Scheme of Valuation, 2018] 1**

Detailed Answer :

$m = ?$

$\left(\dfrac{1+i}{1-i}\right)^m = 1$

$\left(\dfrac{1+i}{1-i} \times \dfrac{1+i}{1+i}\right)^m = 1$ **1**

$\left(\dfrac{1+i^2+2i}{1-i^2}\right)^m = 1$ $[i^2 = -1]$

$\left(\dfrac{1-1+2i}{1-(-1)}\right)^m = 1$

$\left(\dfrac{2i}{2}\right)^m = 1$

$i^m = 1$ **1**

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$i^m = i^4$

$m = 4$ **1**

30. $5 \times \frac{4!}{(4-r)!} = 6 \times \frac{5!}{[5-(r-1)]!}$ **1**

$5 \times \frac{4!}{(4-r)!} = 6 \times \frac{5 \times 4!}{(6-r)(5-r)(4-r)!}$ **1**

Getting $r = 3$ **1**

[Scheme of Valuation, 2018]

Detailed Answer :

Given, $5 \times {}^4P_r = 6 \times 5p_{r-1}$

$5 \times \frac{4!}{(4-r)!} = 6 \times \frac{5!}{[5-(r-1)]!}$ **1**

$5 \times \frac{4!}{(4-r)!} = 6 \times \frac{5 \times 4!}{(6-r)(5-r)(4-r)!}$ **1**

$(6-r)(5-r) = 6$

$r^2 - 11r + 24 = 0$

$(r-8)(r-5) = 0$

Either $r = 8$ (not possible) or $r = 3$ **1**

31. $T_{(r+1)} = {}^nC_r a^{n-r} b^r$ **1**

$T_6 = {}^{10}C_5 \left(\frac{x}{3}\right)^5 (9y)^5$ **1**

$= 252 \times 3^5 \times x^5 y^5$ or $61236\, x^5 y^5$ **1**

[Scheme of Valuation, 2018]

Detailed Answer :

Middle term in the expansion of $\left(\frac{x}{3} + 9y\right)^{10}$

Middle term $= \left(\frac{10+2}{2}\right)^{th}$ term

$= \left(\frac{12}{2}\right)^{th}$ term

$= 6^{th}$ term

$T_6 = T_{5+1}$

$= {}^{10}C_5 \left(\frac{x}{3}\right)^{10-5} (9y)^5$ **1**

$= 252 \times 3^5 x^5 y^5$ **1**

$= 61236\, x^5 y^2$ **1**

32. Getting $d = -1$ **1**

$a = m + n - 1$ **1**

$Tp = m + n - p$ **1**

[Scheme of Valuation, 2018]

Detailed Answer :

$T_p = ?$

Given $T_m = n$

$a + (m-1)d = n$ ...(i)

$T_n = m$

$a + (n-1)d = m$ ...(ii)

On subtracting eq. (ii) from eq. (i)

$[a + (m-1)d] - [a + (n-1)d] = n - m$

$[a + md - d] - [a + nd - d] = n - m$

$d = -\frac{(m-n)}{m-n}$

$d = -1$ **1**

Put value of d in eq. (i) to get value of a

$a + (m-1)(-1) = n$

$a - m + 1 = n$

$a = n + m - 1$ **1**

$Tp = a + (p-1)d$

$= (n + m - 1) + (p-1)(-1)$

$= n + m - 1 - p + 1$

$Tp = n + m - p$ **1**

Required p^{th} term is $n + m - p$

33. $8, A_1, A_2, A_3, A_4, A_5, 26$ are in AP **1**

Getting $d = 3$ **1**

Writing No. 11, 14, 17, 20, 23 **1**

[Scheme of Valuation, 2018]

Detailed Answer :

$8, A_{,1}, A_2, A_3, A_4, A_5, 26$ **1**

$a = 8, l = 26, n$ (total no. of terms) $= 5 + 2 = 7$

x^{th} term from last of AP in given as

$l = a + (n-1)d$

$26 = 8 + (7-1)d$

$d = 3$ **1**

$A_1 = T_2 = a + d = 8 + 3 = 11$

$A_2 = T_3 = a + 2d + 8 + 2(3) = 14$

$A_3 = T_4 = a + 3d = 8 + 3(3) = 17$

$A_4 = T_5 = a + 4d = 8 + 4(3) = 20$

$A_5 = T_6 = a + 5d = 8 + 5(3) = 23$

11, 14, 17, 20, 23 ..... are in $A.P.$ **1**

34. Writing, Vertices $= (\pm 7, 0)$ **1**

$LR = \frac{72}{7}$ **1**

$e = \frac{\sqrt{13}}{7}$ **1**

[Scheme of Valuation, 2018]

Detailed Answer :

$\frac{x^2}{49} + \frac{y^2}{36} = 1$

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$$\frac{x^2}{(7)^2}+\frac{y^2}{(6)^2} = 1$$

On comparing with

$$\frac{x^2}{a^2}+\frac{y^2}{b^2} = 1$$

$$a = 7, b = 6$$

(i) Vertices $= (\pm a, o)$

Vertices $= (\pm 7, o)$ **1**

(ii) Length of the Latus Rectum

$$LR = \frac{2b^2}{a}$$

$$= \frac{2(6)^2}{7} = \frac{72}{7}$$

$$LR = \frac{72}{7}$$ **1**

(ii) Eccentricity $(e) = \frac{c}{a}$

Since, $a^2 = b^2 + c^2$

$49 = 36 + c^2$

$c = \sqrt{13}$

So, $e = \frac{c}{a}$

$$e = \frac{\sqrt{13}}{7}$$ **1**

35. $f'(x) = \underset{h\to 0}{Lt}\left(\frac{\sin(x+h)-\sin x}{h}\right)$ **1**

$$= \underset{h\to 0}{Lt}\frac{2\cos\left(x+\frac{h}{2}\right)\sin\frac{h}{2}}{h}$$ **1**

$= \cos x$ **1**

[Scheme of Valuation, 2018]

Detailed Answer :

$f(x) = \sin x, f'(x) = ?$

$f(x) = \sin x$

$f(x + h) = \sin (x + h)$

$$f'(x) = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$$ **1**

$$= \lim_{h\to 0}\frac{\sin(x+h)-\sin(x)}{h}$$

Apply $\sin C - \sin D = 2\cos\left(\frac{C+D}{2}\right)\sin\left(\frac{C-D}{2}\right)$

$$= \lim_{h\to 0}\frac{2\cos\frac{(x+h+x)}{2}\sin\frac{(x+h-x)}{2}}{h}$$

$$= \lim_{h\to 0}\frac{2\cos\frac{(x+h)}{2}\sin\frac{h}{2}}{h}$$ **1**

$$= \lim_{h\to 0}\cos\left(\frac{x+h}{2}\right)\frac{\sin\frac{h}{2}}{\frac{h}{2}}$$

$$= \lim_{h\to 0}\cos\left(x+\frac{h}{2}\right)\frac{\sin\frac{h}{2}}{\frac{h}{2}}$$

$$\left[\lim_{h\to 0}\frac{\sin x}{x}=1\right]$$

$$= \cos\left(x+\frac{0}{2}\right)$$

$f'(x) = \cos x$ **1**

36. $\sqrt{7} = \frac{p}{q}$, $p \,\&\, q \in z, q \neq 0$ and there is no common **1**

factor for p & q **1**

Showing 7 divides both p & q conclusion **1**

[Scheme of Valuation, 2018]

Detailed Answer :

Let $\sqrt{7}$ is rational number in the from of $\frac{p}{q}$

Where, $q \neq 0$ and $p, q \in Z$

There is no common factor of p and q.

$$\sqrt{7} = \frac{p}{q}$$ **1**

On squaring both sides

$$7 = \frac{p^2}{q^2}$$

$$7q^2 = p^2 \quad ...(i)$$

Here p^2 is divisible by 7 and p is also divisible by 7

$$\frac{p}{7} = c$$

$$p = 7c$$

On squaring both sides

$$p^2 = 7^2c^2 \qquad \text{...(ii)}$$

On comparing eq. (i) and eq. (ii)

$$7q^2 = 49\,c^2$$
$$7c^2 = q^2$$

Here q^2 is divisible by 7, q is also divisible by 7 **1**

In above p and q both are divisible by 7

Hence our assumption is wrong.

$\therefore$ $\sqrt{7}$ is irrational number. **1**

37. $P(A \text{ prime number will appear}) = \dfrac{1}{2}$ **1**

$P(A \text{ number greater than or equal to } 3) = \dfrac{2}{3}$ **1**

$P(A \text{ number more than } 6) = 0$ **1**

[Scheme of Valuation, 2018]

Detailed Answer :

$S = \{1, 2, 3, 4, 5, 6\}$

(i) Prime number $= \{2, 3, 5\}$

$P(\text{Prime number will appear}) = \dfrac{3}{6} = \dfrac{1}{2}$ **1**

(ii) Number equal to or greater than $= \{3, 4, 5, 6\}$

$P(\text{A number greater than or equal to}) = \dfrac{4}{6} = \dfrac{2}{3}$ **1**

(iii) A number more than 6 = 0 number exist

$P(\text{A number more than } 6) = \dfrac{0}{6} = 0$ **1**

38. Stating

A = Event of both students enter the same section of 40 students

B = Event of both students enter the same section of 60 students **1**

Getting $P(A) = \dfrac{40_{C_2}}{100_{C_2}}$; $P(B) = \dfrac{60_{C_2}}{100_{C_2}}$ **1**

Required probability $= \dfrac{40_{C_2} + 60_{C_2}}{100_{C_2}}$ **1**

PART - D

39. Definition **1**

Graph **2**

Domain **1**

Range **[Scheme of Valuation, 2018] 1**

Detailed Answer :

The signum function S is defined as follows :

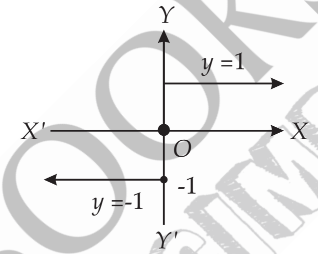
$$S(x) = \begin{cases} -1 & \text{if } x < 0 \\ 0 & \text{if } x = 0 \\ 1 & \text{if } x > 0 \end{cases} \qquad \mathbf{1}$$

The domain of S is R and its range is $\{-1, 0, 1\}$.

Note that for $x \neq 0$

$$S(x) = \frac{x}{|x|}$$

The graph of the signum function is given in the figure :



2

Domain $= R$ **1**

Range $= \{-1, 0, 1\}$ **1**

40. L.H.S. $= \dfrac{\sin 5x + \sin x - 2\sin 3x}{\cos 5x - \cos x}$ **1**

$= \dfrac{2\sin 3x \cos 2x - 2\sin 3x}{-2\sin 3x \sin 2x}$ **1**

$= \dfrac{2\sin 3x\left(\cos 2x - 1\right)}{-2\sin 3x \sin 2x}$ **1**

$= \dfrac{1 - \cos 2x}{\sin 2x}$ **1**

$= \tan x$ **1**

[Scheme of Valuation, 2018]

Detailed Answer :

$$\text{LHS} = \frac{\sin 5x - 2\sin 3x + \sin x}{\cos 5x - \cos x} \qquad \mathbf{1}$$

$$= \frac{\sin 5x + \sin x - 2\sin 3x}{\cos 5x - \cos x}$$

Apply, $\sin C + \sin D = 2\sin\dfrac{C+D}{2}\cos\dfrac{C-D}{2}$

and $\cos C - \cos D = 2\sin\dfrac{C+D}{2}\sin\dfrac{C-D}{2}$

$$= \frac{2\sin 3x \cos 2x - 2\sin 3x}{-2\sin 3x \sin 2x} \qquad \mathbf{1}$$

$$= \frac{2\sin 3x\,[\cos 2x - 1]}{-2\sin 3x \sin 2x} \qquad \mathbf{1}$$

$$= \frac{1-\cos 2x}{\sin 2x}$$

$$= \frac{1-[1-2\sin^2 x]}{2\sin x \cos x} \quad \textbf{1}$$

$$= \frac{2\sin^2 x}{2\sin x \cos x}$$

$= \tan x$ **1**

= R.H.S. **Hence Proved**

41. Verifying $P(1)$ true **1**

Assuming $P(k)$ true **1**

Proving $P(k)$ or $P(k + 1)$ **2**

Conclusion **[Scheme of Valuation, 2018] 1**

Detailed Answer :

$$1.2+2.3+3.4+......+n(n+1)=\frac{n(n+1)(n+2)}{3} \forall n \in N$$

For $x = 1$

$$1(1 + 1) = \frac{1(1+1)(1+2)}{3}$$

$$1(2) = \frac{1(2)(3)}{3}$$

$$2 = 2$$

It is true for $n = 1$ **1**

Let it is also true for $n = k$

$$1.2 + 2.3 + 3.4 + ... + k(k + 1) = \frac{k(k+1)(k+2)}{3} \quad \textbf{1}$$

For $x = k + 1$

On adding $(k + 1)(k + 2)$ on both sides in eq. (1)

