Acing UTME Maths

A Comprehensive Guide with Past Questions and Solutions

By

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Dedication and Acknowledgements

This work is dedicated to our families, whose unwavering support has been our greatest strength throughout this journey. Their constant encouragement and belief in our abilities have fueled our passion and perseverance in creating this resource.

We would also like to express our sincere gratitude to the following individuals and institutions for their invaluable contributions:

- Our mentors and teachers, who instilled in us a love for mathematics and equipped us with the knowledge and skills needed to succeed.
- The examiners and administrators of the UTME, whose dedication to educational standards ensures a fair and effective assessment process.
- Our colleagues and friends, who provided feedback and support throughout the development of this book.
- The wider academic community, whose research and publications have laid the foundation for our understanding of mathematics.

We are truly grateful for the collective effort that has made this book possible. We hope that it will be a valuable resource for students preparing for the UTME and beyond.

How We Wrote This Book

This book was written using the LaTeX document processing package. Specifically, this book was prepared using the MikTex installation of pdflatex on a PC running Windows 11. We must thank the authors of the various packages we used. The diagrams were prepared using METAPOST, a graphics programming language based on Donald Knuth's METAFONT.

About the Authors

Ayodeji Adesegun: He is a teenager. In his spare time, he enjoys solving mathematical problems from various contests not excluding the Olympiads. You can find more about him here.

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Preface

Welcome to "Ace UTME Mathematics," a comprehensive guide designed to help you conquer the upcoming UTME Mathematics exam. This book provides you with a wealth of past questions, detailed solutions, and insightful strategies to enhance your understanding and preparation.

This book is organized into chapters that follow the official UTME Mathematics syllabus, covering all key topics and subtopics. Each chapter includes a variety of past questions carefully selected to reflect the types and difficulty levels encountered in the actual exam.

In addition to past questions, we have provided detailed solutions that explain the reasoning behind each step and highlight common mistakes to avoid. We encourage you to work through these solutions carefully and utilize them as learning tools to improve your problem-solving skills.

Furthermore, we have incorporated valuable strategies throughout the book, offering tips and techniques to maximize your efficiency and performance on the exam. These strategies will help you manage your time effectively, approach different question types confidently, and overcome any challenges you may encounter.

We are confident that "Ace UTME Mathematics" will be your ultimate companion on your journey to success. By diligently working through the material and utilizing the resources provided, you will gain the knowledge, skills, and confidence needed to achieve your desired score on the UTME Mathematics exam.

Best of luck!

Ayodeji Adesegun and Chimobi Nwafor

Chapter 1

Number and Numeration

1.1 Number Bases

1.1.1 Questions

1. The number 25 when converted from the tens and units base to the binary base (base 2) is one of the following
   A. 10011
   B. 1111011
   C. 111000
   D. 11001
   E. 110011
2. The currency used in a country bought 4 bags of rice at $N56$ per bag and 3 tins of milk at $N4$ per tin. What is the total cost of the items she bought?
   A. $N245$
   B. $N242$
   C. $N236$
   D. $N341$
   E. $N338$
3. Evaluate $212_3 - 121_3 + 222_3$.
   A. 313_3
   B. 1000_3
   C. 1020_3
   D. 1222_3
   E. 1213_3
4. A trader in a country where their currency 'MONT' (M) is in base five bought 103_5 oranges at $M14_5$ each. If he sold the oranges at $M24_5$ each, what would be his gain?
   A. $M103_5$
   B. $M1030_5$
   C. $M102_5$
   D. $M2002_5$
   E. $M3024_5$
5. Find x if $(x_4)^2 = (100100)_2$
   A. 6
   B. 12
   C. 100
   D. 210
   E. 10042
6. Convert 241_5 to base 8.
   A. 71_8
   B. 107_8
   C. 176_8
   D. 241_8
7. In the equation $\dfrac{11_2}{x_2} = \dfrac{1000_2}{x_2 + 101_2}$, solve for x.
   A. 101
   B. 11
   C. 110
   D. 111
   E. 10
8. $4243_5 - 12x4_5 = y344_5$. What is the difference between x and y?
   A. 4
   B. 2
   C. 1
   D. 3
   E. 5

9. In base ten, the number 101101_2 equals?
   A. 15
   B. 45
   C. 23
   D. 12

10. Convert the number 39 to base 2.
   A. 100111
   B. 111001
   C. 110111
   D. 111111
   E. 100101

11. Find n if $34_n = 10110_2$.
   A. 5
   B. 6
   C. 7
   D. 8
   E. 9

12. If $2_9 \times (Y3)_9 = 3_5 \times (Y3)_5$. Find the value of Y.
   A. 4
   B. 3
   C. 2
   D. 1
   E. 5

13. Simplify $213_4 \times 23_4$.
   A. 10321_4
   B. 12231_4
   C. 13221_4
   D. 10311_4
   E. 13021_4

14. $55_x + 52_x = 77_{10}$, find x.
   A. 5
   B. 6
   C. 7
   D. 8
   E. 10

15. If $x_{10} = 23_5$, find x.
   A. 15
   B. 12
   C. 14
   D. 13
   E. 16

16. Find the sum of 25_6, 52_6, 43_6 in base 8.
   A. 411
   B. 141
   C. 114
   D. 417

17. $2A3_3 = 77_8$, find A.
   A. 1
   B. 2
   C. 0
   D. 4

18. Evaluate $(202_3)^2$ - $(112_3)^2$
   A. 21112
   B. 21121
   C. 21011
   D. 21120

19. If 321_4 is divided by 23_4 and leaves a remainder r, what is the value of r ?
   A. 4
   B. 2
   C. 3
   D. 0
   E. 1

20. Convert 521_{10} to a number in base 5
   A. 1404_5
   B. 4041_5
   C. 4140_5
   D. 4014_5
   E. 4104_5

21. If $6R7_8 = 511_9$, find R.
   A. 6
   B. 5
   C. 3
   D. 2
   E. 8

22. Find the value of x if $121_x + 112_x = 30_{10}$.
   A. 5
   B. 7
   C. $-\frac{9}{2}$
   D. 3
   E. 4

23. Evaluate $(1011_2)^2$ - 1012_2.

A. 110000_2

B. 110000_2

C. 101011_2

D. 110110_2

24. Add 1101_2, 11011_2 and 111_2.

A. 110110_2

B. 101011_2

C. 111011_2

D. 101010_2

E. 110011_2

25. Find the value of m if $13_m + 24_m = 41_m$

A. 8

B. 5

C. 4

D. 6

E. 3

26. If $125_x = 20_10$, find x.

A. 2

B. 3

C. 4

D. 6

E. 5

27. If $(K2)_6 \times 3_6 = 3_5(K4)_5$, what is the value of k?

A. 2

B. 1

C. 3

D. 4

E. 5

28. Find P, if $451_6 - P_7 = 305_6$

A. 116_7

B. 62_7

C. 611_7

D. 142_7

29. The sum of four numbers is 1214_5. What is the average expressed in base 5?

A. 141

B. 411

C. 417

D. 114

E. 471

30. $(1P03)_4 = 115_{10}$, find P.

A. 2

B. 0

C. 1

D. 4

E. 3

31. $(P344)_6 - (23P2)_6 = (2PP2)_6$, find the digit P.

A. 1

B. 2

C. 3

D. 4

E. 5

32. $4243_5 - (12X4)_5 = Y344$. What is the difference between X and Y?

A. 1

B. 2

C. 3

D. 4

E. 5

33. A.

B.

C.

D.

34. A.

B.

C.

D.

35. A.

B.

C.

D.

36. A.

B.

C.

D.

37. A.

B.

C.

D.

38. A.

B.

C.

D.

39. A.
B.
C.
D.

40. A.
B.
C.
D.

41. A.
B.
C.
D.

42. A.
B.
C.
D.

43. A.
B.
C.
D.

44. A.
B.
C.
D.

45. A.
B.
C.
D.

46. A.
B.
C.
D.

47. A.
B.
C.
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48. A.
B.
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49. A.
B.
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50. A.
B.
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51. A.
B.
C.
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52. A.
B.
C.
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53. A.
B.
C.
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54. A.
B.
C.
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55. A.
B.
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56. A.
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57. A.
B.
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58. A.
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59. A.
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78. A.
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79. A.

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80. A.
B.
C.
D.

81. A.
B.
C.
D.

82. A.
B.
C.
D.

83. A.
B.
C.
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84. A.
B.
C.
D.

85. A.
B.
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86. A.
B.
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87. A.
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88. A.
B.
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89. A.
B.
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90. A.
B.
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D.

91. A.
B.
C.
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92. A.
B.
C.
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93. A.
B.
C.
D.

94. A.
B.
C.
D.

95. A.
B.
C.
D.

96. A.
B.
C.
D.

97. A.
B.
C.
D.

98. A.
B.
C.
D.

99. A.
B.

C.

D.

100. A.

B.

C.

D.

1.1.2 Answers

1.

5	25	*rem*
5	5	0
5	1	0
	0	1

2.

3. Your results are in base 3, so changing all the number to base 10 before solving would, is time wastage, rather evaluate while they are in base 3

4.

5.

6. **(B)** convert 241_5 to base 8 first

$$\begin{aligned} 241_5 &= 2 \times 5^2 + 4 \times 5^1 + 1 \times 5^0 \\ &= 2 \times 25 + 4 \times 5 + 1 \times 1 \\ &= 50 + 20 + 1 = 71_{10} \end{aligned}$$

then, convert 71_{10} to base 8

8	71	*rem*
8	8	7
8	1	0
	0	1

$\therefore\ 241_5 = 107_8$

7. It's easier to work with number while they are in base 10

   - $11_2 = 1 \times 2^1 + 1 \times 2^0 = 2 + 1 = 3_{10} = 3$
   - $101_2 = 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0 = 4 + 0 + 1 = 5_{10} = 5$
   - $1000_2 = 1 \times 2^3 = 8_{10} = 8$

   you should have notice every other part with zero's will automatically be zero, so just ignore those parts

$$\frac{3}{x_2} = \frac{8}{x_2 + 5}$$

$3(x_2 + 5) = 8x_2 \ \Rightarrow\ 3x_2 + 15 = 8x_2$
$\therefore \quad x_2 = 3_{10} = 11_2$

8. If your first thought was to convert everything to base ten, that's really going to be a pain in the ass my friend, rather make an arrangement like this

$$\begin{array}{r} 4243- \\ \underline{12x4} \\ \hline \end{array}$$

9. **(B)**

$$\begin{aligned} 101101_2 &= 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 \\ &\quad + 0 \times 2^1 + 1 \times 2^0 \\ &= 32 + 0 + 8 + 4 + 0 + 1 = 45 \end{aligned}$$

10. **(A)**

2	39	*rem*
2	19	1
2	9	1
2	4	1
2	2	0
2	1	0
	0	1

$\therefore 39_{10} = 100111$ in base 2

11. Convert all to base 10, To speed things up ignore all the zero's

$$\begin{aligned} 34_n &= 10110_2 \\ 3 \times n + 4 &= 1 \times 2^4 + 1 \times 2^1 + 1 \times 2^0 = 16 + 2 + 1 \\ 3n + 4 &= 19 \qquad \Rightarrow 3n = 23 \end{aligned}$$

12.

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100.