$1.2 + 2.3 + ... + k(k + 1) + (k + 1)(k + 2)$

$$= \frac{k(k+1)(k+2)}{3}+(k+1)(k+2)$$

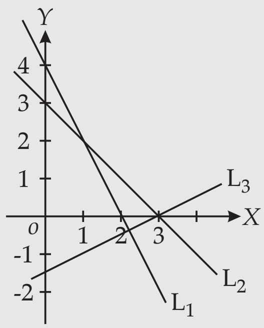
$$= (k+1)(k+2)\left[\frac{k}{3}+1\right]$$

$$= \frac{(k+1)(k+2)(k+3)}{3} \quad \textbf{2}$$

Here, it is also true for $n = k + 1$. **Hence Proved. 1**

42. Drawing 3 lines **1 + 1 + 1**

Shading the solution **1**



Conclusion **[Scheme of Valuation, 2018] 1**

Detailed Answer :

$2x + y \geq 4$

x	0	2	1
y	4	0	2

1

$x + y \leq 3$

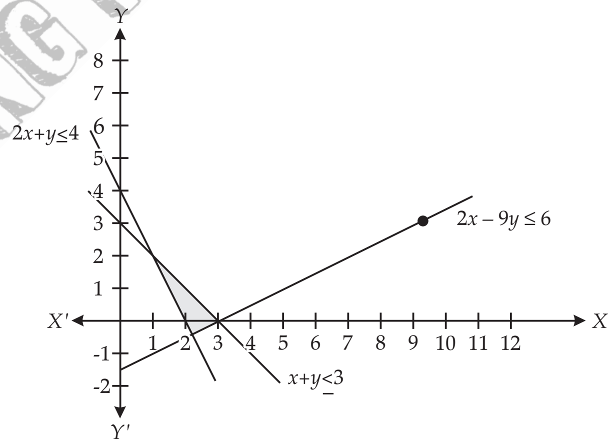
x	0	3	1
y	3	0	2

1

$2x - 9y \leq 6$

x	3	12
y	0	2

1



Shaded region is the solution. 1+1

43. No of ways of choosing 4 cards = $^{52}C_4$ = 270725 **1**

(1) No. of ways of choosing 4 cards of same suit = $13C_4 + 13C_4 + 13C_4 + 13C_4$ = 2860 **1**

(2) No. of ways of choosing cards of different suits = $13C_1 \times 13C_1 \times 13C_1 \times 13C_1$ = 28561 **1**

(3) No. of ways of choosing 4 face cards = $^{12}C_4$

= 495 **1**

(4) No. of ways of choosing 2 red and 2 black cards

= $^{26}C_2 \times {}^{26}C_2$ = 105625 **1**

[Scheme of Valuation, 2018]

44.	Verifying $P(1)$ true	1
	Assume $P(k)$ true	1
	$P(k)$ or $P(k+1)$	2
	Conclusion **[Scheme of Valuation, 2018]**	1

Detailed Answer :

Let $P(n)$ be the proposition where :

$$P(n) = (a+b)^n \sum_{r=0} {}^nC_r\, a^{n-r}\, b^r$$

Show $P(n)$ is true, when $n = 1$

LHS : $(a+b)^1 = a + b$

RHS : $\sum_{r=0}^{1} {}^1C_r\, a^{1-r}\, b^r$

${}^1C_0\, a^1\, b^0 + {}^1C_1\, a^0\, b_1 = a + b = \text{LHS}$

$\therefore P(n)$ is true, when $n = 1$. 1

Assume $n = k$

$$P(k) : (a+b)^k = \sum_{r=0}^{k} {}^kC_r\, a^{k-r}\, b^r$$

If $P(k)$ is true, then $P(k+1)$ should also be true. 1

LHS : $(a+b)^{k+1}$

$(a+b)^k\,(a+b)$

$$= \left[\sum_{r=0}^{k} {}^kC_r\, a^{k-r}\, b^r\right](a+b)$$

$$= a\left[\sum_{r=0}^{k} {}^kC_r\, a^{k-r}\, b^r\right] + b\left[\sum_{r=0}^{k} {}^kC_r\, a^{k-r}\, b^r\right]$$

$$= \left[\sum_{r=0}^{k} {}^kC_r\, a^{k-r+1}\, b^r\right] + \left[\sum_{r=0}^{k} {}^kC_r\, a^{k-r}\, b^{r+1}\right]$$

$$= ({}^kC_0)(a^{k+1}) + \left[\sum_{r=1}^{k} {}^kC_r\, a^{k-r+1}\, b^r\right]$$

$$+ \left[\sum_{r=1}^{k-1} {}^kC_r\, a^{k-r}\, b\right] + ({}^kC_k)(b^{k+1})$$

$$= a^{k+1} + \left[\sum_{r=1}^{k} ({}^kC_r\, a^{k-r+1}\, b^r) + \sum_{r=0}^{k-1} ({}^kC_r\, a^{k-r}\, b^{r+1})\right]$$

$$+ b^{k+1}$$

$$= {}^{k+1}C_0\, a^{k+1} + \left[\sum_{r=1}^{k} ({}^kC_r + {}^kC_{r-1})(a^{k-r+1}\, b^r)\right]$$

$$+ {}^{k+1}C_{k+1}\, b^{k+1}$$

$$= {}^{k+1}C_0\, a^{k+1} + \left[\sum_{r=1}^{k} ({}^{k+1}C_r)(a^{k-r+1}\, b^r)\right] + {}^{k+1}C_{k+1}\, b^{k+1}$$

$= ({}^{k+1}C_0)\,(a^{k+1}) + ({}^{k+1}C_1)\,(a^k)\,(b^1) + ({}^{k+1}C_2)\,(a^{k-1})\,(b^2) + ({}^{k+1}C_3)\,(a^{k-2})\,(b^3) + \ldots. + ({}^{k+1}C_k)\,(a^1)\,(b^k) + ({}^{k+1}C_{k+1})\,(b^{k+1})$

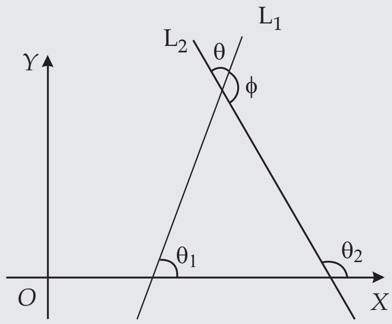
$$= \sum_{r=0}^{k+1} {}^{K+1}C_r\, a^{k-r+1}\, b^r \text{ . Q.E.D.}$$ 2

R.H.S : $\sum_{r=0}^{k+1} {}^{k+1}C_r\, a^{(k+1)-r}\, b^r = \text{LHS}$

$\therefore P(k)$ is true and $P(k+1)$ is true. 1

$\therefore P(n) : (a+b)^n = \sum_{r=0}^{n} {}^nC_r\, a^{n+r}\, b^r$, is true

45.



1

Writing m_1	$=$	$\tan\theta_1$; $m_2 = \tan\theta_2$	1
$\tan\theta$	$=$	$\tan(\theta_2 - \theta_1)$	
	$=$	$\left\lvert\dfrac{\tan\theta_2 - \tan\theta_1}{1+\tan\theta_1\,\tan\theta_2}\right\rvert$	1
Getting, $\tan\theta$	$=$	$\left\lvert\dfrac{m_1 - m_2}{1+m_1\,m_2}\right\rvert$	2

[Scheme of Valuation, 2018]

Detailed Answer :

Let L_1 and L_2 be two non-vertical lines with slopes m_1 and m_2, respectively. If α_1 and α_2 are the inclinations of lines L_1 and L_2, respectively. Then

$$m_1 = \tan\theta_1 \text{ and } m_2 = \tan\theta_2$$ 1

We know that when two lines intersect each to other, they make two pairs of vertically opposite angles such that sum of any two adjacent angle is 180°. Let θ and ϕ be the adjacent angles between lines L_1 and L^2 (sec fig). Then

$$\theta = \theta_2 - \theta_1,\ \theta_1, \theta_2 \neq 90°$$

$\therefore \tan\theta = \tan(\theta_2-\theta_1) = \dfrac{\tan\theta_2 - \tan\theta_1}{1+\tan\theta_1\tan\theta_2} = \dfrac{m_2-m_1}{1+m_1m_2}$

(as $1 + m_1m_2 \neq 0$) and $\phi = 180° - \theta$, so that **1**

$\tan\phi = \tan(180° - \theta) = -\tan\theta = -\dfrac{m_2-m_1}{1+m_1m_2}$, as $1 + m_1m_2 \neq 0$

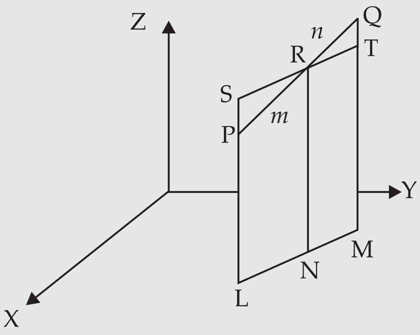
Case I : If $\dfrac{m_2-m_1}{1+m_1m_2}$ is positive, then $\tan\theta$ will be positive and $\tan\phi$ will be – ve, which means θ will be acute and ϕ will be obtuse. **1**

Case II : If $\dfrac{m_2-m_1}{1+m_1m_2}$ is negative, than $\tan\theta$ will be negative and $\tan\phi$ will be positive, which means that θ will be obtuse and ϕ will be acute. **1**

Thus, the acute angle (sayθ) between lines L_1 and L_2 with slopes m_1 and m_2, respectively is given by

$$\tan\theta = \left|\frac{m_2-m_1}{1+m_1m_2}\right|, \text{ as } 1 + m_1m_2 \neq 0. \quad \mathbf{1}$$

46.



1

Getting $\dfrac{m}{n} = \dfrac{PR}{QR} = \dfrac{SP}{QT}$ **1**

Getting $z = \dfrac{m_1z_2+n_1z_1}{m+n}$ **2**

Getting the point of division

$$= \left(\frac{mx_2+nx_1}{m+n}, \frac{my_2+my_1}{m+n}, \frac{mz_2+nz_1}{m+n}\right)$$

[Scheme of Valuation, 2018] 1

Detailed Answer :

Let us consider two points $P(x_1, y_1, z_1)$ and $Q(x_2, y_2, z_2)$. Consider and points R (x, y, z) dividing PQ in the ratio $m : n$ as shown in figure. **1**

- Draw PL, RN, and QM perpendicular to xy plane such that $PL \,||\, RN \,||\, QM$ as shows here.
- The points L, M and N lie on the straight line formed due to the intersection of a plane containing PL, RN and QM and XY-plane.
- From the point R, a line system ST is drawn such that it is parallel to PM.
- ST intersect PL extenally at S and QM at T internally. Since ST is parallel to LM and $PL||RN$ therefore, the quadrilaterals $LNRS$ and $NMTR$ qualify as parallelograms.