1.2 Fraction and Decimals

1.2.1 Questions

1. The sum of $3\frac{7}{8}$ and $1\frac{1}{3}$ is greater than the difference between $\frac{3}{8}$ and $1\frac{2}{3}$ by.

   A. $3\frac{2}{3}$ C. $8\frac{1}{8}$ E. $5\frac{1}{4}$

   B. $1\frac{1}{2}$ D. $3\frac{11}{12}$

2. After getting a rise of 15%, a man's new monthly salary is N 345. How much per month did he earn before the increase?

   A. N360 C. N293.25 E. N396.75

   B. N300 D. N330

3. Find correct to 3 significant figures, the value of $\sqrt{41830}$

   A. 647 C. 205 E. 6470

   B. 2050 D. 647

4. 12 men complete a job in 9 days. How many men working at the same rate, would be required to complete the job in 6 days?.

   A. 24 C. 8 E. 18

   B. 9 D. 12

5. Simplify $2\frac{5}{12} - 1\frac{7}{8} \times \frac{6}{5}$.

   A. $\frac{11}{30}$ C. $\frac{1}{6}$ E. $\frac{13}{20}$

   B. $\frac{9}{4}$ D. $\frac{5}{3}$

6. By selling an article for N45.00 a man makes a profit of 8%. For how much should he have sold it in order to make a profit of 32%?

   A. N59.00 C. N180.00 E. N42.00

   B. N55.00 D. N63.00

7. Which of the following fractions is less than one-third?

   A. $\frac{4}{11}$ C. $\frac{15}{44}$ E. $\frac{6}{14}$

   B. $\frac{122}{383}$ D. $\frac{22}{63}$

8. The ratio of the price of loaf of bread to the price of a packet of sugar in 1975 was $a : x$. In 1980, the price of a loaf of bread went up by 25% and that of a packet of sugar by 10%. Their new ratio is now ?

   A. $50a : 44x$ C. $40a : 44x$ E. $44a : 55x$

   B. $44a : 50x$ D. $55a : 44x$

9. Simplify: $1 + \cfrac{2}{3 + \cfrac{4}{5 + \cfrac{6}{7}}}$

   A. $\frac{7}{95}$

   B. $\frac{177}{95}$

   C. $\frac{233}{151}$

   D. $\frac{17}{10}$

   E. $\frac{3}{10}$

10. Evaluate and correct to 4 decimal places 827.51×0.015 .

    A. 124.1265

    B. 8.8415

    C. 12.4127

    D. 12.4120

    E. 124.1265

11. A micrometer is defined as one millionth of a millimeter. A length of of $12,000$ micrometer may be represented as

    A. $0.000012m$

    B. $0.12m$

    C. $0.00000012m$

    D. $0.00000000012m$

    E. $0.0000012m$

12. The difference between $4\frac{5}{7}$ and $2\frac{1}{4}$ is greater than the sum of $\frac{1}{14}$ and $1\frac{1}{2}$ by.

    A. $\frac{27}{28}$

    B. $\frac{23}{28}$

C. $\frac{50}{56}$

D. $\frac{48}{56}$

E. $\frac{24}{48}$

13. When a dealer sells a bicycle for N81, he makes a profit of 8%. What did he pay for the bicycle.

A. N75

B. N75.52

C. N74.52

D. N87.48

E. N73

14. A man and wife went to by an article costing N400. The woman had 10% of the cost and the man 40% of the remainder. How much did they have altogether?

A. N186

B. N184

C. N200

D. N144

E. N100

15. A sum of money invested at 5% per annum simple interest amount to N285.20 after 3 years. How long will it take the same sum to amount to N434.00 at $7\frac{1}{2}\%$ per annum simple interest?

A. 10 years

B. 12 years

C. $7\frac{1}{2}$ years

D. 14 years

E. 5 years

16. A construction company is owned by two partners A and B and it is agreed that their profit will be divided in ratio $4:5$, at the end of the year, B recieved N$5,000$ more than A. What is the total profit of the company for the year?

A. N$45,000$

B. N$30,000$

C. N$150,000$

D. N$25,000$

E. N$30,000$

17. The diameter of metal rod is meased as 23.40cm to 4 significant figures. What isthe maximum error in the measurement?

A. 0.0004cm

B. 0.05cm

C. 0.005cm

D. 0.5cm

E. 0.45cm

18. Simplify: $3 - \dfrac{2}{\frac{4}{5} + \frac{1}{2}}$

A. $1\frac{9}{10}$

B. $1\frac{3}{10}$

C. $1\frac{3}{4}$

D. -1

E. 1

19. Given that $x : y = \frac{1}{3} : \frac{1}{2}$ and $\psi : \theta = \frac{2}{5} : \frac{4}{7}$, find $x : \theta$.

A. $20 : 21$

B. $7 : 15$

C. $3 : 20$

D. $2 : 35$

E. $4 : 105$

20. If N560 is shared in the ratio $7 : 2 : 1$, what is the smallest share?

A. N392

B. N113.40

C. N56.00

D. N87.48

E. N126.41

21. Simplify: $\dfrac{1}{2} + \dfrac{1}{2 + \dfrac{1}{2 - \dfrac{1}{4 + \frac{1}{5}}}}$

A. $\frac{169}{190}$

B. $-\frac{1}{3}$

C. $\frac{13}{15}$

D. $-\frac{3}{4}$

E. $-\frac{14}{27}$

22. $22\frac{1}{2}\%$ of the Nigerian Naira equals $17\frac{1}{10}\%$ of a foreign currency M. What is the conversion rate of M to Naira?

A. $2\frac{11}{57}$ Naria

B. $1\frac{18}{57}$ Naria

C. $\frac{15}{59}$ Naria

D. $\frac{15}{57}$ Naria

E. $38\frac{1}{4}$ Naria

23. Divide the LCM of 48, 64, and 80 by their HCF.

A. 30

B. 48

C. 52

D. 20

E. 60

24. A sum of money was invested at 8% per annum simple interest. If after 4 years the money amounts to N330.00, find the amount originally invested.

A. N150

B. N200

C. N165

D. N180

E. N250

25. P sold his bicycle to Q at a profit of 10%. Q sold to R for N209 at a loss of 5%. How much did the bicycle cost P?

A. N150

B. N205

C. N180

D. N196

E. N200

26. Find the smallest number by which 252 can be multiplied to obtain a perfect square.

A. 2

B. 3

C. 5

D. 7

E. 9

27. Find the reciprocal of: $\dfrac{\frac{2}{3}}{\frac{1}{2}+\frac{1}{3}}$

A. $\frac{4}{5}$

B. $\frac{2}{5}$

C. $\frac{6}{9}$

D. $\frac{5}{4}$

E. $\frac{3}{4}$

28. Three boys shared some oranges, the first recieved $\frac{1}{3}$ of the oranges, the second received $\frac{2}{3}$ of the remainder, if the third boy recieved the remaining 12 oranges. How many oranges did they share?

A. 48

B. 72

C. 54

D. 42

E. 60

29. Udoh deposited N150.00 in the bank. At the end of 5 years, the simple interest on the principal was N55.00. At what rate per annum was the interest paid

A. $7\frac{1}{3}\%$

B. 5%

C. 11%

D. $3\frac{1}{2}\%$

E. $4\frac{2}{5}\%$

30. A number of pencil were shared among Desmond, Florence, and Kevin in ratio $2:3:5$ respectively. If Desmond got 5, how many were shared out?

A. 30

B. 15

C. 25

D. 20

E. 35

31. Find the least length of a rod which can be cut into exactly equal strips, each of 40 cm or 48 cm in length.

A. 240 cm

B. 480 cm

C. 360 cm

D. 120 cm

E. 480 cm

32. A rectangular lawn has an area of 1815 square yards. If its length is 50 metres, find its width in meters. Given that 1 metre equals 1.1 yard.

A. $30.00\,\mathrm{m}$

B. $33.00\,\mathrm{m}$

C. $32.00\,\mathrm{m}$

D. $39.93\,\mathrm{m}$

E. $36.45\,\mathrm{m}$

33. Reduce each number to two significant figures and then evaluate $\dfrac{0.021741 \times 1.2047}{0.023789}$

A. 0.8

B. 1.2

C. 1.1

D. 0.9

E. 0.6

34. A cinema hall contains a certain number of people. If $27\frac{1}{2}\%$ are children, $47\frac{1}{2}\%$ are men and 84 are women, find the number of men in the hall

A. 133

B. 84

C. 63

D. 113

35. A woman buys 270 oranges for N$1,800$ and sells at 5 for N40. What is her profit?

A. N $1,620$

B. N 630

C. N 360

D. N $2,160$

36. If a car travels 120km on 45 litres of petrol, how much petrol is needed for a journey of 600km?

A. 720 litres

B. 225 litres

C. 960 litres

D. 160 litres

37. Simplify $1 - \left(\dfrac{1}{7} \times 3\dfrac{1}{2}\right) \div \dfrac{3}{4}$

A. 2

B. 1

C. $\dfrac{1}{3}$

D. $\dfrac{2}{3}$

38. Evaluate: $\dfrac{12.02 \times 20.06}{26.04 \times 60.06}$, correct to 3 significant figures

A. 0.154

B. 0.155

C. 0.158

D. 0.157

39. Evaluate: $\dfrac{0.8 \times 0.43 \times 0.031}{0.05 \times 0.72 \times 0.021}$, correct to 3 significant figures

A. 14.1

B. 14.09

C. 14.12

D. 14.11

40. A man bought a car for N$500,000$ and was able to sell it for N$350,000$, what was his percentage loss?

A. 50%

B. 30%

C. 70%

D. 60%

41. Simplify: $1\dfrac{2}{3} + 4\dfrac{1}{4} + 1\dfrac{5}{12}$

A. $4\dfrac{1}{3}$

B. $4\dfrac{2}{3}$

C. $4\dfrac{12}{17}$

D. $4\dfrac{3}{17}$

42. A man donates 16% of his monthly net earning to the church. If it amounts to N$4,500$, what is his monthly income?

A. N$40,500$

B. N$52,000$

C. N$52,500$

D. N$45,000$

43. If a student measured the length of a table to be 2.30 m insted of 2.50 m. What was his percentage error in measuring the length?

A. 7%

B. 10%

C. 9%

D. 8%

44. A man bought a second-hand photocopy machine for $34,000$. He serviced it at a cost of N$2,000$ and then sold it at a profit of 15%. What was the selling price?

A. $37,550$

B. $40,000$

C. $41,400$

D. $42,400$

45. A student spent $\dfrac{1}{5}$ of his allowance on books, $\dfrac{1}{3}$ of the remainder on food and kept the rest for contingencies. What fraction was kept?

A. $\dfrac{8}{15}$

B. $\frac{4}{5}$

C. $\frac{2}{3}$

D. $\frac{7}{15}$

46. If $p : q = \frac{2}{3} : \frac{5}{6}$ and $\frac{3}{4} : \frac{1}{2}$, find $p : q : r$

A. $12 : 15 : 10$

B. $10 : 15 : 24$

C. $9 : 10 : 15$

D. $12 : 15 : 16$

47. Simplify: $\frac{3\frac{2}{3} \times \frac{5}{6} \times \frac{2}{3}}{\frac{11}{25} \times \frac{3}{4} \times \frac{2}{27}}$

A. $4\frac{1}{3}$

B. 30

C. $5\frac{2}{3}$

D. 50

48. A man earns N$3,500$ per month out of which he spend 15% on his children's education. If he spends additional N$1,950$ on food, how much does he have left?

A. N$2,975$

B. N$1,950$

C. N525

D. N1025

49. Evaluate $\frac{21}{9}$ to 3 significant figures

A. 2.30

B. 2.31

C. 2.32

D. 2.33

50. A girl shares a number of apples in the ratio $5 : 3 : 2$. If the highest share is 40, find the smallest share.

A. 74

B. 38

C. 36

D. 16

51. Calculate the time taken for N$3,000$ to earn N600 at 8% simple interest.

A. 3 years

B. $2\frac{1}{2}$ years

C. $1\frac{1}{2}$ years

D. $3\frac{1}{2}$ years

52. Find the tax on an income of N$20,000$ if no tax is paid on the first N$10,000$ and tax is paid at N50 and in N$1,000$ on the next N$5,000$ and at N55 and N1000 on the remainder.

A. N225

B. N525

C. N552

D. N500

53. The time taken to do a piece of work is inversely proportional to the number of men employed. If it takes 30 men to do a piece of work in 6days, how many men are required to do the work in 4 days?

A. 35

B. 45

C. 25

D. 60

54. Three boys shared oranges. The first received $\frac{1}{3}$ of the oranges and the second received $\frac{2}{3}$ of the remainder. If the third boy received the remaining 12 oranges, how much oranges did they share?

A. 42

B. 60

C. 54

D. 48

55. A farmer planted $5,000$ grains of maize and harvested $5,000$ cobs, each bearing 500 grains. What is the ratio of the number of grains sowed to the number harvested?

A. $1 : 5,000$

B. $1 : 25,000$

C. $1 : 500$

D. $1 : 250,000$

56. Evaluate: $\frac{0.21 \times 0.072 \times 0.00054}{0.006 \times 1.68 \times 0.063}$

A. 0.1286

B. 0.01285

C. 0.01286

D. 0.1285

57. A man's initial salary is N540 a month and increases after a period of six months by N36 a month. Find his salary in the eight month of the third year.

A. 828

B. 756

C. 720

D. 684

58. Find correct to 3 decimal places:

$$\left(\frac{1}{0.05}\right) \div \left(\frac{1}{5.005}\right) - (0.05 \times 2.05)$$

A. 99.998

B. 9.998

C. 98.999

D. 89.899

59. Express $62 \div 3$ as a decimal correct to 3 significant figures.

A. 20.667

B. 20.6

C. 20.7

D. 20.67

60. Factory P produces 20,000 bags of cement per day while factory Q produces 15,000 bags of per day. If P reduces production by 5% and Q increases production by 5% determine the effective loss in the number of bags produced per day by the two factories

A. 750

B. 250

C. 1000

D. 1250

61. If 3 gallons of spirit containing 20% water are added to 5 gallons of another spirit containing 15% water, what percentage of the mixture is water?

A. $2\frac{4}{5}$

B. $18\frac{7}{8}$

C. $18\frac{1}{8}$

D. $16\frac{7}{8}$

62. The radius of a circle is given as 5cm subject to an error of 0.1cm. What is the percentage erro in the area of the circle.

A. $\frac{1}{4}$

B. $\frac{1}{25}$

C. 25

D. 4

63. A man invested a sum of N280.00 partly at 5% and partly at 4%. If the total interest is N12.8 per annum, find the amount invested at 5%.

A. N120

B. N160

C. N200

D. N140

64. Evaulate $\frac{3524}{0.05}$ correct to 3 significant figures

A. 70000

B. 70480

C. 705

D. 70500

65. If N225 yields N27 in x years simple interest at the rate of 4% per annum, find x

A. 12

B. 4

C. 27

D. 3

66. A man's initial salary is N540 a month and increases after each period of six month by N36 a month. Find his salary in teh eighth month of the third year.

A. N756

B. N648

C. N720

D. N828

67. $\frac{1}{3} \div \left[\frac{5}{7}\left(\frac{9}{10} - 1 + \frac{3}{4}\right)\right]$

A. $\frac{13}{24}$

B. $\frac{39}{28}$

C. $\frac{28}{39}$

D. $\frac{84}{13}$

68. Two sisters, Taiwo and Kehinde, own a store. The ratio of Taiwo's share to Kehinde's is $11 : 9$. Later Kehinde sells $\frac{2}{3}$ of her share to Taiwo of N720. Find the value of the store.

A. 1080

B. 3000

C. 3600

D. 2400

69. A tax payer has allowed $\frac{1}{8}$th of his income tax free, and pays 20% on the remainder. If he pays N490 tax, what is his income?

A. N2450

B. N2800

C. N3920

D. N560

70. A basket contains green, black and blue balls in the ratio $5 : 2 : 1$. If there are 10 blue balls, find the correspondin new ratio when 10 green and 10 black balls are removed from the basket
    A. $1 : 1 : 1$
    B. $4 : 2 : 1$
    C. $5 : 1 : 1$
    D. $4 : 1 : 1$
71. The prime factors of $2,520$ are.
    A. $2, 3, 5, 7$
    B. $2, 9, 5$
    C. $2, 3, 7, 9$
    D. $2, 9, 7$
72. A.
    B.
    C.
    D.
73. A.
    B.
    C.
    D.
74. A.
    B.
    C.
    D.
75. A.
    B.
    C.
    D.
76. A.
    B.
    C.
    D.
77. A.
    B.
    C.
    D.
78. A.
    B.
    C.
    D.
79. A.
    B.
    C.
    D.
80. A.
    B.
    C.
    D.
81. A.
    B.
    C.
    D.
82. A.
    B.
    C.
    D.
83. A.
    B.
    C.
    D.
84. A.
    B.
    C.
    D.
85. A.
    B.
    C.
    D.
86. A.
    B.
    C.
    D.
87. A.
    B.
    C.
    D.
88. A.
    B.
    C.
    D.
89. A.

B.
C.
D.

90. A.
B.
C.
D.

91. A.
B.
C.
D.

92. A.
B.
C.
D.

93. A.
B.
C.
D.

94. A.
B.
C.
D.

95. A.
B.
C.
D.

96. A.
B.
C.
D.

1.2.2 Solution

1. (D) We begin by converting all the mixed fractions to improper fractions and add them up.

$$3\frac{7}{8} = \frac{31}{8} \text{ and } 1\frac{1}{3} = \frac{4}{3}$$

Taking LCM of 8 and 3 we get 24,

$$\frac{31}{8} + \frac{4}{3} = \frac{(31 \times 3) + (8 \times 4)}{24}$$
$$= \frac{93 + 32}{24} = \frac{125}{24}$$

Similarly,

$$1\frac{2}{3} - \frac{3}{8} \Rightarrow \frac{5}{3} - \frac{3}{8}$$
$$= \frac{(5 \times 8) - (3 \times 3)}{24}$$
$$= \frac{31}{24}$$

Now subtract $\frac{31}{24}$ from $\frac{125}{24}$

$$\frac{125}{24} - \frac{31}{24} = \frac{125 - 31}{24} = \frac{94}{24} = 3\frac{11}{12}$$

2. (B) Amount he earned before the increase i.e his initial salary Let initial salary = x and his new salary = N345
From the question, he had 15% of his initial salary (x) added to his initial salary (x)
initial salary + 15% of initial = new salary

$$1\frac{2}{3} - \frac{3}{8} \Rightarrow \frac{5}{3} - \frac{3}{8} = \frac{(5 \times 8) - (3 \times 3)}{24} = \frac{31}{24}$$

Now, subtract $\frac{31}{24}$ from $\frac{125}{24}$

$$\frac{125}{24} - \frac{31}{24} = \frac{125 - 31}{24} = \frac{94}{24} = 3\frac{11}{12} \text{(D)}$$

3. (C) $\sqrt{41830}$ is not a perfect square, so we can't evaulate using tables

$$\sqrt{41830} \approx 204.5 = 205 \qquad \{\text{ to 3d.p}\}$$

4. (E) The **time taken (t)** to complete a job is inversely proportional to **numbers ot men (n)** i.e as the number of men increase the job is done faster.

$$\text{time taken} \propto \frac{1}{\text{number of men}} \Rightarrow t \propto \frac{1}{n} \qquad (1.1)$$

Removing proportionality sign $t = \frac{k}{n} \Rightarrow tn = k$
Generally: $t_1 n_1 = t_2 n_2 = \cdots = t_k n_k$
given $t_1 = 9$, $n_1 = 12, t_2 = 6$ and $n_2 =?$
Using: $t_1 n_1 = t_2 n_2 \Rightarrow 9 \times 12 = 6 \times n_2$
taking the advantage that $6 \mid 12$

$$n_2 = \left(\frac{12}{6}\right) \times 9 = 18$$

5. (C) Remember convert to improper fraction first

$$2\frac{5}{12} - 1\frac{7}{8} \times \frac{6}{5} \Rightarrow \frac{29}{12} - \frac{15}{8} \times \frac{6}{5}$$

Applying BODMAS multilplication comes before substraction

$$\frac{29}{12} - \left(\frac{\cancel{15}^{3} \times \cancel{6}^{3}}{\cancel{8}^{4} \times \cancel{5}^{1}}\right) \Rightarrow \frac{29}{12} - \frac{9}{4} = \frac{29 - (9 \times 3)}{12} = \frac{2}{12} = \frac{1}{6}$$

6. (B) Selling Price = N45.00, profit% = 8%. Let the cost price = x.

$$\%\text{profit} = \frac{\text{Selling Price - Cost Price}}{\text{Cost Price}} \times 100$$
$$8 = \frac{45 - x}{x} \times 100 \Rightarrow 8x = 4500 - 100x$$
$$108x = 4500 \Rightarrow x = \frac{4500}{108}$$
$$\therefore \quad \text{Cost price} = \frac{4500}{108}$$

Now the question says he made a profit of 32%. How much did he sell it for?