Also, $\Delta PSR \sim \Delta QTR$, therefore,

$$\frac{m}{n} = \frac{PR}{QR} = \frac{PS}{QT} = \frac{SL-PL}{QM-TM}$$

$$= \frac{NR-PL}{QM-RN} = \frac{z-z_1}{z_2-z} \quad \mathbf{1}$$

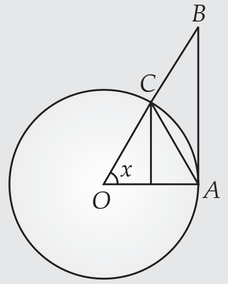
Rearranging the above equation we get $z = \dfrac{my_2+ny_1}{m+n}$ **2**

Similarly,

The above procedure can be repeated by drawing perpendiculars to xz and yz planes to get the x and y co-ordinates of the points R that divides the line segment PQ in the ratio $m : n$ internally

$$x = \frac{mx_2+nx_1}{m+n}, \; y = \frac{my_2+ny_1}{m+n} \quad \mathbf{1}$$

47. Correct fig



1

Getting Area of Δ OAC **1**

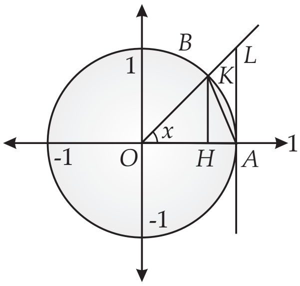
Area of sector OAC **1**

Area of ΔOAC < Area sector OAC < Area of OAB **1**

Getting $\underset{x\to 0}{Lt}\left(\dfrac{\sin x}{x}\right) = 1$ **1**

[Scheme of Valuation, 2018]

Detailed Answer :



1

The geometric idea is that

Area of ΔKOA < Area of Sector KOA < Area of ΔLOA

Area of $\Delta KOA = \frac{1}{2}$ (1) ($\sin x$) [area = ($\frac{1}{2}$ base × height)]

Area of Sector $KOA = \frac{1}{2}(1)^2 x$ (x is in radians) **1**

Area of $\Delta LOA = \frac{1}{2}\tan x$ ($AL = \tan x$) **1**

So, we have : $\frac{\sin x}{2} < \frac{x}{2} < \frac{\tan x}{2}$

For small positive x, we have ($x > 0$) so we can multiply through by $\frac{2}{\sin x}$ to get

$$1 < \frac{x}{\sin x} < \frac{1}{\cos x}$$

So, $\cos x < \frac{\sin x}{x} < 1$ for $0 < x < \frac{\pi}{2}$

$$\lim_{x\to 0^+} \cos x = 1 \text{ and } \lim_{x\to 0^+} 1 = 1$$

So, $\lim_{x\to 0^+} \frac{\sin x}{x} = 1$

We also have, for these small x

$$\sin(-x) = -\sin x$$

So, $\frac{-x}{\sin(-x)} = \frac{-x}{\sin x}$ and $\cos(-x) = \cos x$

So, $\cos x < \frac{\sin x}{x} < 1$ for $\frac{-\pi}{2} < x < 0$ **1**

$$\lim_{x\to 0^-} \cos x = 1 \text{ and } \lim_{x\to 0^-} 1 = 1$$

So, $\lim_{x\to 0^-} \frac{\sin x}{x} = 1$ **1**

Since, both one sided limits are 1, the limit is 1.

48.

			(x_i)		
Class	**Freq**	*CF*	**M.pt**	$\lvert x_i - M\rvert$	$f_i\lvert x_i - M\rvert$
0-10	6	6	5	23	138
10-20	7	13	15	13	91
20-30	15	28	25	3	45
30-40	16	44	35	7	112
40-50	4	48	45	17	68
50-60	2	50	55	27	54
Total	**50**				**508**

1 + 1 + 1

Getting Median = 28

using formula : median $= l + \frac{\frac{N}{2} - C}{f} \times h$ **1**

Hence, $M.D.\ (M) = 10.16$ **1**

using formula : $M.P.(M) = \frac{1}{N}\ \Sigma\ f\lvert x - M\rvert$

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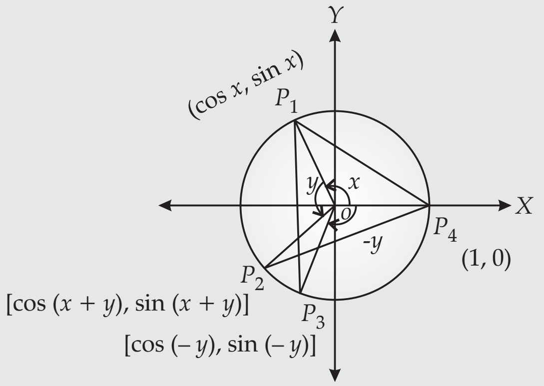
PART - E

49. (a)



2

Getting $P_2P_4 = \sqrt{2 - 2\cos(x+y)}$ **1**

$P_1P_3 = \sqrt{2 - 2\left(\cos x \cos y - \sin x \sin y\right)}$

Getting $\cos(x + y) = \cos x \cos y - \sin x \sin y$ **1**

Getting $\cos 75° = \dfrac{\sqrt{3}-1}{2\sqrt{2}}$ **1**

$\cos 75° = \cos(45° + 30°)$

$= \cos 45° \cos 30° - \sin 45° \sin 30°$

$= \dfrac{1}{\sqrt{2}} \times \dfrac{\sqrt{3}}{2}$

$\cos 75° = \dfrac{\sqrt{3}-1}{2\sqrt{2}}$ **1**

[Scheme of Valuation, 2018]

Detailed Answer :

Consider the triangles P_1OP_3 and P_2OP_4. Therefore, P_1P_3 and P_2P_4 are equal. By using distance formula, we get

$P_1P_3^2 = [\cos x - \cos(-y)]^2 + [\sin x - \sin(-y)]^2$ **1**

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

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

$= 2 - 2(\cos x \cos y - \sin x \sin y)$ 1

Also, $P_2P_4^2 = [1 - \cos(x+y)]^2 + [0 - \sin(x+y)]^2$ **1**

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

$= 2 - 2\cos(x + y)$ **1**

Since, $P_1P_3 = P_2P_4$, we have $P_1P_3^2 = P_2P_4^2$ **1**

$\therefore 2 - 2(\cos x \cos y - \sin x \sin y) = 2 - 2\cos(x + y)$

Hence, $\cos(x + y) = \cos x \cos y - \sin x \sin y$. **1**

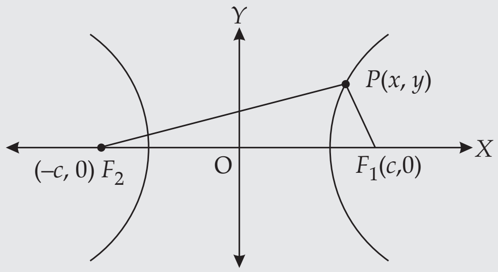
(b) Writing $S_n = \dfrac{1}{1\times 2} + \dfrac{1}{2\times 3} + \dfrac{1}{3\times 4} + \ldots\ldots + \dfrac{1}{n(n+1)}$ **1**

$= \left(\dfrac{1}{1} - \dfrac{1}{2}\right) + \left(\dfrac{1}{2} - \dfrac{1}{3}\right) + \left(\dfrac{1}{3} - \dfrac{1}{4}\right) + \ldots\ldots + \left(\dfrac{1}{n} - \dfrac{1}{n+1}\right)$ **1**

$= \dfrac{1}{1} - \dfrac{1}{n+1}$ **1**

$= \dfrac{n}{n+1}$ **1**

50. (a) Hyperbola : A hyperbola is the set of all points in a plane, the differences of whose distances from two fixed points in the plane is constant. **1**



1

Getting $F_1P = \sqrt{(x+c)^2 + y^2}$ **1**

$F_2P = \sqrt{(x-c)^2 + y^2}$

Writing $F_1P - F_2P = 2a$ **1**

Getting $(x + c)^2 + y^2 = 4a^2 + (x - c)^2 + y^2 + 4a\sqrt{(x-c)^2 + y^2}$ **1**

Getting $\dfrac{x^2}{a^2} - \dfrac{y^2}{b^2} = 1$ **1**

[Scheme of Valuation, 2018]

Detailed Answer :

Since, $F_1P - F_2P = 2a$ **1**

Using distance formula, we get

$\sqrt{(x+c)^2 + y^2} - \sqrt{(x-c)^2 + y^2} = 2a$ **1**

i.e., $\sqrt{(x+c)^2 + y^2} = 2a + \sqrt{(x-c)^2 + y^2}$

Squaring both sides, we get

$(x + c)^2 + y^2 = 4a^2 + 4a\sqrt{(x-c)^2 + y^2} + (x - c)^2 + y^2$ **1**

or $\dfrac{cx}{a} - a = \sqrt{(x-c)^2 + y^2}$ **1**

On squaring again and further simplifying, we get

$$\frac{x^2}{a^2}-\frac{y^2}{c^2-a^2}=1 \qquad \mathbf{1}$$

i.e.,
$$\frac{x^2}{a^2}-\frac{y^2}{b^2}=1 \quad (\text{since } c^2-a^2=b^2)\ \mathbf{1}$$

Hence proved

(b) $\frac{d}{dx}\left(\frac{x^5-\cos x}{\sin x}\right)$

$$=\frac{\sin x\frac{d}{dx}(x^5-\cos x)-(x^5-\cos x)\frac{d}{dx}(\sin x)}{(\sin x)^2} \qquad \mathbf{1}$$

$$=\frac{\sin x\left(5x^4+\sin x\right)-\left(x^5-\cos x\right)\cos x}{\sin^2 x} \qquad \mathbf{1}$$

$$=\frac{\sin x\, 5x^4+\sin^2 x-x^5\cos+\cos^2 x}{\sin^2 x} \qquad \mathbf{1}$$

$$=\frac{x^4\left(5\sin x-x\cos x\right)+1}{\sin^2 x} \qquad \mathbf{1}$$

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SOLVED PAPER	I PUC Annual Examination 2018	Mathematics Subject Code 35(S)

Time : 3 Hours 15 minutes **Max. Marks : 100**

Instructions :

(i) The question paper consists of five parts. A, B, C, D and E. Answer all the parts.

(ii) Use the graph sheet for the question on linear inequality in Part-D.

PART - A

I. Answer All the questions. $10 \times 1 = 10$

1. Define power set of a set.
2. If $(x + 1, y - 2) = (3, 1)$ find the values of x and y.
3. Convert 240° into radian measure.
4. Find the multiplicative inverse of $2 - 3i$.
5. Compute $\frac{12!}{10!\,2!}$
6. Find the 17th term of the sequence whose n^{th} term is $a_n = 4n - 3$.
7. Find the slope of the line joining the points $(3, -2)$ and $(-1, 4)$.
8. Evaluate $\lim_{x \to 0} \frac{ax+b}{cx+1}$
9. Write the negation of the statement '$\sqrt{2}$ is not a complex number'.
10. A coin is tossed and a die is thrown. Write the sample space.

PART - B

II. Answer any Ten questions. $10 \times 2 = 20$

11. If $A = \{3, 5, 7, 9, 11\}$, $B = \{7, 9, 11, 13\}$, $C = \{11, 13, 15\}$ find $A \cap (B \cup C)$.
12. If S and T are two sets such that S has 21 elements, T has 32 elements and $S \cap T$ has 11 elements. How many elements does $S \cup T$ have ?
13. Let $A = \{1, 2\}$, $B = \{3, 4\}$. Write $A \times B$. How many subsets will $A \times B$ have ?
14. Find the value of sin 75°.
15. Find the general solution of $2 \sin x + \sqrt{3} = 0$.
16. Express $\frac{(3+i\sqrt{5})(3-i\sqrt{5})}{(\sqrt{3}+i\sqrt{2})-(\sqrt{3}-i\sqrt{2})}$ in the form $a + ib$.
17. Solve $7x + 3 < 5x + 9$ and show the graph of the solution on the number line.
18. Derive the equation of the straight line passing through the point (x_1, y_1) and having the slope 'm'.
19. Reduce the equation $3x + 2y - 12 = 0$ into intercept form and find its intercepts on the axes.
20. Show that the points $A(-2, 3, 5)$, $B(1, 2, 3)$ and $C(7, 0, -1)$ are collinear.
21. Evaluate $\lim_{x \to 1} \frac{x^{15}-1}{x^{10}-1}$
22. Write the converse and contrapositive of 'If a number is divisible by 9 then it is divisible by 3'.
23. An analysis of monthly wages paid to workers in two firms A and B belonging to the same industry gives the following results.

	Firm A	Firm B
No. of wages earners	586	648
Mean of monthly wages	Rs. 5253	Rs. 5253
Variance of distribution of wages	100	100

(i) Which firm A or B pays larger amount as monthly wages ?
(ii) Which firm A or B shows greater variability in individual wages ?

24. If A and B are events such that $P(A) = 0.42$, $P(B) = 0.48$ and $P(A \cap B) = 0.16$. Determine
(i) P (not A) (ii) P (A or B)

PART - C

III. Answer any Ten questions. **10 × 3 = 30**

25. In a survey of 600 students in a school, 150 students were found to be taking tea, 225 taking coffee and 100 were taking both tea and coffee.
How many students were taking neither tea for coffee.

26. Let $A = \{1, 2, 3, 4, 6\}$. Let R be the relation on A defined by $R = \{(a, b) : a, b \in A, b$ is exactly divisible by $a\}$.
(i) Write R in roster form.
(ii) Find the domain of R.
(iii) Find the range of R.

27. Prove that $\cos 3x = 4 \cos^3 x - 3 \cos x$.

28. Represent the complex number $z = \dfrac{1}{1+i}$ in the polar form.

29. Solve $\sqrt{5}x^2 + x + \sqrt{5} = 0$.

30. Find the number of arrangements of the letters of the word INDEPENDENCE. In how many of these arrangements,
(i) do the words start with P.
(ii) do all the vowels always occur together.

31. Find the middle term in the expansion of $\left(\dfrac{x}{3} + 9y\right)^{10}$

32. Insert five number between 8 and 26 such that the resulting sequence is an $A.P.$

33. Find the sum of the sequence 7, 77, 777, ..., to n terms.

34. Find the equation of the parabola which is symmetric about y-axis and passes through the point (2 – 3).

35. Find the derivative of tan x w.r.t. x from first principle.

36. Verify by the method of contradiction that " $\sqrt{7}$ is irrational."

37. A bag contains 9 discs of which 4 are red, 3 are blue and 2 are yellow. The discs are similar in shape and size. A disc is drawn at random from the bag. Calculate the probability that it will be :
(i) red (ii) not blue (iii) either red or blue.

38. A die is thrown. Find the probability of the following events.
(i) A prime number will appear.
(ii) A number greater than or equal to 3 will appear.
(iii) A number less than 6 will appear.

PART - D

IV. Answer any six questions. **6 × 5 = 30**

39. Define modulus function. Draw the graph of modulus function. Write down its domain and range.

40. Prove that $\dfrac{(\sin 7x + \sin 5x) + (\sin 9x + \sin 3x)}{(\cos 7x + \cos 5x) + (\cos 9x + \cos 3x)} = \tan 6x$.

41. Prove by using the principle of mathematical induction that $1^2 + 2^2 + 3^2 + \ldots.. n^2 = \dfrac{n(n+1)(2n+1)}{6}$ $\forall\ n \in N$

42. Solve the following system of inequalities graphically $x + 2y \le 8$, $2x + y \le 8$, $x \ge 0$, $y \ge 0$.

43. What is the number of ways of choosing 4 cards from a pack of 52 playing cards ? In how many of these :
(i) four cards are of same suit.
(ii) four face cards.

(iii) two are red cards and two are black cards.
(iv) four cards are of same colour.

44. State and prove Binomial theorem for any positive integer 'n'.
45. Derive the formula to find the distance of the point (x_1, y_1) from the line $Ax + By + C = 0$.
46. Find the coordinates of the point $R(x, y, z)$ dividing the line segment joining the points $P(x_1, y_1, z_2)$ and $Q((x_1, y_2, z_2)$ internally in the ratio $m : n$.
47. Prove geometrically that $\lim\limits_{x \to 0} \dfrac{\sin x}{x} = 1$ where x is measured in radian. Hence evaluate $\lim\limits_{x \to 0} \dfrac{\tan x}{x}$.
48. Find the mean deviation about median for the following data.

Class	0 – 10	10 – 20	20 – 30	30 – 40	40 – 50	50 – 60
Prequence	6	7	15	16	4	2

PART - E

V. Answer any One questions. **1 × 10 = 10**

49. (a) Prove geometrically that $\cos(x + y) = \cos x \cos y - \sin x \sin y$ and hence prove that $\left(\dfrac{\pi}{2} + x\right) = -\sin x$. **6**
(b) Find the sum to n terms of the series $1 \times 2 \times 3 + 2 \times 3 \times 4 + 3 \times 4 \times 5 + ...$ **4**

50. (a) Define hyperbola. Derive its equation in the form $\dfrac{x^2}{a^2} - \dfrac{y^2}{b^2} = 1$ **6**
(b) Find the derivative of $f(x) = \dfrac{x + \cos x}{\tan x}$ w.r.t. x. **4**

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SOLUTIONS
As Per Scheme of Valuation
(Issued by Department of PUE, Karnataka)

PART - A

1. The collection of all subsets of a set A is called the power set of A. **1**

2. $x = 2, y = 3$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$(x + 1, y - 2) = (3, 1)$$

Equivalence their coordinates

$$x + 1 = 3$$
$$x = 3 - 1$$
$$\boxed{x = 2}$$
$$y - 2 = 1$$
$$y = 1 + 2$$
$$\boxed{y = 3}$$
$$x = 2 \text{ and } y = 3$$ **1**

3. $240° = 4\pi/3$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$240 = 240° \times \frac{\pi}{180°} \text{ radian}$$
$$= \frac{4\pi}{3} \text{ radian}$$ **1**

4. $\frac{2}{13}+\frac{3}{13}i$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

Multiplicative inverse of $2-3i$ is $\frac{1}{2-3i}$

$$= \frac{1}{2-3i}\times\frac{2+3i}{2+3i}$$

$$= \frac{2+3i}{(2)^2-(3i)^2}$$

$$= \frac{2+3i}{13}$$

$$= \frac{2}{13}+\frac{3}{13}i$$ **1**

5. 66 **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$\frac{12!}{10!\,2!} = \frac{12\times 11\times 10!}{10!\,2!}$$

$$= \frac{12\times 11}{2\times 1}$$

$$= 6\times 11$$

$$= 66$$ **1**

6. $a_{17} = 65$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$a_n = 4n-3,\ a_{17} = ?$$

$$a_n = 4n-3$$

On putting $n = 17$

$$a_{17} = 4(17)-3$$

$$= 68-3$$

$$= 65$$ **1**

7. Slope = – 3/2 **(Scheme of Valuation, 2018) 1**

Detailed Answer :

Let, $(x_1, y_1) = (3, -2)$

$(x_2, y_2) = (-1, 4)$

Slope (m) of line which is passing through two given points (x_1, y_1) and (x_2, y_2)

$$m = \frac{y_2-y_1}{x_2-x_1}$$

$$m = \frac{4-(-2)}{-1-3}$$

$$m = \frac{6}{-4}$$

$$\boxed{m = \frac{-3}{2}}$$

$\therefore$ Required Slope is $\frac{-3}{2}$ **1**

8. b **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$= \lim_{x\to 0}\frac{ax+b}{cx+1}$$

$$= \frac{a(0)+b}{c(0)+1}$$

$$= b \qquad \mathbf{1}$$

9. $\sqrt{2}$ is a complex number **1**

10. S = {$H1, H2, H3, H4, H5, H6, T1, T2\ T3, T4, T5, T6$} **1**

PART - B

11.
$$B \cup C = \{7, 9, 11, 13, 15\}$$
$$A \cap (B \cup C) = \{7, 9, 11\}$$
(Scheme of Valuation, 2018) 2

Detailed Answer :

$$A = \{3, 5, 7, 9, 11\}$$
$$B = \{7, 9, 11, 13\}$$
$$C = \{11, 13, 15\}$$
$$B \cup C = \{7, 9, 11, 13\} \cup \{11, 13, 15\}$$
$$= \{7, 9, 11, 13, 15\} \qquad \mathbf{2}$$
$$A \cap (B \cup C) = \{3, 5, 7, 9, 11\} \cap \{7, 9, 11, 13, 15\}$$
$$= \{7, 9, 11\}$$

12. $n(S \cup T) = n(S) + n(T) - n(S \cap T)$ **1**

or $n(S) = 21 \quad n(T) = 32 \quad n(S \cap T) = 11$

Getting $n(S \cup T) = 21 + 32 - 11 = 42$ **1**

13. $A \times B = \{(1, 3), (1, 4), (2, 3), (2, 4)\}$ **1**

No. of subsets of $A \times B = 2^4 = 16$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$A = \{1, 2\}, B = \{3, 4\}$$
$$A \times B = \{(1, 3), (1, 4), (2, 3), (2, 4)\} \qquad \mathbf{1}$$
$$\text{Number of subsets} = 2^4$$
$$= 16 \qquad \mathbf{1}$$

14.
$$\sin 75° = \sin (45° + 30°)$$
$$= \sin 45° \cos 30° + \cos 45° \sin 30° \qquad \mathbf{1}$$
Getting $\sin 75° = \dfrac{\sqrt{3}+1}{2\sqrt{2}}$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$\sin 75° = \sin (45° + 30°)$$
$$\therefore \quad \sin (A + B) = \sin A \cos B + \cos A \sin B$$
$$= \sin 45° \cos 30° + \cos 45° \sin 30° \qquad \mathbf{1}$$
$$= \frac{1}{\sqrt{2}} \times \frac{\sqrt{3}}{2} + \frac{1}{\sqrt{2}} \times \frac{1}{2}$$
$$= \frac{\sqrt{3}+1}{2\sqrt{2}} \qquad \mathbf{1}$$

15. Writing $\sin x = -\sqrt{3}/2$ **1**

Getting $x = n\pi + (-1)^n\, 4\pi/3$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$2 \sin x + \sqrt{3} = 0$$
$$\sin x = \frac{-\sqrt{3}}{2} \qquad \mathbf{1}$$

$$\sin x = \sin\frac{4\pi}{3}$$

$$\boxed{x = n\pi + (-1)^n \frac{4\pi}{3}}$$ **1**

16. Getting $7/\sqrt{2}i$ **1**

Getting $-7\sqrt{2}i/2$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$= \frac{(3+i\sqrt{5})(3-i\sqrt{5})}{(\sqrt{3}+i\sqrt{2})-(\sqrt{3}-i\sqrt{2})}$$ **[using $x^2 - y^2 = (x+y)(x-y)$]**

$$= \frac{9-5i^2}{2\sqrt{2}\,i}$$ $[i^2 = -1]$

$$= \frac{9+5}{2\sqrt{2}\,i}$$

$$= \frac{7}{\sqrt{2}\,i}$$ **1**

$$= \frac{7}{\sqrt{2}\,i} \times \frac{\sqrt{2}\,i}{\sqrt{2}\,i}$$

$$= \frac{-7\sqrt{2}\,i}{2} = -\frac{7\sqrt{2}i}{2}$$ **1**

17. Getting $x < 3$ **1**

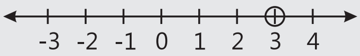


Fig. **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$7x + 3 < 5x + 9$$

or $7x + 3 - 3 < 5x + 9 - 3$

or $7x < 5x + 6$

or $7x - 5x < 5x + 6 - 5x$

or $2x < 6$

or $\frac{2x}{2} < \frac{6}{2}$

or $x < 3$ **1**

$x \in (-\infty, 3)$

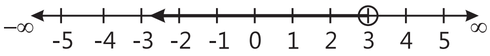
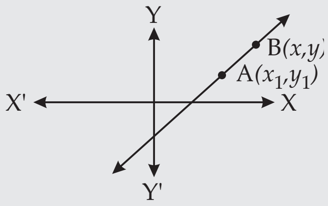


Fig. **1**

18.



1

Fig.