Using the formula, we have:

$$32 = \frac{SP - \left(\frac{4500}{108}\right)}{\left(\frac{4500}{108}\right)} \times 100$$
$$= \frac{108\left[SP - \left(\frac{4500}{108}\right)\right]}{4500} \times 100$$
$$= \frac{108Sp - 4500}{4500} \times 100$$
$$\frac{32 \times 4500}{100} = 108SP - 4500$$
$$SP = \frac{(32 \times 45) + 4500}{108} = \frac{5940}{108} = 55$$

7. (B) The easiest ways is to compare $\frac{1}{3}$ with every other item

$$\frac{4}{11} \text{ vs } \frac{1}{3} \Rightarrow \frac{4}{11} \text{ vs } \frac{4}{12}$$
$$\frac{122}{383} \text{ vs } \frac{1}{3} \Rightarrow \frac{122}{383} \text{ vs } \frac{122}{366}$$
$$\frac{15}{44} \text{ vs } \frac{1}{3} \Rightarrow \frac{15}{44} \text{ vs } \frac{15}{45}$$
$$\frac{22}{63} \text{ vs } \frac{1}{3} \Rightarrow \frac{22}{63} \text{ vs } \frac{22}{66}$$
$$\frac{6}{14} \text{ vs } \frac{1}{3} \Rightarrow \frac{6}{14} \text{ vs } \frac{6}{18}$$

Since the denominator in $\frac{122}{383}$ is greater than $\frac{122}{366} = \frac{1}{3}$ therefore $\frac{122}{383}$ is lessthan one-third

8. **(A)** In 1980: The intial price $a : x$ rose by 25% and 10% respectively, hence:

$$a : x \Rightarrow a + \frac{25}{100}a : x + \frac{10}{100}x$$
$$= \frac{125}{\cancel{100}}a : \frac{110}{\cancel{100}}x$$
$$= 125a : 110x$$

dividing by 5 $\quad \frac{125}{5}a : \frac{110}{5}x \Rightarrow 25a : 22x$

$\therefore$ Multiplying by 2 $\quad 50a : 44x$

9. **(B)** For Questions like this its best to start from the bottom

$$5 + \frac{6}{7} = \frac{35+6}{7} = \frac{41}{7}$$

$$\Rightarrow \frac{4}{5 + \frac{6}{7}} = \frac{4}{41/7} = \frac{4 \cdot 7}{41} = \frac{28}{41}$$

now, $3 + \frac{4}{5 + \frac{6}{7}} = 3 + \frac{28}{41} = \frac{123+28}{41} = \frac{151}{41}$

$$\Rightarrow \quad \frac{2}{3 + \frac{4}{5 + \frac{6}{7}}} = \frac{2}{151/41} = \frac{2 \cdot 41}{151} = \frac{82}{151}$$

$$\Rightarrow \quad 1 + \frac{2}{3 + \frac{4}{5 + \frac{6}{7}}} = 1 + \frac{82}{151} = \frac{151+82}{151} = \frac{233}{151}$$

10.

11. **(A)** In 1980: The initial price $a : x$ rose by 25% and 10% respectively, hence:

$$a : x \Rightarrow a + \frac{25}{100}a : x + \frac{10}{100}x \Rightarrow \frac{125}{100}a : \frac{110}{100}x$$
$$= 125a : 110x$$

Dividing by 5, $\frac{125}{5}a : \frac{110}{5}x \Rightarrow 25a : 22x \therefore$
Multiplying by 2, $\quad$ 50a : 44x

12. **(B)** For questions like this, it's best to start from the bottom.

$$5 + \frac{6}{7} = \frac{35+6}{7} = \frac{41}{7} \Rightarrow \frac{4}{5 + \frac{6}{7}} = \frac{4}{41/7} = \frac{4 \cdot 7}{41} = \frac{28}{41}$$

Now, $3 + \frac{4}{5 + \frac{6}{7}} = 3 + \frac{28}{41} = \frac{123+28}{41} = \frac{151}{41}$

$$\Rightarrow \quad \frac{2}{3 + \frac{4}{5 + \frac{6}{7}}} = \frac{2}{151/41} = \frac{2 \cdot 41}{151} = \frac{82}{151}$$

$$\Rightarrow \quad 1 + \frac{2}{3 + \frac{4}{5 + \frac{6}{7}}} = 1 + \frac{82}{151} = \frac{151+82}{151} = \frac{233}{151}$$

13. **(C)**

$$827.51 \times 15 \times 10^{-3} = 12.41265$$
$$= 12.4127 \quad \{ \text{ to 4d.p} \}$$

14. Notice the difference between million and million**th**

$$1\text{micrometer} = 10^{-6}\text{millimeter}$$
$$12,000 \text{ micrometer} = x \text{ millimeter}$$

$$x = 12000 \times 10^{-6} = 1.2 \times 10^{-4-6} = 1.2 \times 10^{-10}$$
$$= 0.00000000012\text{m}$$

15. **(C)** Converting to improper fraction gives

$$4\frac{5}{7} - 2\frac{1}{4} \Rightarrow \frac{33}{7} - \frac{9}{4} = \frac{(33 \times 4) - (9 \times 7)}{28}$$
$$= \frac{132 - 63}{28} = \frac{69}{28}$$

Solving for the second:

$$\frac{1}{14} + 1\frac{1}{2} = \frac{1}{14} + \frac{3}{2} = \frac{1 + (7 \times 3)}{14} = \frac{22}{14}$$

Now substracting $\frac{22}{14}$ from $\frac{69}{28}$:

$$\frac{69}{28} - \frac{22}{14} = \frac{69 - (22 \times 2)}{28} = \frac{25}{28} = \frac{50}{56}$$

16. **(A)** SP = N81, %profit = 8%

17. SP = N81, %Profit = 8%
What did he pay for the bicycle = **CP** = x

$$\%\text{profit} = \frac{\text{SP - CP}}{\text{CP}} \times 100$$
$$\Rightarrow \quad 8 = \frac{81 - x}{x} \times 100$$
$$8x = 100(81 - x)$$
$$2x = 25(81 - x) = (81 \times 25) - 25x$$
$$27x = 81 \times 25$$
$$\therefore \quad x = \frac{81 \times 25}{27} = \text{N75}$$
$$8x = 100(81 - x)$$
$$2x = 25(81 - x) = (81 \times 25) - 25x$$
$$27x = 81 \times 25$$
$$\therefore x \quad = \frac{81 \times 25}{27} = \text{N75}$$

18. **(B)** Let the cost price be CP, hence CP = 400, woman's money = 10% of 400 = N40
the remainder is supposed to be N360, but the man has
40% of 360 = $\frac{4\cancel{0}}{1\cancel{0}\cancel{0}} \times 36\cancel{0} = 144$
So, answer is 40 + 144 = 184

19. **(A)** Note that the same amount was invested in both cases which is also the principal (P) $\therefore P_1 = P_2$

$$\Rightarrow \quad A_1 = P_1 + I_1 = P_1 + \frac{P_1 \times R_1 \times T_1}{100}$$
$$285.20 = P_1 + \frac{P_1 \times 5 \times 3}{100}$$
$$28520 = 100P_1 + 15P_1 = 115P_1$$
$$\frac{28520}{115} = P_1 = 248$$
$$\Rightarrow \quad A_2 = P_2 + I_2 = P_2 + \frac{P_2 \times R_2 \times T_2}{100}$$
$$434 = P_2 + \frac{P_2 \times 7\frac{1}{2} \times T_2}{100}$$
$$\{\because P_1 = P_2\} \quad 434 = 248 + \frac{248 \times 7\frac{1}{2} \times T_2}{100}$$
$$186 = \frac{248 \times 15 \times T_2}{100 \times 2}$$
$$\therefore \quad T_2 = 10 \text{ years}$$

20. **(A)** Given that, $B = A + 5000 \text{and} \frac{A}{B} = \frac{4}{5}$, we are to find the sum of the total profit $(A + B)$

$$B = \frac{5}{9}(A + B) \text{ and } A = \frac{4}{9}(A + B)$$
$$B - A = 5000$$
$$\frac{5}{9}(A + B) - \frac{4}{9}(A + B) = 5000$$
$$\therefore \quad A + B = 45000$$

21.

22. Start by resolving

$$\frac{4}{5} + \frac{1}{2} = \frac{13}{10} \text{ now } \frac{2}{13/10} = \frac{20}{13}$$

then,

$$3 - \frac{20}{13} = \frac{39 - 20}{13} = \frac{19}{13} = 1\frac{6}{13}$$

23. **(B)** Given $\frac{x}{y} = \frac{1/3}{1/2} = \frac{2}{3} = \frac{28}{42}$ and $\frac{\psi}{\theta} = \frac{2/5}{4/7} = \frac{42}{60}$

$$\frac{x/y}{\theta/\psi} = \left(\frac{x}{y}\right) \cdot \left(\frac{\psi}{\theta}\right) = \frac{28 \cdot \cancel{42}}{\cancel{42} \cdot 60} = \frac{7}{15}$$

$\therefore \quad x : \theta = 7 : 15$

Note I multiplied y and ψ by 14 and 3 respectively, so that they cancel each other

24. **(C)** The smallest share is one with the least ratio value

$$\therefore \quad \frac{1}{7 + 2 + 1} \times 560 = \frac{1}{10} \times 560 = 56$$

25. Start form bottom:

$$\frac{1}{4 + \frac{1}{5}} = \frac{1}{21/5} = \frac{5}{21} \Rightarrow 2 - \frac{5}{21} = \frac{37}{21}$$

now we have that the bottom $2 - \frac{1}{4 + \frac{1}{5}} = \frac{37}{21}$

$$2 + \frac{1}{37/21} = 2 + \frac{21}{37} = \frac{74 + 7}{12} = \frac{81}{12} = \frac{27}{4}$$

Notice that $2 + \frac{1}{2 - \frac{1}{4 + \frac{1}{5}}} = \frac{27}{4}$

$$\frac{1}{2} + \frac{1}{27/4} = \frac{1}{2} + \frac{4}{27} = \frac{27 + 8}{54} = \frac{35}{54}$$

26. **(B)** $22\frac{1}{2}\% = \frac{45}{2}\%$ and $17\frac{1}{10}\% = \frac{171}{10}\%$, let Naira = N, we can ignore the % sign since they both carry it

$$\frac{45}{2} N = \frac{171}{10} M \Rightarrow 45 \times 10\, N = 171 \times 2\, M$$
$$\Rightarrow \left(\frac{45 \times 10}{171 \times 2}\right) N = M = \frac{225}{171}$$

$$\therefore \qquad M = 1\frac{54}{171} = 1\frac{18}{57}$$

Hint: How did i know a large number like 171 is divisible by 3.
For a number to be divisible by 3, the sum of the individual number must be divisible by 3 like 171, the sum of the digit is 9 like wise 54

27. (E) Express these number in index form
$48 = 2^3 \times 3^1, 64 = 2^5$ and $80 = 2^4 \times 5$

The LCM is **is the number with the largest index** while HCF is the number with the **least index**

$$\therefore \text{LCM } = 2^5 \times 3^1 \times 5^1 \text{ while HCF} = 2^3$$
$$\frac{\text{LCM}}{\text{HCF}} = \frac{2^5 \times 3^1 \times 5^1}{2^3} = 60$$

28. given that rate = 8%, time = 4, amount = 330

$$\text{A} = \text{P} + \text{I} = \text{P} + \frac{\text{P} \cdot \text{R} \cdot \text{T}}{100} = \text{P} + \frac{\text{P} \cdot 8 \cdot 4}{100}$$
$$100\text{A} = 100\text{P} + 32\text{P} = 132\text{P}$$
$$\therefore \text{P} = \frac{100}{132}$$

29. (E) let C_p = cost price for P and $\{S_p = C_q\}$ = selling price for P equals the cost price for Q, likewise the $\{S_q = C_r = \text{N}209\}$ the selling price for Q equals the cost price for, R The motive is to find C_p {cost price for P}
Given % profit of P = 10% and % loss Q = 5%

$$\Rightarrow \%\text{profit} = \frac{\text{Selling price} - \text{Cost price}}{\text{Cost price}} \times 100$$
$$\Rightarrow \%\text{loss} = \frac{\text{Cost price} - \text{Selling price}}{\text{Cost price}} \times 100$$

$$\text{for } q: \quad 5 = \frac{C_q - S_q}{C_q} \times 100 = \frac{C_q - C_r}{C_q} \times 100$$
$$5 = \frac{C_q - 209}{C_q} \times 100$$
$$5C_q = (C_q - 209)100 \Rightarrow -95C_q = -20900$$
$$C_q = 220$$
$$\text{for } p: \quad 10 = \frac{S_p - C_p}{C_p} \times 100 = \frac{C_q - C_p}{C_p} \times 100$$
$$10 = \frac{220 - C_p}{C_p} \times 100 \Rightarrow 110C_p = 22000$$
$$\therefore \qquad C_p = 200$$

the cost price for P = N200

30. (D) Let that number = x, and expressing 252 in index

2	252
2	126
3	63
3	21
7	7
	1

$\therefore 252 = 2^2 \times 3^2 \times 7^1 = (2 \times 3)^2 \times 7$ so inorder for the expression to be a perfect square we would have to multiply it by 7