Getting the equation the line $y - y_1 = m(x - x_1)$. **(Scheme of Valuation, 2018) 1**

Detailed Answer :

Let $A(x_1, y_1)$ & $B(x, y)$ be the two points

slope of line AB $\quad m = \dfrac{y - y_1}{x - x_1}$

$$\boxed{y - y_1 = m(x - x_1)}$$ **1**

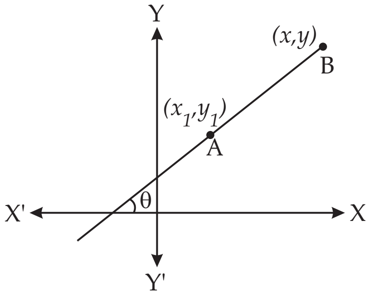


Fig. **1**

19. Writing $\dfrac{x}{4} + \dfrac{y}{6} = 1$ **1**

x-intercept = 4, $\quad y$-intercept = 6 **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$3x + 2y - 12 = 0$$
$$3x + 2y = 12$$

Converting into intercept form

$$\frac{3x}{12} + \frac{2y}{12} = 1$$

$$\boxed{\frac{x}{4} + \frac{y}{6} = 1}$$ **1**

Where x intercept is 4 and y intercept is 6 **1**

20. $AB = \sqrt{14}$, $BC = 2\sqrt{14}$, $AC = 3\sqrt{14}$ **1**

(1 mark for any two correct distances)

Showing $AB + BC = AC$ and conclusion **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$A(x_1, y_1, z_1) = (-2, 3, 5)$$
$$B(x_2, y_2, z_2) = (1, 2, 3)$$
$$C(x_3, y_3, z_3) = (7, 0, -1)$$

Distance between A and B

$$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2 + (z_2 - z_1)^2}$$
$$AB = \sqrt{(1+2)^2 + (2-3)^2 + (3-5)^2}$$
$$AB = \sqrt{9 + 1 + 4}$$
$$AB = \sqrt{14}$$

Now, distance between B and C

$$BC = \sqrt{(x_3 - x_2)^2 + (y_3 - y_2)^2 + (z_3 - z_2)^2}$$
$$BC = \sqrt{(7-1)^2 + (0-2)^2 + (-1-3)^2}$$
$$BC = \sqrt{(6)^2 + (-2)^2 + (-4)^2}$$
$$BC = \sqrt{36 + 4 + 16}$$

$$BC = \sqrt{56}$$
$$BC = 2\sqrt{14}$$

Distance between A and C

$$AC = \sqrt{(x_3 - x_1)^2 + (y_3 - y_1)^2 + (z_3 - z_1)^2}$$
$$= \sqrt{(7+2)^2 + (0-3)^2 + (-1-5)^2}$$
$$= \sqrt{(9)^2 + (-3)^2 + (-6)^2}$$
$$= \sqrt{81 + 9 + 36}$$
$$= \sqrt{126}$$
$$AC = 3\sqrt{14} \quad \mathbf{1}$$

Here $\qquad AB + BC = AC$

Hence, given points A (–2, 3, 5), B(1, 2, 3) and C (7, 0, – 1) are collinear. **1**

$\longleftarrow 3\sqrt{14} \longrightarrow$

A $\leftarrow \sqrt{14} \rightarrow$ B $\leftarrow 2\sqrt{14} \rightarrow$ C

21. $\lim\limits_{x \to 1} \dfrac{x^{15} - 1}{x - 1} \div \dfrac{x^{10} - 1}{x - 1}$ **1**

Getting Ans. = 3/2 **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$\lim_{x \to 1} \frac{x^{15} - 1}{x^{10} - 1} = \lim_{x \to 1} \frac{x^{15} - (1)^{15}}{(x)^{10} - (1)^{10}} = \lim_{x \to 1} \frac{\dfrac{x^{15} - (1)^{15}}{x - 1}}{\dfrac{x^{10} - (1)^{10}}{x - 1}} \quad \mathbf{1}$$

Using $\lim\limits_{x \to a} \dfrac{x^n - a^n}{x - a} = na^{n-1}$

$$= \frac{15(1)^{15-1}}{10(1)^{10-1}}$$
$$= \frac{15}{10}$$
$$= \frac{3}{2} \quad \mathbf{1}$$

22. **Converse :** If a number is divisible by 3 then it is divisible by 9 **1**

Contrapositive : If a number is not divisible by 3 then it is not divisible by 9 **(Scheme of Valuation, 2018) 1**

Detailed Answer :

Do copy from Marking Scheme.

23. Showing Firm B pays larger amount of monthly wages. **1**

Proving Firm B shows greater variability. **(Scheme of Valuation, 2018) 1**

Detailed Answer :

(i) Number of wage earners in firm A = 586

Mean of Monthly wages of firm $A(\bar{x}_1)$ = 5253

Total Amount paid by firm A = 586 × 5253 = 3078258

Number of wage earners is firm B = 648

Mean of Monthly wages of firm $B(\bar{x}_2) = 5253$

Total Amount paid by firm $B = 648 \times 5253 = 3403944$

$\therefore$ Firm B pays the larger amount as monthly wages as compare to firm A. **1**

(ii) Variance of the distribution of wages in firm A is $\sigma_1{}^2 = 100$

$\therefore$ Standard deviation of the distribution of wages is n firm $A(\sigma_1) = \sqrt{100} = 10$

$$C.V. = \frac{\sigma_1}{\bar{x}_2} \times 100 = \frac{10}{5253} \times 100 = 0.1903$$

Variance of the distribution to wages in firm $B(\sigma_2)^2 = 121$

$\therefore$ Standard deviation of the distribution of wages in firm $B(\sigma_2) = \sqrt{121} = 11$

$$\begin{aligned} C.V. &= \frac{\sigma_2}{\bar{x}_2} \times 100 \\ &= \frac{11}{5253} \times 100 \\ &= 0.2094 \end{aligned}$$

Hence, firm B shows greater variability is individual wages. **1**

24. $P(\text{not } A) = 0.58$ **1**

$P(A \text{ or } B) = 0.74$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$\begin{aligned} P(A) &= 0.42 \\ P(B) &= 0.48 \\ P(A \cap B) &= 0.16 \\ P(\bar{A}) &= \, ? \\ P(A \cup B) &= \, ? \end{aligned}$$

(i)
$$\begin{aligned} P(\bar{A}) &= 1 - P(A) \\ &= 1 - 0.42 \\ &= 0.58 \end{aligned}$$ **1**

(ii)
$$\begin{aligned} P(A \cup B) &= P(A) + P(B) - P(A \cap B) \\ &= 0.42 + 0.48 - 0.16 \\ &= 0.74 \end{aligned}$$ **1**

PART - C

25. Writing $n(T \cup C) = n(T) + n(C) - n(T \cap C)$

or $n(U) = 600, n(T) = 150, n(C) = 225, n(T \cap C) = 100$ **1**

Getting $n(T \cup C) = 275$ **1**

Getting $n(T' \cap C') = 325$ **1**

(Scheme of Valuation, 2018)

Detailed Answer :

$$\begin{aligned} n(U) &= 600 \\ n(T) &= 150 \\ n(C) &= 225 \\ n(T \cap C) &= 100 \\ n(T \cup C) &= n(T) + n(C) - n(T \cap C) \\ &= 150 + 225 - 100 \\ &= 275 \\ n(\bar{T} \cap \bar{C}) &= n(u) - n(T \cup C) \\ &= 600 - 275 \\ &= 325 \end{aligned}$$

26. $R = \{(1, 1) (1, 2), (1, 3), (1, 4), (1, 5), (1, 6), (2, 2), (2, 4), (2, 6), (3, 3) (3, 6), (4, 4), (6, 6)\}$ **1**

Domain of $R = \{1, 2, 3, 4, 6\}$ **1**

Range of $R = \{1, 2, 3, 4, 6\}$ **1**

27. $\cos 3x = \cos (2x + x) = \cos 2x \cos x - \sin 2x \sin x$ **1**

$= (2 \cos^2 x - 1) \cos x - 2 \sin x \cos x \sin x$ **1**

$= 4 \cos^3 x - 3 \cos x$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

To prove $\cos 3x = 4 \cos^3 x - 3 \cos x$

L.H.S. $\cos 3x = \cos (2x + x)$ **1**

Using $[\cos (A + B) = \cos A \cos B - \sin A \sin B]$

$= \cos 2x \cos x - \sin 2x \sin x$

$= \cos 2x \cos x - 2 \sin x \cos x \sin x$

$= \cos x [\cos 2x - 2 \sin^2 x]$

$= \cos x [2 \cos^2 x - 1 - 2 (1 - \cos^2 x)]$ **1**

$= \cos x [2 \cos^2 x - 1 - 2 + 2 \cos^2 x]$

$= \cos x [4 \cos^2 x - 3]$

$= 4 \cos^3 x - 3 \cos x$ **1**

$=$ R.H.S.

28. $z = \frac{1}{1+i} \times \frac{1-i}{1-i} = \frac{1}{2} - \frac{i}{2}$ **1**

Getting modulus $= 1/\sqrt{2}$ argument $= -\pi/4$ **1**

Polar form $1/\sqrt{2}$ $[\cos (-\pi/4) + \sin (-\pi/4)]$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$z = \frac{1}{1+i}$$

$$z = \frac{1}{1+i} \times \frac{1-i}{1-i}$$

$$= \frac{1}{2} - \frac{1}{2}i \quad \textbf{1}$$

$$z = a + ib$$

$$a = \frac{1}{2}, b = \frac{-1}{2}$$

$$r = \sqrt{a^2 + b^2}$$

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

$$r = \frac{1}{\sqrt{2}}$$

$$\tan \theta = \frac{b}{a}$$

$$= \frac{-\frac{1}{2}}{\frac{1}{2}}$$

$$\tan \theta = -1$$

$$\theta = \frac{-\pi}{4} \qquad 1$$

$$\text{Polar form} = r(\cos\theta + \sin\theta)$$

$$= \frac{1}{12}\left[\cos\left(\frac{-\pi}{4}\right) + i\sin\left(\frac{-\pi}{4}\right)\right] \qquad 1$$

29. Getting Discriminant $= b^2 - 4ac = -19$ ($\because a = \sqrt{5}, b = 1, c = \sqrt{5}$) **1**

Getting $x = \dfrac{-1 \pm \sqrt{-19}}{2\sqrt{5}}$ $\left(\text{using formula} : x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}\right)$ **1**

Solution are $x = \dfrac{-1 \pm \sqrt{-19}}{2\sqrt{5}} = \dfrac{-1 \pm i\sqrt{19}}{2\sqrt{5}}$ **1**

30. Total no. of arrangements $= \dfrac{12!}{3!4!2!} = 1663200$ **1**

No. of arrangement start with $P = \dfrac{11!}{3!2!4!} = 138600$ **1**

No. of arrangement in which all the vowels occur together $= \dfrac{8!}{3!2!} \times \dfrac{5}{4} = 16800$

(Scheme of Valuation, 2018) 1

Detailed Answer :

There are 12 letters, of which N appears 3 times, E appears 4 times and D appears 2 times and the rest are all different. **1**

Therefore,

The required arrangements $= \dfrac{12!}{3!\ 4!\ 2!} = 1663200$

(i) Let us fix P at the extreme left position, we, then, count the arrangements of remaining 11 letters. Therefore, the required number of words starting with P are $= \dfrac{11!}{3!\ 2!\ 4!} = 138600$ **1**

(ii) There are 5 vowels in the given word, which are 4 Es and 1I. Since, they have to always occur together, we treat them as a single object $\boxed{EEEEI}$ for the time being. This single object together with 7 remaining objects will account for 8 objects. There 8 objects, in which there are 3 Ns and 2 Ds, can be rearranged in $\dfrac{8!}{3!\ 2!}$ ways. Corresponding to each of there arrangements, the 5 vowels E, E, E and I can be arranged in $\dfrac{5!}{4!}$ ways. Therefore, by multiplication principle the required number of arrangements $= \dfrac{8!}{3!\ 2!} \times \dfrac{5!}{4!} = 16800$. **1**

31. Writing 6^{th} term is the middle term and $T_{r+1} = {}^nC_r\, a^{n-r}\, b^r$ **1**

Getting $T_6 = {}^{10}C_5 \left(\dfrac{x}{3}\right)^5 (9y)^5$ **1**

$T_6 = 61236\, x^5 y^5$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

Middle term in the expression at $\left(\dfrac{x}{3} + 9y\right)^{10}$

$$\text{Middle Term} = \left(\frac{n+2}{2}\right)^{th} \text{term}$$

$$= \left(\frac{10+2}{2}\right)^{th} \text{term}$$

$$= 6^{th} \text{ term} \qquad 1$$

To find Middle term we have to find 6^{th} term

By using formula $T_{r+1} = {}^nC_r\, x^{n-r}\, a^r$ **1**

$$T_6 = T_{5+1}$$

$$T_{5+1} = {}^{10}C_5\left(\frac{x}{3}\right)^{10-5}(9y)^5$$

$$= \frac{\lfloor 10}{\lfloor 5\,\lfloor 5}\,\frac{x^5}{243}\times 81\times 81\times 9y^5$$

$$= \frac{10\times 9\times 8\times 7\times 6}{5\times 4\times 3\times 2\times 1}\times 81\times 3x^5y^5$$

$$\boxed{\text{Middle term} = 61236\ x^5y^5}$$ 1

32. Let a_1, a_2, a_3, a_4, a_5, be the 5 number between 8 and 26 so that
$8, a_1, a_2, a_3, a_4, a_5, 26$ are in $A.\ P.$ 1
Getting $d = 3$ 1
Getting $a_1 = 11, a_2 = 14, a_3 = 17, a_4 = 20, a_5 = 23$ **(Scheme of Valuation, 2018)** 1

Detailed Answer :
Let fives numbers between 8 and 26 are A_1, A_2, A_3, A_4 and A_5. 1
$8, A_1, A_2, A_3, A_4, A_5, 26$ ..... are in A_8

$$a = 8, l = 26, n = 5 + 2 = 7$$

Since,

$$l = a + (n-1)d$$

$$26 = 8 + (7-1)d$$

$$\boxed{d = 3}$$ 1

$$A_1 = T_2 = a + (2-1)d = a + d = 8 + 3 = 11$$
$$A_2 = T_3 = a + (3-1)d = a + 2d = 8 + 2(3) = 14$$
$$A_3 = T_4 = a + (4-1)d = a + 3d = 8 + 3(3) = 17$$
$$A_4 = T_5 = a + (5-1)d = a + 4d = 8 + 4(3) = 20$$
$$A_5 = T_6 = a + (6-1)d = a + 5d = 8 + 5(3) = 23$$ 1

11, 14, 17, 20, 23 are the required number.