31. (B) Resolving the denominator $\frac{1}{2} + \frac{1}{3} = \frac{3+2}{6} = \frac{5}{6}$

now the question $\dfrac{\frac{2}{3}}{\frac{1}{2} + \frac{1}{3}} = \dfrac{2/3}{5/6} = \dfrac{2}{\cancel{3}} \cdot \dfrac{\overset{2}{\cancel{6}}}{5} = \dfrac{4}{5}$

Lets say a is a number, the reciprocal of a is $\frac{1}{a}$

$\therefore$ Reciprocal of the question $\quad 1 \div \frac{4}{5} = \frac{5}{4}$

32. (C) let the number of oranges share = x.
The first boy received $\frac{1}{3}x$, now the remiander is

$$x - \frac{1}{3}x = \frac{3x - x}{3} = \frac{2x}{3}, \quad \therefore \text{remainder} = \frac{2x}{3}$$

The second boy received $\frac{2}{3} \times \frac{2x}{3} = \frac{4}{9}x$

Now remainder = Old remainder - second boy's share
$$= \frac{2x}{3} - \frac{4x}{9} = \frac{6x - 4x}{9} = \frac{2x}{9}$$

The remaining orange = 12 $= \dfrac{2x}{9} = \dfrac{\overset{6}{\cancel{12}} \cdot 9}{\cancel{2}} =$ 54 oranges

33. (A) P = N150.00, T = 5 years, I = N55.00 and $R = x$

$$I = \frac{P \times R \times T}{100} \Rightarrow 55 = \frac{150 \times R \times 5}{100} \Rightarrow \frac{5500}{150 \times 5} = R$$
$$\therefore \quad R = 7\frac{250}{750} = 7\frac{1}{3}$$

34. let the total pencil share = p, Desmond's portion of the ratio is 2 and the sum of the ratio = 2 + 3 + 5 = 10

Desmond's share $= \frac{2}{10} \times p = 5 \quad \therefore p = 25$
The total number of pencil shared is 25

35.

36. (B) Given, $1m$ = $1.1yard$ and $l = 50m$
$\therefore 1yard = \frac{1}{1.1}m$

$$l \times w = 1815y^2 \Rightarrow 50m \times w = 1815\left(\frac{1}{1.1}\right)^2 m$$
$$w = \frac{1815}{50 \times 1.1^2} = 30m$$

37. $0.02147 = 0.023$, $1.2047 = 1.2$ and $0.023789 = 0.024$
$\therefore$ we have the expression as,

$$\frac{0.023 \times 1.2}{0.024} = \frac{0.023 \times \cancel{1.2}}{\overset{2}{\cancel{2.4}} \times 10^{-2}} = \frac{2.3}{2} = 1.15 \approx 1.2$$

38. let number of people in cinema = x

$$\begin{aligned} x &= 27\frac{1}{2}\%x + 47\frac{1}{2}\%x + 84 \\ &= \frac{55}{200}x + \frac{95}{200}x + 84 \\ 200x &= 55x + 95x + (84 \cdot 200) \end{aligned}$$

$$200x - 150x = 84 \cdot 200 \Rightarrow \quad x = \frac{84 \cdot \cancel{200}^{\,4}}{\cancel{50}} = 336$$

Finding for Men: $\dfrac{95}{200} \times 336$

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Chapter 2

Algebra

2.1 Factorization and Remainder Theorem

2.1.1 Questions

1. If the function f is defined by $f(x+2) = 2x^2+7x-5$, find $f(-1)$
   A. -8
   B. 4
   C. 10
   D. -10
2. Factorize $a^2x - b^2y - b^2x + a^2y$
   A. $(y-x)(a-b)(a+b)$
   B. $(a-b)(x+y)$
   C. $(x-y)(a-b)$
   D. $(x+y)(a-b)(a+b)$
3. if $x-1$ and $x+1$ are both factors of the equation: $x^3+px^2+qx+6 = 0$, evaluate p and q
   A. $-6, -1$
   B. $1, -1$
   C. $6, 1$
   D. $6, -6$
4. if $f(x) = \dfrac{1}{x-1} + \dfrac{x-1}{x^2-1}$, find $f(1-x)$
   A. $\dfrac{1}{x} + \dfrac{1}{x-2}$
   B. $-\dfrac{1}{x} - \dfrac{1}{x-2}$
   C. $x + \dfrac{1}{2x-1}$
   D. $\dfrac{1}{x} + \dfrac{1}{x^2-1}$
   E. $-\dfrac{1}{x} - \dfrac{1}{2x-1}$
5. Multiply $(x+3y+5)$ by $(2x^2+5y+2)$
   A. $2x^3+3x^2y+10xy^2+13y+10x^2+2x+10$
   B. $2x^3+2x^2y+10xy+10y^2+31y+5x^2+2x+10$
   C. $2x^3+6x^2y+5xy+10y^2+13y+5x^2+2x+10$
   D. $2x^3+6x^2y+5xy+15y^2+31y+5x^2+2x+10$
   E. $2x^3+3x^2y+5xy+10y^2+13y+5x^2+2x+10$
6. If kx^3+10x^2+lx-3 is divisible by $(x-1)$ and if when it is divided by $(x+2)$ the remainder is 27, find the constant k and l.
   A. $k = -7, l = -15$
   B. $k = \dfrac{-21}{5}, l = \dfrac{-61}{5}$
   C. $k = -15, l = -7$
   D. $k = -\dfrac{5}{3}, l = \dfrac{19}{5}$
   E. $k = -\dfrac{5}{3}, l = -\dfrac{19}{3}$
7. Factorize $3x^3+4x^2-13x+6$ completely, given that $x-1$ is a factor
   A. $(x-1)(x-3)(x+2)$
   B. $(x-1)(x-3)(3x+2)$
   C. $(x-1)(x-2)(x+3)$
   D. $(x-1)(x+3)(3x+2)$
   E. $(x-1)(x+3)(3x-2)$
8. Multiply x^2+x+1 by x^2-x+1
   A. x^4+3x^2+x+1
   B. x^4+4x^2-6x+1
   C. x^4+4x^2+1
   D. $x^4-x^3-x^2+x+1$
   E. x^4-6x^2-4x+1

9. If $x = 1$ is a root of the equation: $x^3 - 2x^2 - 5x + 6$, find the other roots.
   A. -3 and 2
   B. 1 and 3
   C. -2 and 2
   D. 3 and -2
   E. -3 and 1

10. If $x + 2$ and $x - 1$ are factors of the expression: $lx^3 + 2kx^2 + 24$, find the values of l and k
   A. $l = -6, k = -9$
   B. $l = -2, k = -1$
   C. $l = -2, k = 1$
   D. $l = 0, k = 1$
   E. $l = 6, k = 0$

11. Factorize completely: $81a^4 - 16b^4$
   A. $(3a + 2b)(2a - 3b)(9a^2 + 4b^2)$
   B. $(3a - 2b)(2a - 3b)(9a^2 - 4b^2)$
   C. $(3a - 2b)(3a - 2b)(9a^2 + 4b^2)$
   D. $(3a - 2b)(2a - 3b)(4a^2 - 9b^2)$
   E. $(3a - 2b)(3a + 2b)(9a^2 + 4b^2)$

12. The factor which is common to all three bionomial expressions: $4a^2 - 9b^2$, $8a^2 + 27b^3$, $(4a + 6b)^2$
   A. $4a - 6b$
   B. $4a + 6b$
   C. $2a - 3b$
   D. $2a + 3b$
   E. $3a - 2b$

13. If $x - 2$ and $x + 1$ are factors of the expression: $x^3 + px^2 + qx + 1$
   A. -3
   B. 0
   C. $-\frac{17}{3}$
   D. $-\frac{2}{3}$
   E. 3

14. The factors of $9 - (x^2 - 3x - 1)^2$ are.
   A. $(x - 4)(x - 1)(x - 1)(x + 2)$
   B. $(x - 4)(x + 1)(x - 2)(x - 1)$
   C. $(x - 2)(x + 2)(x + 1)(x + 4)$
   D. $(x - 2)(x + 2)(x + 1)(x - 1)$
   E. $(x - 4)(x - 3)(x - 2)(x + 1)$

15. If $f(x - 2) = 4x^2 + x + 7$ find $f(1)$
   A. 27
   B. 7
   C. 17
   D. 46
   E. 12

16. If $g(y) = \frac{y - 3}{11} + \frac{11}{y^2 - 9}$ what is $g(y + 3)$
   A. $\frac{y}{11} + \frac{11}{y(y + 5)}$
   B. $\frac{y + 30}{11} + \frac{11}{y(y + 3)}$
   C. $\frac{y}{11} + \frac{11}{y(y + 3)}$
   D. $\frac{y + 3}{11} + \frac{11}{y(y - 6)}$

17. Factorize completely $3a + 125a^3$
   A. $(2a + 5x)(4 + 10ax + 25ax^2)$
   B. $(2a + 5x^2)(4 + 25ax)$
   C. $a(2 + 5x)(4 - 10x + 25ax^2)$
   D. $a(2 + 5x)(4 + 10ax + 25ax^2)$

18. Factorize $x^2 + 2a + ax + 2x$
   A. $(x^2 - 1)(x + a)$
   B. $(x + 2)(x + a)$
   C. $(x + 2a)(x + 3)$
   D. $(x + 2a)(x - 1)$

19. The graphical method of solving the equation: $x^3 + 3x^2 + 4x - 28 = 0$ is by drawing the graphs of the curves
   A. $y = x^3$ and $y = 3x^2 + x - 28$
   B. $y = x^3 + 3x^2 + 4x$ and y
   C. $y = x^3 + 3x^2 + 4x - 28$ and the line $y = \frac{28}{x}$
   D. $y = x^2 + 3x + 4$ and $y = \frac{28}{x}$
   E. $y = x^2 + 3x + 4$ and line $y = 28x$

20. Factorize $(4a + 3)^2 - (3a - 2)^2$
   A. $(x + 2a)(x - 1)$
   B. $(x + 1)(x + 2a)$
   C. $(x + 2)(x + a)$
   D. $(x^2 - 1)(x + a)$

21. If $x^3 - 12x - 16 = 0$ has $x - 2$ as a solution, then the equation has
   A. 3 roots all different
   B. $x - 4$ as a solution also
   C. 3 roots all equal

D. 3 roots with two equal and the third different

E. only one root

22. The expression: $x^3 - 4x^2 + cx + d$ is such that $x + 1$ is a factor and its values is 1 when x is -2. find c and d