33.

$$S_n = 7 + 77 + 777 + \dots + \text{to } n \text{ terms}$$

$$\frac{9S_n}{7} = 9 + 99 + 999 + \dots + \text{to } n \text{ terms}$$ 1

$$\frac{9S_n}{7} = (10 + 100 + 1000 + \dots \text{to } n \text{ terms}) - (1 + 1 + 1 + \dots \text{to } n \text{ terms})$$ 1

Getting

$$S_n = \frac{7}{9}\left[\frac{10\,(10^4 - 1)}{9} - n\right]$$ 1

34. Equation of the parabola is $x^2 = -4ay$ 1
Getting $a = 1/3$ 1
Writing the equation $3x^2 = -4y$ 1
(Scheme of Valuation, 2018)

Detailed Answer :
Equation of Parabola which is symmetric about y-axis is

$$x^2 = -4ay$$

This parabola is passing through (2, – 3) Therefore, point (2, – 3) will satisfy equation 1

$$x^2 = -4ay$$

On putting $x = 2, y = -3$

$$x^2 = -4ay$$
$$(2)^2 = -4a(-3)$$
$$4 = 4(3a)$$
$$1 = 3a$$
$$\boxed{a = \frac{1}{3}}$$

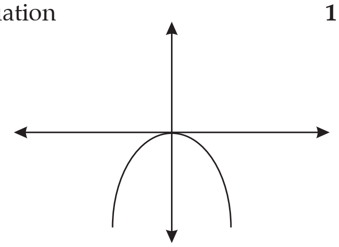


Fig. 1

Put $a = \frac{1}{3}$

$$x^2 = -4\left(\frac{1}{3}\right)y$$

$$3x^2 = -4y$$

$3x^2 = -4y$ is required equation of Parabola **1**

35. $f(x) = \tan x$

$$\frac{d}{dx}[f(x)] = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$$

$$= \lim_{h\to 0}\frac{\tan(x+h)-\tan x}{h}$$ **1**

$$= \lim_{h\to 0}\frac{\sin(x+h)\cos x - \cos(x+h)\sin x}{\cos(x+h)\cos x.h}$$ **1**

$= \sec^2 x$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$f(x) = \tan x \, f'(x) = ?$$

$$f(x+h) = \tan(x+h)$$

$$f'(x) = \lim_{h\to 0}\frac{f(x+h)-f(x)}{h}$$

$$f'(x) = \lim_{h\to 0}\frac{\tan(x+h)-\tan x}{h}$$

$$= \lim_{h\to 0}\frac{\sin(x+h)\cos x - \cos(x+h)\sin x}{h\cos(x+h)\cos x}$$ **1**

{using sin A cos B – cos A sin B = sin (A – B)}

$$= \lim_{h\to 0}\frac{\sin(x+h-x)}{h\cos(x+h)\cos x}$$

$$= \lim_{h\to 0}\frac{\sin h}{h\cos(x+h)\cos x}$$

$$= \lim_{h\to 0}\frac{\sin h}{h}\times\lim_{h\to 0}\frac{1}{\cos(x+h)\cos x}$$

$$= 1\times\frac{1}{\cos(x+0)\cos x}$$

$$= \frac{1}{\cos^2 x}$$ **1**

$$\boxed{f'(x) = \sec^2 x}$$ 1

36. Assuming $\sqrt{7} = \frac{a}{b}$, a and b are positive integers with out common factors **1**

Getting 7 is the common division of both a and b. **(Scheme of Valuation, 2018) 1**

Conclusion **1**

Detailed Answer :

Let $\sqrt{7}$ is rational number is the term of $\frac{p}{q}$.

where , $q \neq 0$ and $p, q \in z$.

These is no common factor of p and q. **1**

$$\sqrt{7} = \frac{p}{q}.$$

On squaring both sides

$$7 = \frac{p^2}{q^2}$$

$$7q^2 = p^2 \quad ...(i)$$

Here p^2 is divisible by 7

$\therefore$ p is also divisible by 7

$$\frac{p}{7} = c \quad \mathbf{1}$$

$$p = 7c$$

On squaring both sides

$$p^2 = 7^2 c^2 \quad ...(ii)$$

On computing eq. (i) and eq. (ii)

$$7q^2 = 49c^2$$

$$7c^2 = q^2$$

Here q^2 is divisible by 7 is also divisible by 7.

In above p and q both use divisible by 7

Hence our assumption is wrong.

$\therefore$ $\sqrt{7}$ is irrational number. **1**

37. Let A, B, C be the events defined as

A : The disc drawn is red

B : The disc drawn is yellow

C : The disc drawn is blue.

Getting $P(A) = 4/9$ **1**

Getting $P(C') = 2/3$ **1**

Getting $P(A \cup C) = 7/9$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

Let A, B, C be the events defined as

A : The disc drawn is red (4)

B : The disc drawn is Blue (3)

C : The disc drawn is yellow (2)

(i) P (Probability of getting red discs) $= \dfrac{\text{No. of Red disc in bag}}{\text{Total no of disc is bag}}$

$$P(A) = \frac{4}{4+3+2}$$

$$P(A) = \frac{4}{9} \quad \mathbf{1}$$

(ii) P (Probability of getting not blue) $= 1 -$ Probability of getting blue disc

$$= 1 - P(B)$$

$$= 1 - \frac{3}{4+3+2}$$

$$= \frac{2}{3} \quad \mathbf{1}$$

(iii) (Probability of either red or blue) $=$ Probability of getting red disc + Probability of getting blue disc

$$= P(A) + P(B)$$

$$= \frac{4}{9} + \frac{3}{9}$$

$$= \frac{7}{9} \quad \mathbf{1}$$

38. $S = \{1, 2, 3, 4, 5, 6\}$

(1) $E_1 = \{2, 3, 5\}, P(E_1) = 1/2$ **1**

(2) $E_2 = \{3, 4, 5, 6\}\ P(E_2) = 2/3$ **1**

(3) $E_3 = \{1, 2, 3, 4, 5\}\ P(E_3) = 5/6$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$S = \{1, 2, 3, 4, 5, 6\}$$

(i) $$\text{Prime numbers} = \{2, 3, 5\}$$

$$P(\text{Prime number}) = \frac{3}{6}$$

$$= \frac{1}{2}$$ **1**

(ii) $$\text{Number} \geq 3 = \{3, 4, 5, 6\}$$

$$\text{P(Number} \geq 3) = \frac{4}{6} = \frac{2}{3}$$ **1**

(iii) $$\text{Number less than } 6 = \{1, 2, 3, 4, 5\}$$

$$\text{P(Number less than} < 6) = \frac{4}{6}$$

$$= \frac{2}{3}$$ **1**

PART - D

39. Define : The function $f : R \to \text{R}$ defined by $f(x) = |\,x\,|$ for each $x \in \text{R}$ is called modulus function :

$$f(x) = \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{if } x < 0 \end{cases}$$ 1

Graph : **2**

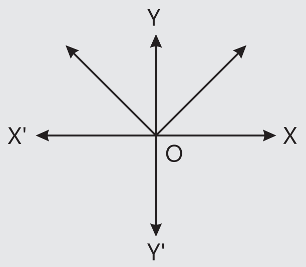


Fig.

$$\text{Domain} = R$$ **1**

$$\text{Range} = R+ \text{ or } [0, \infty)$$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

Do copy from Marking scheme.

40. Applying $\sin C + \sin D$ **1**

Applying $\cos C + \cos D$ **1**

$$\text{L.H.S.} = \frac{2\sin 6x \cos x + 2\sin 6x \cos 3x}{2\cos 6x \cos x + 2\cos 6x \cos 3x}$$ **1**

$$= \frac{2\sin 6x(\cos x + \cos 3x)}{2\cos 6x\,(\cos x + \cos 3x)}$$ **1**

$$= \tan 6x$$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$\text{L.H.S.}\ \frac{(\sin 7x + \sin 5x) + \sin (9x + \sin 3x)}{(\cos 7x + \cos 5x) + (\cos 9x + \cos 3x)}$$

Using $\sin C + \sin D = 2\sin\frac{C+D}{2}\cos\frac{C-D}{2}$ **1**

$\cos C + \cos D = 2\cos\frac{C+D}{2}\cos\frac{C-D}{2}$ **1**

$$= \frac{2\sin\frac{7x+5x}{2}\cos\frac{7x-5x}{2}+2\sin\frac{9x+3x}{2}\cos\frac{9x-3x}{2}}{2\cos\frac{7x+5x}{2}\cos\frac{7x-5x}{2}+2\cos\frac{9x+3x}{2}\cos\frac{9x-3x}{2}}$$ **1**

$$= \frac{2\sin 6x\cos x + 2\sin 6x\cos 3x}{2\cos 6x\cos x + 2\cos 6x\cos 3x}$$ **1**

$$= \frac{\sin 6x}{\cos 6x}$$

$= \tan 6x$ **1**

$=$ R.H.S.

41. Let $p(n) : 1^2 + 2^2 + 3^2 + ... + n^2 = \frac{n(n+1)(2n+1)}{6}$

Verifying $p(1)$ is true **1**

Assuming that $p(m)$ is true **1**

Proving that $p(m+1)$ is true **2**

Conclusion **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$1^2 + 2^2 + 3^2 + ... + n^2 = \frac{n(n+1)(2n+1)}{6}$$

Put $n = 1$

$$(1)^2 = \frac{(1)(1+1)(2+1)}{6}$$

$$1 = \frac{(1)(2)(3)}{6}$$

$1 = 1$ **1**

Hence it is true for $n = 1$

Let it is also true for $n = k$

$$1^2 + 2^2 + 3^2 + ... + k^2 = \frac{k(k+1)(2k+1)}{6}$$ **1**

For $n = k + 1$, adding $(k+1)^2$ on both sides

$$1^2 + 2^2 + 3^2 + ... + k^2 + (k+1)^2 = \frac{k(k+1)(2k+1)}{6} + (k+1)^2$$

$$= (k+1)\left[\frac{k(2k+1)}{6} + \frac{k+1}{1}\right]$$

$$= (k+1)\left[\frac{2k^2+k+6k+6}{6}\right]$$

$$= (k+1)\left[\frac{2k^2+7k+6}{6}\right]$$

$$= \frac{(k+1)(k+2)[2(k+1)+1]}{6}$$ **2**

Hence, by the P. M. I. $p(n)$ is true for $n = k + 1$, when $n = k$ is true. **1**

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42.

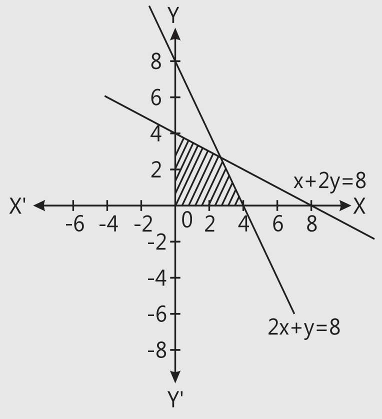


Fig.

Drawing the line $x + 2y = 8$ **1**

Shading the region $x + 2y \leq 8$ **1**

Drawing the line $2x + y = 8$ **1**

Shading region $2x + y \leq 8, x \geq 0, y \geq 0$ **1**

Shading the solution region **(Scheme of Valuation, 2018) 1**

Detailed Answer :

$$x + 2y \leq 8, 2x + y \leq 8, x \geq 0, y \geq 0$$

$$x + 2y \leq 8$$

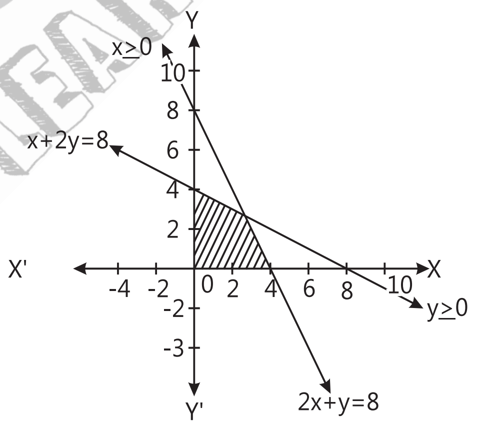
$$x + 2y = 8$$ **1**

x	0	8
y	4	0

$$2x + y \leq 8$$ **1**

$$2x + y = 8$$ **1**

x	0	4
y	8	0



2

Fig.