A. $c = -4$ and $d = 9$

B. $c = 20$ and $d = 9$

C. $c = -20$ and $d = 15$

D. $c = -20$ and $d = -15$

E. $c = 20$ and $d = -15$

23. What factor is common to all the expressions: $x + 1, 2x^2 + x + 1$ and $x^2 - 1$

A. $x + 1$

B. 1

C. No common factor

D. $2x - 1$

E. x

24. **(B)** Facorize completely: $(x^2 + x)^2 - (2x + 2)^2$

A. $(x + y)(x + 2)(x - 2)$

B. $(x + 1)^2(x + 2)(x - 2)$

C. $(x + y)^2(y - 2)^2$

D. $(x + 1)^2(x + 2)^2$

25. if $f(x) = 2x^2 + 5x + 3$, find $f(x + 1)$

A. $2x^2 - x + 10$

B. $2x^2 - x$

C. $4x^2 + 3x + 12$

D. $4x^2 + 3x + 2$

26. If one factor of $x^3 - 8^{-1}$ is $x - 2^{-1}$, the other factor is

A. $x^2 + 2^{-1}x - 4^{-1}$

B. $x^2 - 2^{-1}x - 4^{-1}$

C. $x^2 - 2^{-1}x - 4^{-1}$

D. $x^2 + 4^{-1}x - 2^{-1}$

27. Factorize $9(x + y)^2 - 4(x - y)^2$

A. $(x + y)(5x + y)$

B. $(x + y)^2$

C. $5(x + y)^2$

D. $(x + 5y)(5x - y)$

28. Factorize $4a^2 - 12ab - c^2 + 9b^2$

A. $(2a + 3b - c)(2a + 3b + c)$

B. $4a(a - 3b) + (3b - c)^2$

C. $(2a - 3b - c)(2a - 3b + c)$

D. $4a(a - 3b) + (3b + c)^2$

29. What are k and l respectively if: $\frac{1}{2}(3y - 4x)^2 = (8x^2 + kxy + ly^2)$

A. $12, \frac{9}{2}$

B. $-12, \frac{9}{2}$

C. $6, 9$

D. $-6, 9$

30. if $f(x - 4) = x^2 + 2x + 3$, find $f(2)$

A. 11

B. 6

C. 51

D. 27

31. Factorize completely: $y^3 - 4xy + xy^3 - 4y$

A. $y(1 - x)(y + 2)(y - 2)$

B. $y(1 + x)(y - 2)(y - 2)$

C. $(y + xy)(y + 2)(y - 2)$

D. $(y + xy)(y + 2)(y - 2)$

32. If $g(x) = x^2 + 3x + 4, findg(x + 1) - g(x)$

A. $2(x + 2)$

B. $(x + 2)$

C. $(2x + 1)$

D. $x^2 + 4$

33. Factorize: $m^3 - 2m^2 - m + 2$

A. $(m + 1)(m + 1)(m + 2)$

B. $(m^2 + 1)(m - 2)$

C. $(m^2 + 2)(m - 1)$

D. $(m - 2)(m + 1)(m - 1)$

34. Which of the following is a factor of $rs + tr - pt - ps$

A. $(p - s)$

B. $(r - p)$

C. $(s - p)$

D. $(r + p)$

35. If $x + 1$ is a factor of: $x^3 + 3x^2 + kx + 4$, find the value of k

A. -6

B. 6

C. 8

D. -8

36. Factorize: $9p^2 - q^2 + 6qr - 9r^2$

A. $(3p - 3q + r)(3p - q)$

B. $(6p - 3q - 3r)(3p - q - 4r)$

C. $(3p - 3q + r)(3p - q - 3r)$

D. $(3p-3q+r)(3p-q+4r)$

37. if a function is defined by $f(x+1)=3x^2-x+4$, find $f(0)$
    A. 6
    B. 8
    C. 0
    D. 2
    E. 4

38. $f(x+2)=3x^2+4x+1$. find $f(1)$
    A. 32
    B. 40
    C. 8
    D. 32
    E. 21

39. Factorize: $6x^2-14x-12$
    A. $2(x+3)(3x-2)$
    B. $2(x-3)(3x+2)$
    C. $6(x-2)(x+1)$
    D. $6(x+2)(x-1)$
    E. $(3x+4)(2x+3)$

40. Factorize: $abx^2+8y-4bx-2axy$
    A. $(ax-4)(bx-2y)$
    B. $(bx-4)(ax-2y)$
    C. $(ax+b)(x-8y)$
    D. $(x-2y)(abx-4)$
    E. $(ax-2y)(by-4)$

41. Factorize: $1-(a-b)^2$
    A. $(1+a+b)(1-a-b)$
    B. $(1-a+b)(1+a-b)$
    C. $(1+a-b)(1-a+b)$
    D. $(1-a-b)(1-a+b)$
    E. $(1-a+b)(1+a+b)$

42. Which of the following is a factor of: $15+7x-2x^2$
    A. $x+3$
    B. $x-5$
    C. $x+5$
    D. $x-3$

43. Divide the expression: x^3+7x^2-x-7 by $-1+x^2$
    A. $x+7$
    B. $-x^3+7x^2-x-7$
    C. $x-7$
    D. $-x^2+7x+7$

44. Find a positve value of p if the expression: $2x^2-px+p$ leaves a remainder 6 when divided by $x-p$
    A. 1
    B. 2
    C. 3
    D. 4

45. When the expression: pm^2+qm+1 is divided by $(m-1)$, it has a remainder of 2 and when divided by $(m+1)$ the remainder is 4, find p and q respectively
    A. $-2,3$
    B. $2,-1$
    C. $-1,2$
    D. $3,-2$

46. Factorize: $r^2-r(2p+q)+2pq$
    A. $(r-q)(r-2p)$
    B. $(r-2q)(2r-p)$
    C. $(2r-p)(r+p)$
    D. $(r-p)(r+q)$

47. Divide $2x^3+11x^2+17x+6$ by $2x+1$
    A. x^2+5x+6
    B. x^2-5x+6
    C. $2x^2+5x+6$
    D. x^2+5x+6

48. Factorize completely: $x^2+2xy+y^2+3x+3y-18$
    A. $(x+y+6)(x+y-3)$
    B. $(x-y-6)(x-y+3)$
    C. $(x-y+6)(x-y-3)$
    D. $(x+y-6)(x+y+3)$

49. Divide $4x^3-3x+1$ by $2x-1$
    A. $2x^2-x+1$
    B. $2x^2+x-1$
    C. $2x^2-x-1$
    D. $2x^2+x+1$

50. if $(x-1)$, $(x+1)$ and $(x-2)$ are factors of the polynomial: ax^3+bx^2+cx-1, find a, b,c respectively.
    A. $\frac{-1}{2},1,\frac{1}{2}$
    B. $\frac{1}{2},1,\frac{1}{2}$
    C. $\frac{1}{2},-1,\frac{1}{2}$
    D. $\frac{1}{2},1,1\frac{1}{2}$

51. Factorize: $4x^2 - 9y^2 + 20x + 25$
    A. $(2x - 3y + 5)(2x - 3y - 5)$
    B. $(2x - 3y + 5)(2x + 3y + 5)$
    C. $(2x + 3y - 5)(2x + 3y + 5)$
    D. $(2x + 3y - 5)(2x - 3y - 5)$
    E. $(2x - 3y + 5)(2x - 3y - 5)$

52. Divide $a^{3x} - 26a^{2x} + 156a^x - 216$ by $a^{2x} - 24a^x + 108$
    A. $a^x + 2$
    B. $a^x - 2$
    C. $a^x - 18$
    D. $a^x - 6$

53. Find the values of x where the curve: $y = x^3 + 2x^2 - 5x - 6$ crosses the x axis
    A. $2, -1$ and -3
    B. $2, 1$ and 3
    C. $2, 1$ and -3
    D. $2, -1$ and 3

54. The Polynomial whose roots are $\frac{4}{3}$ and $-\frac{3}{5}$ is
    A. $15x^2 - 11x - 12$
    B. $12x^2 + 11x - 15$
    C. $12x^2 - x - 12$
    D. $15x^2 + 11x - 12$

55. If $9x^2 + 6xy + 4y^2$ is a factor of $27x^3 - 8y^3$, find the other factor
    A. $2y + 3x$
    B. $2y - 3x$
    C. $3x + 2y$
    D. $3x - 2y$

56. Factorize completely: $\dfrac{x^3 + 3x^2 - 10x}{2x^2 - 8}$
    A. $\dfrac{x(x-5)}{2(x-2)}$
    B. $\dfrac{x(x-5)}{2(x+2)}$
    C. $\dfrac{x(x+5)}{2(x+2)}$
    D. $\dfrac{x^2+5}{2x+4}$

57. Find the remainder when $3x^3 + 5x^2 + 11x - 4$ is divided by $x + 3$
    A. 1
    B. 4
    C. -4
    D. -1

58. Factorize completely: $ac - 2bc + a^2 + 4b^2$
    A. $(a - 2b)(c + a - 2b)$
    B. $(a - 2b)(c - a + 2b)$
    C. $(a - 2b)(c + a + 2b)$
    D. $(a - 2b)(c - a - 2b)$

59. Factorize $2y^2 - 15xy + 18x^2$
    A. $(2y - 3x)(y + 6x)$
    B. $(2y - 3x)(y - 6x)$
    C. $(3y + 2x)(y - 6x)$
    D. $(2y + 3x)(y - 6x)$

60. find the value of k if $y-1$ is a factor of: $y^3 + 4y^2 + ky - 6$
    A. -6
    B. -4
    C. 0
    D. 1

61. Divide: $6x^2 + 13x + 5$ by $2x + 1$
    A. $3x - 5$
    B. $3x + 5$
    C. $5x - 3$
    D. $5x + 3$

62. The polynomial whose roots are -2, -1 and 3 is
    A. $x^3 - 7x + 6$
    B. $x^3 + 7x - 6$
    C. $x^3 - 7x - 6$
    D. $x^3 + 7x + 6$

63. Find the value of k if the expression: $kx^3 + x^2 - 5x - 2$ if it leaves a remainder of 2 when divided by $2x + 1$
    A. 10
    B. -8
    C. -10
    D. 8

64. Find the roots of: $x^3 - 2x^2 - 5x + 6 = 0$
    A. $-1, -2, 3$
    B. $-1, 2, -3$
    C. $1, 2, -3$
    D. $1, -2, 3$