43. No. of ways of choosing 4 cards = ${}^{52}C_4 = 270725$ **1**

No. of ways of choosing 4 cards of same suit = $4 \times {}^{13}C_4 = 2860$ **1**

No. of ways of choosing 4 face cards = ${}^{12}C_4 = 495$ **1**

No. of ways of choosing 2 red cards and 2 black cards = ${}^{26}C_2 \times {}^{26}C_2 = 105625$ **1**

No. of ways of choosing four cards of same colour = ${}^{26}C_4 + {}^{26}C_4 = 29900$ **1**

Detailed Answer :

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44. Statement :

$$P(n) = (a+b)^n = {}^nC_0\, a^n + {}^nC_1\, a^{n-1}\, b + {}^nC_2\, a^{n-2}\, b^2 + \ldots + {}^nC_n\, b^n \qquad 1$$

Showing $P(1)$ is true and assuming $p(m)$ is true 1

Proving $P(m+1)$ is true 2

Concluding $p(n)$ is true by induction **(Scheme of Valuation, 2018) 1**

Detailed Answer :

Let $P(n)$ be the proposition where :

$$\text{P}(n) = (a+b)^n \sum_{r=0}^{n} {}^nC_r a^{n-r} b^r \qquad \mathbf{1}$$

Show $P(n)$ is true, when $n = 1$.

L.H.S. : $(a+b)^1 = a + b$ **1**

R.H.S. : $\sum_{r=0}^{1} {}^1C_r\, a^{1-r}\, b^r$

$${}^1C_0\, a^1\, b^0 + {}^1C_1\, a^0\, b^1$$

$$a + b = \text{L.H.S.}$$

$\therefore$ $P(n)$ is true, when $n = 1$.

Assume $n = k$

$$P(k) : (a+b)^k = \sum_{r=0}^{k} {}^kC_r\, a^{k-r}\, b^r \qquad \mathbf{1}$$

If $P(k)$ is true, then $P(k+1)$ should also be true.

L.H.S. :
$$= (a+b)^{k+1}$$
$$= (a+b)^k (a+b)$$
$$= \left[\sum_{r=0}^{k} {}^kC_r\, a^{k-r}\, b^r\right](a+b)$$
$$= a\left[\sum_{r=0}^{k} {}^kC_r\, a^{k-r}\, b^r\right] + b\left[\sum_{r=0}^{k} {}^kC_r\, a^{k-r}\, b^r\right]$$
$$= \left[\sum_{r=0}^{k} {}^kC_r\, a^{k-r+1}\, b^r\right] + \left[\sum_{r=0}^{k} {}^kC_r\, a^{k-r}\, b^{r+1}\right]$$
$$= \left[\sum_{r=0}^{k} {}^kC_r\, a^{k-r+1}\, b^r\right] + \left[\sum_{r=1}^{k+1} {}^kC_{r-1}\, a^{k-r+1}\, b^{r+1}\right]$$
$$= \left({}^{k+1}C_0\right)\left(a^{k+1}\right) + \left[\sum_{r=1}^{k} {}^kC_r\, a^{k-r+1}\, b^r\right] + \left[\sum_{r=1}^{k} {}^kC_{r-1}\, a^{k-r+1}\, b^r\right] + \left({}^{k+1}C_{k+1}\right)\left(b^{k+1}\right)$$
$$= a^{k+1} + \left[\sum_{r=1}^{k}\left[\left({}^kC_r a^{k-r+1}\, b^r\right) + \left({}^kC_{r-1}\, a^{k-r+1} b^r\right)\right]\right] + b^{k+1}$$
$$= a^{k+1} + \left[\sum_{r=1}^{k}\left({}^{k+1}C_r\right)\left(a^{k-r+1} b^r\right)\right] + b^{k+1}$$
$$= \left({}^{k+1}C_0\right)\left(a^{k+1}\right) + \left({}^{k+1}C_1\right)\left(a^k\right)\left(b^1\right) + \left({}^{k+1}C_2\right)\left(a^{k-1}\right)\left(b^2\right) + \left({}^{k+1}C_3\right)\left(a^{k+2}\right)\left(b^3\right) + \ldots\ldots$$
$$+ \left({}^{k+1}C_k\right)\left(a^1\right)\left(b^k\right) + \left({}^{k+1}C_{k+1}\right)\left(b^{k+1}\, {}^{k+1}C_r\, a^{k-r+1}\, b^r\right.$$

R.H.S. :
$$= \sum_{r=0}^{(k+1)} {}^{k+1}C_r\, a^{(k+1)^{-r}}\, b^r = \text{L.H.S.}$$

$\because$ $P(k)$ is true and $P(k+1)$ is true.

$\therefore$ $P(n) : (a+b)^n = \sum_{r=0}^{n} {}^nC_r\, a^{n-r} b^r$, is true. **2**

45. Figure $L : Ax + By + C = 0$ **1**

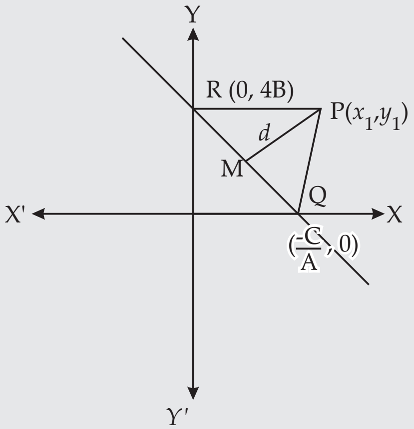


Fig.

Getting $$PM = \frac{2 \text{ area of } \Delta^{le} PQR}{QR}$$ **1**

Getting $$2 \text{ area of } \Delta^{le}\, PQR = \left|\frac{C}{AB}\right| |Ax_1 + By_1 + C|$$ **1**

Getting $$QR = \left|\frac{C}{AB}\right| \left|\sqrt{A^2+B^2}\right|$$ **1**

Getting $$d = \left|\frac{Ax_1 + By_1 + C}{\sqrt{A^2+B^2}}\right|$$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

The distance of a point from a line is the length of the perpendicular drawn from the point to the line. Let $L : Ax + By + c = 0$ be a line, whose distance from the point $P(x_1, y_1)$ is d. Draw perpendicular PM from the point P to the line L (see figure).

If the line meets the x-axis and y-axis at the points Q and R, respectively. Then, coordinates of the points are $Q \left(-\frac{C}{A}, 0\right)$ and $R \left(0, -\frac{C}{B}\right)$. Thus, the area of the triangle PQR is given by

$$\text{area } (\Delta PQR) = \frac{1}{2} PM.\, QR, \text{ which gives } PM = \frac{2 \text{ area}(\Delta PQR)}{QR} \quad ...(i)$$

Also, $$\text{area } (\Delta PQR) = \frac{1}{2}\left|x_1\left(0 + \frac{C}{B}\right) + \left(-\frac{C}{A}\right)\left(-\frac{C}{B} - y_1\right) + 0(y_1 + 0)\right|$$ **1**

$$= \frac{1}{2}\left|x_1 \frac{C}{B} + y_1 \frac{C}{A} + \frac{C^2}{AB}\right|$$ **1**

or $$\text{area } (\Delta PQR) = \left|\frac{C}{AB}\right| . |Ax_1 + By_1 + c|, \text{ and } QR = \sqrt{\left(0 + \frac{C}{A}\right)^2 + \left(\frac{C}{B} - 0\right)^2} = \left|\frac{C}{AB}\right| \sqrt{A^2+B^2}$$

Substituting the values of area (ΔPQR) and QR in (i), we get

$$PM = \frac{|Ax_1 + By_1 + C|}{\sqrt{A^2+B^2}}$$ **1**

or $$d = \frac{|Ax_1 + By_1 + C|}{\sqrt{A^2+B^2}}.$$ **1**

46. Figure

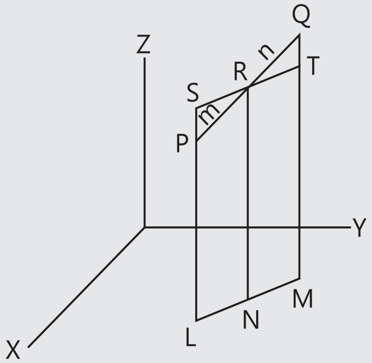


Fig. **1**

Getting $\frac{m}{n} = \frac{PR}{QR} = \frac{SP}{QT}$ **1**

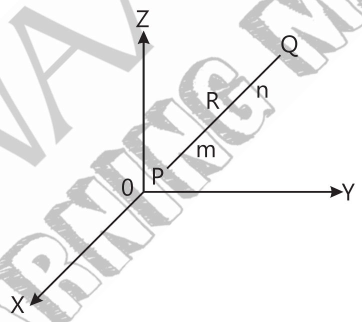
Getting $z = \frac{mz_2 + nz_1}{m+n}$ **2**

Getting the point of division $= \left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}, \frac{mz_2 + nz_1}{m+n}\right)$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

Let us consider two points $P(x_1, y_1, z_1)$ and $Q\ (x_2, y_2, z_2)$. Consider a point $R(x, y, z)$ dividing PQ in the ratio $m : n$ as shown is the figure given below :

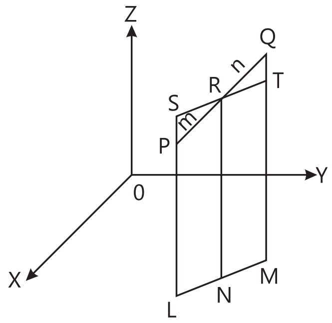
To determine the coordinates of the point R the following steps are followed :



1

Fig.

- Draw PL, RN and QM perpendicular to XY plane such that $PL \mid\mid RN \mid\mid QM$ as shows here. **1**



1

Fig.

- The points L, M & N lie on the straight line formed due to the intersection of a plane containing PL, RN & QM and XY-plane.

- From the point R, a line system ST is drawn such that it is parallel to LM.
- ST intersects PL externally at S and QM at T internally.

Since ST is parallel to LM and $PL \,||\, RN$ therefore, the quadrilaterals $LNRS$ & $NMTR$ qualify as parallelograms.

Also, $\Delta PSR \sim \Delta QTR$ therefore,

$$\frac{m}{n} = \frac{PR}{QR} = \frac{PS}{QT} = \frac{SL-PL}{QM-TM}$$

$$= \frac{NR-PL}{QM-RN} = \frac{z-z_1}{z_2-z}$$

Rearranging the above equation we get, $z = \dfrac{mz_2+nz_1}{m+n}$. **1**

Similarly

The above procedure can be repeated by drawing perpendicular to XZ and YZ-planes to get the x and y coordinates of the points R that divides the line segment PQ in the ratio $m : n$ internally

$$x = \frac{mx_2+nx_1}{m+n},\ y = \frac{my_2+ny_1}{m+n}$$ **1**

47. Figure **1**

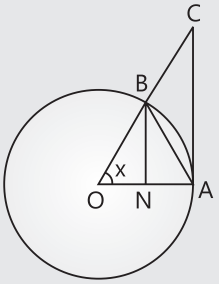


Fig.

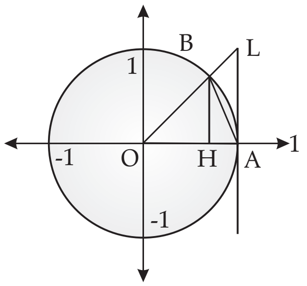
Stating area of Δ^{le} OAB < area of sector OAB < area of Δ^{le} OAC **1**

Getting $\frac{1}{2}\sin x < \frac{1}{2}x < \frac{1}{2}\tan x$ **1**

Getting $\lim\limits_{x\to 0}\dfrac{\sin x}{x} = 1$ **1**

Getting $\lim\limits_{x\to 0}\dfrac{\tan x}{x} = 1$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :



1

Fig.