65. Factorize: $2t^2 + t - 15$
    A. $(t + 3)(2t - 5)$
    B. $(2t + 3)(t - 5)$
    C. $(t + 3)(t - 5)$

D. $(2t-3)(t+5)$

66. if $2x^2 - kx - 12$ is divisible by $x-4$, find the value of k

A. 4

B. 5

C. 6

D. 7

67. Solve for x in the equation: $x^3 - x + 5 = 0$

A. $-1, 1, -5$

B. $1, 1, 5$

C. $1, 1, -5$

D. $1, -1, 5$

68. Find the remainder when $x^3 - 2x^2 + 3x - 3$ is divided by $x^2 + 1$

A. $2x - 1$

B. $x + 3$

C. $2x + 1$

D. $3x - 3$

69. Find the remainder when: $2x^3 - 11x^2 + 8x - 1$ is divided by $x + 3$

A. -871

B. -781

C. -187

D. -178

70. Factorize: $(2x+3y)^2 + 2(2x+3y)(2x-3y) + (2x-3y)^2$

A. $16x^2$

B. $18x^2$

C. $12x^2$

D. none of the above

71. Factorize: $45a^3b + 5ab^3 - 30a^2b^2$

A. $5ab(3a-b)^2$

B. $7ab(5a-b)^2$

C. $5ab(5a-b)^2$

D. none of the above

72. Find the factors of $(a-b)^3 + (b-c)^3 + (c-a)^3$

A. $3(a+b)(b+c)(c+a)$

B. $3(a-b)(b-c)(c-a)$

C. $5(a-b)(b-c)(c-a)$

D. $5(a+b)(b-c)(c-a)$

73. Factorize: $a^2 + \dfrac{1}{a^2} + 3 - 2a - \dfrac{2}{a}$

A. $\left(a + \dfrac{1}{a} - 1\right)\left(a - \dfrac{1}{a} + 1\right)$

B. $\left(a + \dfrac{1}{a} + 1\right)\left(a + \dfrac{1}{a} + 1\right)$

C. $\left(a + \dfrac{1}{a} + 1\right)\left(a + \dfrac{1}{a} - 1\right)$

D. $\left(a + \dfrac{1}{a} - 1\right)\left(a + \dfrac{1}{a} - 1\right)$

74. Resolve into factors: $9(3x+5y)^2 - 12(3x+5y)(2x+3y) + 4(2x+3y)^2$

A. $(5x+9y)$

B. $(5x-9y)^2$

C. $(7x+9y)^2$

D. none of the above

75. Factorize: $(a-b+c)^2 + (b-c+a)^2 + 2(a-b+c)(b-c+a)$

A. $6a^2$

B. $4a^2$

C. $8a^2$

D. $10a^2$

76. Resolve into factors: $81x^2y^2 - 108xyz + 36z^2$

A. $(6xy+9z)^2$

B. $(9xy-7z)^2$

C. $(9xy+6z)^2$

D. $(6xy-7z)^2$

77. What value should a possess so that $x+1$ may be a factor of the polynomial.

$$f(x) = 2x^3 - ax^2 - (2a-3)x + 2$$

A. 3

B. 2

C. -2

D. none of the above

78. if $(x-2)$ is a factor of the polynomial $x^3 - 2ax^2 + ax - 1$, find the value of a.

A. $\dfrac{5}{6}$

B. $\dfrac{7}{6}$

C. $\dfrac{11}{6}$

D. none of the above

79. The remainder when: $6p^3 - p^2 - 47p + 30$ is divided by $p-3$ is

A. 21

B. 63

C. 18

D. 42

80. Factorize: $k^2 - 2kp + p^2$

A. $(k+p)^2$

B. $(k-p)^2$

C. $k^2 - p^2$

D. $k^2 + p^2$

81. If $x+1$ is a factor of x^3+3x^2+mx+4, find the value of m.

A. 8

B. -6

C. 6

D. -8

82. Divide the expression: $x^3 + 7x^2 - x - 7$ by $x^2 - 1$

A. $x - 1$

B. $x + 1$

C. $x - 7$

D. $x + 7$

83. If $x + a$ is a factor of the polynomial $x^3 + ax^2 - 2x + a + 4$, then find the value of a

A. $-\frac{4}{3}$

B. $\frac{4}{3}$

C. $\frac{2}{3}$

D. $-\frac{2}{3}$

84. Resolve into factors: $16x^2 - 72xy + 81y^2 - 12x + 27y$

A. $(6x - 7y)(6x - 7y - 5)$

B. $(6x - 7y)(6x - 7y + 5)$

C. $(4x + 9y)(4x + 9y + 3)$

D. $(4x - 9y)(4x - 9y - 3)$

85. Resolve into factors: $16(x-y)^2 - 9(x+y)^2$

A. $(x - 5y)(5x - y)$

B. $(x + 7y)(7x + y)$

C. $(x - 7y)(7x - y)$

D. $(x + 5y)(5x + y)$

86. Factorize the expression: $a^2 + \frac{1}{4} + a$

A. $\left(a+\frac{1}{2}\right)\left(a-\frac{1}{2}\right)$

C. $\left(a+\frac{1}{2}\right)^3$

B. $\left(a+\frac{1}{2}\right)^2$

D. $\left(a+\frac{1}{2}\right)\cdot a$

87. Resolve into factors: $(a+b)^2 - 2(a^2-b^2) + (a-b)^2$

A. $6b^2$

B. $4b^2$

C. $2b^2$

D. $8b^2$

88. Factorize the Expression: $(a+b)^2 - 14c(a+b) + 49c^2$

A. $(a - b - 9c)^3$

B. $(a + b + 9c)^2$

C. $(a + b - 7c)^2$

D. none of the above

89. When a polynomial $f(x)$ is divided by $x-3$ and $x+6$, the respective remainders are 7 and 22. What is the remainder when $f(x)$ is divided by $(x-3)(x+6)$?

A. $\frac{-5}{3}x + 12$

B. $\frac{-7}{3}x + 14$

C. $\frac{-5}{3}x + 16$

D. $\frac{-7}{3}x + 12$

90. When $4x^3 - ax^2 + bx + 4$ is divided by $x - 2$ and $x + 1$, the respective remainders are 20 and -13. Find the values of a and b.

A. $a = 3, b = 2$

B. $a = 9, b = 8$

C. $a = 7, b = 6$

D. $a = 5, b = 4$

91. When $(x^3 - 2x^2 + px - q)$ is divided by $x^2 - 2x - 3$ the remainder is $(x - 6)$. The values of p and q are:

A. $p = -2, q = -6$

B. $p = 2, q = -6$

C. $p = 2, q = 6$

D. $p = -2, q = 6$

92. if $(x - 1)$ is a factor of $ax^3 + bx^2 - 36x + 22$ and $2^b = 64^a$. Find a and b.

A. $a = 4, b = 16$

B. $a = 6, b = 24$

C. $a = 2, b = 12$

D. $a = 8, b = 16$

93. if $2apq = (p+q)^2 - (p-q)^2$, then the value of a is
    A. 1
    B. 2
    C. 4
    D. 8

94. What is the value of $\dfrac{(a^2+b^2)(a-b)-(a-b)^3}{a^2b-ab^2}$
    A. -1
    B. -2
    C. 1
    D. 2

95. Find the value of m and n in the polynomials $2x^3 + mx^2 + nx - 14$, such that $(x-1)$ and $(x+2)$ are its factors
    A. $m = 4, n = 5$
    B. $m = 9, n = 3$
    C. $m = 6, n = 7$
    D. none of the above

96. Divide the polynomial $4y^3 - 3y^2 + 2y - 4$ by $y+2$ and find the quotient and remainder
    A. $4y^2 - 11y + 24, -52$
    B. $6y^2 - 13y + 36, -64$
    C. $4y^2 + 13y - 24, 52,$
    D. none of the above

97. Suppose that b and c are constants and
$$(x+2)(x+b) = x^2 + cx + 6$$
what is c ?
    A. -5
    B. -3
    C. -1
    D. 3
    E. 5

98. Simplify the expression: $x^3 + 3x + \dfrac{3}{x} + \dfrac{1}{x^3}$
    A. $\left(x - \dfrac{1}{3}\right)^3$
    B. $\left(x - \dfrac{1}{x}\right)^3$
    C. $\left(x - \dfrac{3}{x}\right)^3$
    D. $\left(x + \dfrac{1}{x}\right)^3$

99. if $(x^{3/2} - xy^{1/2} + x^{1/2}y - y^{3/2})$ is divided by $(x^{1/2} - y^{1/2})$, the quotient is
    A. $x^{1/2} + y^{1/2}$
    B. $x^2 - y^2$
    C. $x - y$
    D. $x + y$

100. Let $f(x) = a_0x^n + a_1x^{n-1} + a_2x^{n-2} + \cdots + a_{n-1}x + a_n$, where, $a_0, a_1, a_2, \cdots, a_n$ are constants. If $f(x)$ is divided by $ax - b$, then the remainder is
    A. $f\left(\dfrac{b}{a}\right)$
    B. $f\left(\dfrac{-b}{a}\right)$
    C. $f\left(\dfrac{a}{b}\right)$
    D. $f\left(\dfrac{-a}{b}\right)$

2.1.2 Answers

1. **(A)** For the expression $f(\underbrace{x+2})$ to equal -1, the value of x has to be -3
put -3 into the equation,

$$\begin{aligned} f(-1) &= 2(-3)^2 + 7(-3) - 5 \\ &= 2(9) - 21 - 5 \\ &= 18 - 21 - 5 = -8 \end{aligned}$$

2. **(B)** $a^2x + a^2y - b^2y - b^2x$
$\Rightarrow a^2(x+y) - b^2(x+y)$
$= (a^2 - b^2)(x+y)$
$= (a+b)(a-b)(x+y)$

3. **(A)** for $x - 1 = 0, x = 1$ and $x + 1 = 0, x = -1$
substituting $x = 1$ into $x^3 + px^2 + qx + 6 = 0$

$$\begin{aligned} (1)^3 + p(1)^2 + q(1) + 6 &= 0 \\ 1 + p + q + 6 &= 0 \\ p + q + 7 &= 0 \\ \therefore p + q &= -7 \qquad ...(i) \end{aligned}$$

Similarly, for $x = -1$

$$\begin{aligned} (-1)^3 + p(-1)^2 + q(-1) + 6 &= 0 \\ -1 + p - q + 6 &= 0 \\ p - q + 5 &= 0 \\ p - q &= -5 \qquad ...(ii) \end{aligned}$$

Solving by Elimination

$$\begin{aligned} p + q &= -7 \qquad ...(i) \\ p - q &= -5 \qquad ...(ii) \\ 2p &= -12 \quad \Rightarrow p = -6 \end{aligned}$$

substitute $p = -6$ in any equation

$$p + q = -7 \Rightarrow -6 + q = -7 \Rightarrow q = -1$$

$\therefore p$ and q are -6 and -1 respectively

4. **(B)** First resolve $x^2 - 1$ to $(x-1)(x+1)$ difference of two square

$$\therefore \quad \frac{x-1}{x^2-1} = \frac{\cancel{x-1}}{\cancel{(x-1)}(x+1)} = \frac{1}{x+1}$$

Now, $\quad \dfrac{1}{x-1} + \dfrac{x-1}{x^2-1} = \dfrac{1}{x-1} + \dfrac{1}{x+1}$

Replace all x with $1 - x$

$$\begin{aligned} \frac{1}{(1-x)-1} + \frac{1}{(1-x)+1} &= -\frac{1}{x} + \frac{1}{2-x} \\ &= -\frac{1}{x} - \frac{1}{x-2} \end{aligned}$$

Explanation: $\dfrac{1}{2-x} = \dfrac{1}{-(-2+x)} = \dfrac{1}{-(x-2)}$
$= -\dfrac{1}{x-2}$

5. $(x + 3y + 5)(2x^2 + 5y + 2)$
$= 2x^3 + 5xy + 2x + 6x^2y + 15y^2 + 6y + 10x^2 + 25y + 10$
$= 2x^3 + 6x^2y + 5xy + 15y^2 + 31y +$