The geometric idea is that area of $\Delta\, KOA$ < Area of sector KOA < Area of $\Delta\, LOA$ 1

$$\text{Area of } \Delta\, KOA = \frac{1}{2}(1)(\sin x) \qquad \left(\frac{1}{2}\text{ base } \times \text{height}\right)$$

$$\text{Area of sector } KOA = \frac{1}{2}(1)^2 x \qquad (x \text{ is in radians})$$

$$\text{Area of } \Delta\, LOA = \frac{1}{2}\tan x \qquad (AL = \tan x)$$ **1**

So, we have : $\frac{\sin x}{2} < \frac{x}{2} < \frac{\tan x}{2}$

For small positive x, we have $(x > 0)$. So we can multiply through by $\frac{2}{\sin x}$, to get

$$1 < \frac{x}{\sin x} < \frac{1}{\cos x}$$

So,
$$\cos x < \frac{\sin x}{x} < 1 \qquad \text{for } 0 < x < \frac{\pi}{2}$$

$$\lim_{x \to 0^+} \cos x = 1 \text{ \& So, } \lim_{x \to 0^+} \frac{\sin x}{x} = 1$$ 1

We also have, for these small x,

$$\sin(-x) = -\sin x,$$

So,
$$\frac{-x}{\sin(-x)} = \frac{x}{\sin x}$$

and
$$\cos(-x) = \cos x,$$

So,
$$\cos x < \frac{\sin x}{x} < 1 \quad \text{for } -\frac{\pi}{2} < x < 0$$

$$\lim_{x \to 0^-} \cos x = 1 \text{ and } \lim_{x \to 0^-} 1 = 1$$

So,
$$\lim_{x \to 0} \frac{\sin x}{x} = 1$$ 1

48.

Class	Frequency (f_i)	c.f.	Mid. pt x_i	$\lvert x_i - H \rvert$	$f_i \lvert x_i - H \rvert$
0 – 10	6	6	5	23	138
10 – 20	7	13	15	13	91
20 – 30	15	28	25	3	45
30 – 40	16	44	35	7	112
40 – 50	4	45	45	17	68
50 – 60	2	50	55	27	54
	N = 50				508

(1) (1) (1) **1 + 1 + 1**

Getting Median $(M) = 28$ **1**

Getting Mean deviation about median = 10.16 **(Scheme of Valuation, 2018) 1**

Detailed Answer :

Class	Freq.	C.F.	M.pt	$(x_i - m)$	$f_i(x_i - m)$
0 – 10	6	6	5	23	138
10 – 20	7	13	15	13	91
20 – 30	15	28	25	3	45
30 – 40	16	44	35	7	112
40 – 50	4	48	45	17	68
50 – 60	2	50	55	27	54
Total	50				508

3

$$\text{median} = 28 \text{ using formula : } l + \frac{\frac{N}{2} - c}{f} \times h$$ 1

$$M.D.\,(M) = \frac{\Sigma f_i (x_i - m)}{\Sigma \text{Freq.}}$$ 1

$$= \frac{508}{50} = 10.16$$

PART - E

49. **(a)** Figure and explanation 1

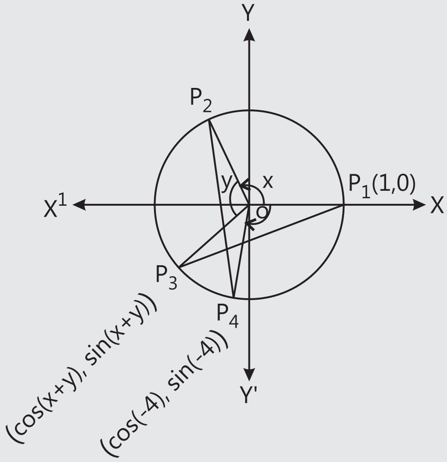


Fig.

Showing $P_1 P_3 = P_2 P_4$ 1

Getting $P_1P_3 = \sqrt{2 - 2\cos(x+y)}$ 1

Getting $P_2P_4 = \sqrt{2 - 2(\cos x \cos y - \sin x \sin y)}$ 1

Getting $\cos(x + y) = \cos x \cos y - \sin x \sin y$ 1

Getting $\cos(\pi/2 + x) = -\sin x$ 1

(b) Writing n^{th} term $a_n = n(n + 1)(n + 2)$ 1

Getting $a_n = n^3 + 3n^2 + 2n$ 1

Getting $S_n = \sum a_n = \frac{n^2(n+1)^2}{4} + \frac{n(n+1).(2n+1)}{2} + n(n+1)$ 1

Getting $S_n = \frac{n(n+1)(n+2)(n+3)}{4}$ **(Scheme of Valuation, 2018)** 1

Detailed Answer :

(a) **cos $(x + y)$ = cos (x). cos (y) – sin (x). sin (y)**

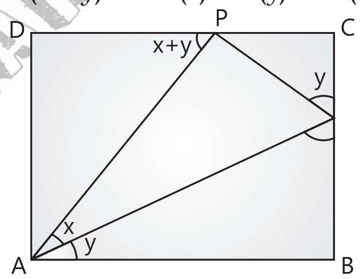


Fig. 1

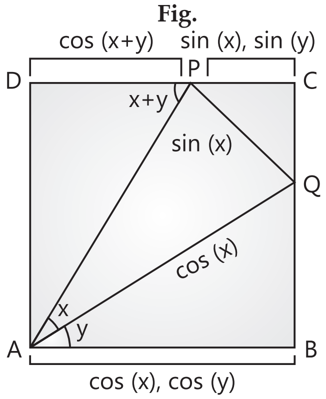


Fig. 1

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A triangle AQP has been constructed along the hypotenuse of triangle ABQ with angle x above angle y as in the diagram.

The line segment AP is identical as the unit length for all measurements in this system.

A rectangle is constructed with base AB by extending the line from B through Q until a point C is reached where PC is parallel to the bottom (AB) completion of the rectangle establishes point D) within triangle AQP is clear that (since $|AP| = 1$)

$$|AQ| = \cos(x) \qquad \mathbf{1}$$

Therefore in triangle ABQ $\quad |PQ| = \sin(x)$ **1**

$|AB| = \cos(y). \cos(x) \cos(y)$ scaled up by the $\cos(x)$.

Similarly in triangle QCP

$$|PC| = \sin(x). \sin(y)$$

Since DC is parallel to AB (by construction angle APD = angle $PAB = x + y$)

and $\quad |DP| = \cos(x + y)$ **1**

From the diagram

$$\cos(x + y) + \sin(x). \sin(y) = \cos(x). \cos(y)$$

or $\quad \cos(x + y) = \cos(x). \cos(y) - \sin(x). \sin(y).$ **1**

(b) $\quad S_n = 1 \times 2 \times 3 + 2 \times 3 \times 4 + 3 \times 4 \times 5 + ... +$ upto x terms.

$$T_n = \{1 + (n-1)\,1\} \times \{2 + (n-1)\,1\} \times \{3 + (n-1)\} \qquad \mathbf{1}$$

$$T_n = n\,(n+1)(n+2) \qquad \mathbf{1}$$

$$\Sigma T_n = \Sigma n(n+1)\,(n+2)$$

$$\Sigma T_n = \Sigma n(n^2 + 3n + 2) \qquad \mathbf{1}$$

$$\sum_{k=1}^{n} T_k = \sum_{k=1}^{n} (k^3 + 3k^2 + 2k)$$

$$S_n = \left[\frac{n(n+1)}{2}\right]^2 + 3\frac{n(n+1)(2n+1)}{6} + \frac{2n(n+1)}{2}$$

$$= \frac{n^2(n+1)^2}{4} + \frac{n(n+1)(2n+1)}{2} + n(n+1)$$

$$= n(n+1)\left[\frac{n(n+1)}{4} + \frac{2n+1}{2} + 1\right]$$

$$= \frac{n(n+1)(n+2)(n+3)}{4} \qquad \mathbf{1}$$

50. **(a)** Definition : A hyperbola is the set of all points in the plane, the difference of whose distances from two fixed points in the plane is a constant. **1**

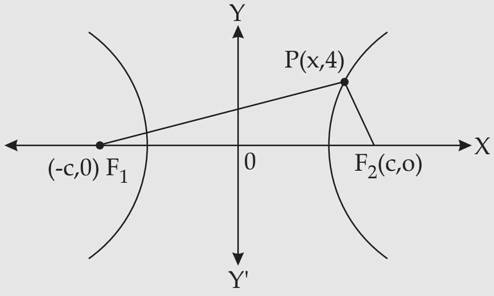

Fig. **1**

Taking $PF_1 - PF_2 = 2a$ **1**

Writing $\sqrt{(x+c)^2 + y^2} - \sqrt{(x-c)^2 + y^2} = 2a$ **1**

For simplification **1**

Getting $\dfrac{x^2}{a^2} - \dfrac{y^2}{b^2} = 1$ **1**

(b) Applying quotient rule **1**

Knowing the derivatives of x, $\cos x$, $\tan x$ **2**

(any one correct derivative – 1 mark)

Getting $\dfrac{dy}{dx} = \dfrac{\tan x(1-\sin x)-(x+\cos x)\sec^2 x}{\tan^2 x}$ **(Scheme of Valuation, 2018) 1**

Detailed Answer :

(a) Hyperbola : A hyperbola is the set of all points in a plane, the difference of whose distance from two fixed **points in the plane is a constant :** **1**

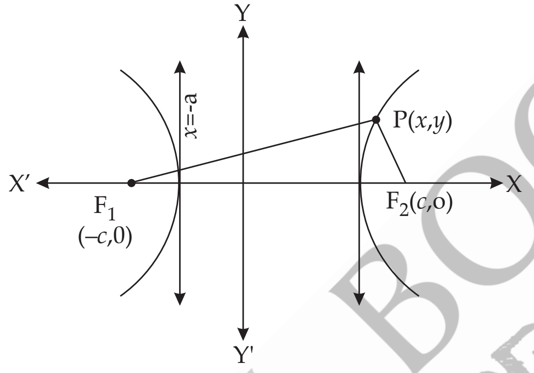

Fig.

$$PF - PF_2 = 2a$$ **1**

Using distance formula, we have

$$PF_1 = \sqrt{\{x-(-c)\}^2+(y-0)^2}$$

$$PF_1 = \sqrt{(x+c)^2+y^2}$$

$$PF_2 = \sqrt{(x-c)^2+(y-0)^2}$$

$$PF_2 = \sqrt{(x-c)^2+y^2}$$

$$PF_1 - PF_2 = 2a$$ **1**

$$\sqrt{(x+c)^2+y^2} - \sqrt{(x-c)^2+y^2} = 2a$$ **1**

$$\sqrt{(x+c)^2+y^2} = 2a+\sqrt{(x-c)^2+y^2}$$

On squaring both sides

$$\left(\sqrt{(x+c)^2+y^2}\right)^2 = (2a+\sqrt{(x-c)^2+y^2})^2$$

$$(x+c)^2+y^2 = 4a^2+(x-c)^2+y^2+4a\sqrt{(x-c)^2+y^2}$$

$$x^2+c^2+2xc+y^2 = 4a^2+x^2+c^2-2xc+y^2+4a\sqrt{(x-c)^2+y^2}$$

$$2xc+2xc-4a^2 = 4a\sqrt{(x-c)^2+y^2}$$

$$4xc-4a^2 = 4a\sqrt{(x-c)^2+y^2}$$

$$xc-a^2 = a\sqrt{(x-c)^2+y^2}$$

Again squaring both sides :

$$(xc-a^2)^2 = a^2[(x-c)^2+y^2]$$

$$x^2c^2+a^4-2xca^2 = a^2[x^2+c^2-2xc+y^2]$$

$$x^2c^2+a^4-2xca^2 = a^2x^2+a^2c^2-2xca^2+a^2y^2$$

$$x^2(c^2-a^2)-a^2y^2 = a^2c^2-a^4$$

$$x^2(c^2-a^2)-a^2y^2 = a^2(c^2-a^2)$$ **1**

$$\frac{x^2}{a^2} - \frac{y}{c^2 - a^2} = 1 \qquad [c^2 = a^2 + b^2, b^2 = c^2 - a^2]$$

$$\boxed{\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1}$$

Hence Proved.

(b) $$f(x) = \frac{x + \cos x}{\tan x}$$

Differentiate w.r.t. to x

$$f'(x) = \frac{\tan x \frac{d}{dx}(x + \cos x) - (x + \cos x)\frac{d}{dx} \tan x}{\tan^2 x}$$ **1**

$$f'(x) = \frac{\tan x\,(1 - \sin x) - (x + \cos x)\sec^2 x}{\tan^2 x}$$ **2**

$$f'(x) = \frac{\tan x - \sin x.\tan x - x\sec^2 x - \cos x \sec^2 x}{\tan^2 x}$$

$$f'(x) = \frac{\tan x - \sin x \tan x - x\sec^2 x - \sec x}{\tan^2 x}$$ **1**

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