6. If $x-1$ divides $kx^3 + 10x^2 + lx - 3$, means substituting $x = 1$ in the equation the result is 0

$$\begin{aligned} k(1)^3 + 10(1)^2 + l(1) - 3 &= 0 \\ k + 10 + l - 3 &= 0 \\ k + l + 7 &= 0 \\ k + l &= -7 \qquad \text{(i)} \end{aligned}$$

but if you subsittute for $x = 2$ you get 27

$$\begin{aligned} k(-2)^3 + 10(-2)^2 + l(-2) - 3 &= 27 \\ -8k + 40 - 2l - 3 &= 27 \\ -8k - 2l + 37 &= 27 \\ -8k - 2l &= 27 - 37 \\ -2(4k + l) &= -10 \\ 4k + l &= 5 \qquad \text{(ii)} \end{aligned}$$

Substracting equ(i) from equ(ii)

$$\begin{aligned} k + l &= -7 \\ -\ 4k + l &= 5 \\ (k - 4k) + (l - l) &= -7 - 5 \\ -3k &= -12 \\ \frac{\cancel{-3}k}{\cancel{-3}} &= \frac{\cancel{-12}^{\,4}}{\cancel{-3}} \end{aligned}$$

$\therefore k = 4,$ substitute $k = 4$ in any equation

$$k + l = -7 \ \Rightarrow 4 + l = -7 \ \Rightarrow l = -11$$

$\therefore k = 4$ and $l = -11$

7. **(E)**

$$\begin{array}{r} 3x^2 + 7x - 6 \\ x - 1 \,\overline{)\,3x^3 + 4x^2 - 13x + 6} \\ -\ \underline{3x^3 - 3x^2} \\ 7x^2 - 13x \\ -\ \underline{7x^2 - 7x} \\ -6x + 6 \\ -\ \underline{-6x + 6} \\ \underline{\quad - \quad} \end{array}$$

Find the roots of $3x^2+7x-6=0$ using factorization

$$\begin{aligned}3x^2+7x-6 &= 3x^2+9x-2x-6\\ &= 3x(x+3)-2(x+3)\\ &= (3x-2)(x+3)\end{aligned}$$

$\therefore$ the roots are $(x-1)(x+3)(3x-2)$

8. $(x^2+x+1)(x^2-x+1)$
$= x^4-x^3+x^2+x^3-x^2+x+x^2-x+1$
$= x^4-x^3+x^3+x^2-x^2+x^2+x-x+1$
$= x^4+x^2+1$

9.

$$\begin{array}{r} x^2-x-6 \\ x-1\overline{)\,x^3-2x^2-5x+6} \\ \underline{-\,x^3-x^2} \\ -x^2-5x \\ \underline{-\,x^2+x} \\ -6x+6 \\ \underline{-\,6x+6} \\ \underline{\quad---} \end{array}$$

Now solve the Quadratic equation

$$\begin{aligned}x^2-x-6 &= x^2-3x+2x-6=0\\ &= x(x-3)+2(x-3)=0\\ &= (x+2)(x-3)=0\end{aligned}$$

$\therefore x=-2$ or 3, so its other roots are 3 and -2

10. for $x-1=0$ substitute $x=1$

$$\begin{aligned}lx^3+2kx^2+24 &= l(1)^3+2k(1)^2+24=0\\ &= 3l+2k+24=0\\ &= 3l+2k=-24 \quad ...(i)\end{aligned}$$

for $x+2=0$ substitute $x=-2$

$$\begin{aligned}lx^3+2kx^2+24 &= l(-2)^3+2k(-2)^2+24=0\\ &= -8l+8k+24=0\\ &= -l+k+3=0\\ &= -l+k=-3 \quad ...(ii)\end{aligned}$$

We would be solving by Elimation to take out k, so we would have to modify $-l+k=-3$ into $-2l+2k=-6$ by multiplying by 2
So, because the sign of the k on both equation are same, we would use substraction

$$\begin{aligned}&3l+2k=-24 \quad ...(i)\\ -\ &(-2l+2k=-6) \quad ...(ii)\\ &5l=18 \Rightarrow l=\frac{18}{5}\end{aligned}$$

substitute $l=\frac{18}{5}$ into any equation

$$\begin{aligned}-l+k=-3 &\Rightarrow -\frac{18}{5}+k=-3\\ k &= -3+\frac{18}{5}=\frac{3}{5}\end{aligned}$$

11. **(E)** $81a^4-16b^4 = (9a^2)^2-(4b^2)^2 = \underbrace{(9a^2-4b^2)}(9a^2+4b^2)$
$= ((3a)^2-(2b)^2)(9a^2+4b^2)$
$= (3a-2b)(3a+2b)(9a^2+4b^2)$

12. $4a^2-9b^2=(2a)^2-(3b)^2=(2a-3b)\underbrace{(2a+3b)}$
$(4a+6b)^2=(2(2a+3b))^2=2^2\underbrace{(2a+3b)}^2$
$8a^3+27b^3=(2a)^3+(3b)^3$
To simplify $(2a)^3+(3b)^3$, we should call $2a=p$ and $3b=q$, and just follow along.

$$\begin{aligned}(p+q)^3 &= p^3+3p^2q+3pq^2+q^3\\ (p+q)^3 &= p^3+q^3+3pq(p+q)\\ (p+q)^3-3pq(p+q) &= p^3+q^3\\ (p+q)((p+q)^2-3pq) &= p^3+q^3\end{aligned}$$

So, let replace them back,
$\Rightarrow (2a)^3+(3b)^3=\underbrace{(2a+3b)}\,((2a+3b)-3(2a)(3b))$
$\therefore (2a+3b)$ is common to all 3 expressions

13. kaldk label ajdkj lfkasld

14. **Advice:** *you shouldn't be tempted to expand every expression you see, as for this question* 9 *is a perfect square, so this allow the use of* difference of two square

$$\boxed{p^2-q^2=(p+q)(p-q)}$$

$9-(x^2-3x-1)^2=\underbrace{3^2}_{p}-\underbrace{(x^2-3x-1)}_{q}^2$
$= (3-(x^2-3x-1))(3+(x^2-3x-1))$
$= (3-x^2+3x+1)(3+x^2-3x-1)$
$= (-x^2+3x+4)(x^2-3x+2)$
lets resolve each part,

$$\begin{aligned}-x^2+3x+4 &= -x^2-x+4x+4\\ &= -x(x+1)+4(x+1)\\ &= (-x+4)(x+1)\\ x^2-3x+2 &= x^2-x-2x+2\\ &= x(x-1)-2(x-1)\\ &= (x-2)(x-1)\end{aligned}$$

The factors are $(-x+4)(x+1)(x-2)(x-1)$

15. **(D)** $f(x-2)=4x^2+x+7$ equate $x-2=1 \Rightarrow x=3$

$$\begin{aligned}f(x-2) &= 4x^2+x+7\\ \Rightarrow f(3-2)=f(1) &= 4(3)^2+3+7\\ &= 36+10=46\end{aligned}$$

16. replace all $y's$ with $y+3$

$$g(y) = \frac{y-3}{11} + \frac{11}{y^2-9}$$
$$\Rightarrow g(y+3) = \frac{(y+3)-3}{11} + \frac{11}{(y+3)^2-9}$$
$$= \frac{y}{11} + \frac{11}{y^2+6y+9-9}$$
$$= \frac{y}{11} + \frac{11}{y^2+6y} = \frac{y}{11} + \frac{11}{y(y+6)}$$

17.

18. (C)

$$x^2+2a+ax+2x = x^2+ax+2a+2x$$
$$= x(x+a)+2(x+a)$$
$$= (x+2)(x+a)$$

19.

20. Applying difference of two square

$$p^2-q^2 = (p+q)(p-q)$$

$$\Rightarrow [\underbrace{(4a+3)}_{p} + \underbrace{(3a-2)}_{q}][\underbrace{(4a+3)}_{p} - \underbrace{(3a-2)}_{q}]$$
$$= (7a+1)(a+5)$$

21. (D) We should first reduce the equation to its quadratic form

$$\begin{array}{r} x^2+2x-8 \\ x-2\overline{)\,x^3-12x-16} \\ -\ \underline{x^3-2x^2} \\ \quad 2x^2-12x \\ -\ \underline{2x^2-4x} \\ \quad -8x-16 \\ -\ \underline{(-8x-16)} \end{array}$$

Factorizing the equation into roots

$$x^2+2x-8=0 \Rightarrow x^2+4x-2x-8=0$$
$$= x(x+4)-2(x+4)$$
$$= (x-2)(x+4)$$

$x^3-12x-16 = (x-2)(x-2)(x+4)$
$\therefore$ the equation has 2 equal roots and a third different root

22. (D) for $x+1=0, \Rightarrow x=-1$ is a root
substituting $x=-1$ in the equation

x^3-4x^2+cx+d
$$= (-1)^3-4(-1)^2+c(-1)+d=0$$
$$= -1-4-c+d=0$$
$$= -c+d=5$$

Substituting $x=-2$ gives 1
x^3-4x^2+cx+d
$$= (-2)^3-4(-2)^2+c(-2)+d=1$$
$$= -8-16-2c+d=1$$
$$= -2c+d=25$$

Adding the two Equations

$$-c+d=5$$
$$\text{—}\ 2c+d=25$$
$$c=-20$$

substitute $c=-20$ in any equation

$$-c+d=-(-20)+d=5$$
$$\Rightarrow\ d=5-20=-15$$

$\therefore c=-20$ and $d=-15$

23.

24. Using the difference of two sqauare's

$$p^2-q^2=(p+q)(p-q)$$
$(x^2+x)^2-(2x+2)^2$
$$= \left[(x^2+x)+(2x+2)\right]\left[(x^2+x)-(2x+2)\right]$$
$$= \left[x^2+x+2x+2\right]\left[x^2+x-2x-2\right]$$
$$= [x(x+1)+2(x+1)]\,[x(x+1)-2(x+1)]$$
$$= (x+1)(x+1)(x+2)(x-2)$$
$$= (x+1)^2(x+2)(x-2)$$

25. given $f(x)=2x^2+5x+3$, replace all x with $x+1$

$$f(x+1) = 2(x+1)^2+5(x+1)+3$$
$$= 2(x^2+2x+1)+5(x+1)+3$$
$$= 2x^2+4x+2+5x+1+3$$
$$= 2x^2+9x+6$$

26. (A)

$$\begin{array}{r} x^2+2^{-1}x-4^{-1} \\ x-2^{-1}\overline{)\,x^3-8^{-1}} \\ -\ \underline{x^3-2^{-1}x^2} \\ \quad 2^{-1}x^2-8^{-1} \\ -\ \underline{2^{-1}x^2-4^{-1}x} \\ \quad -4^{-1}x-8^{-1} \\ -\ \underline{4^{-1}x-8^{-1}} \\ \quad \text{-----} \end{array}$$

the other factor is $x^2+2^{-1}x-4^{-1}$

27. **(D)** By careful inspection we notice that the question allows us use difference of two squares $9(x+y)^2 - 4(x-y)^2$
Let's make it more useful
$\underbrace{[3(x+y)]}_{p}^2 - \underbrace{[2(x-y)]}_{q}^2$

$$= [3(x+y) - 2(x-y)]\,[3(x+y) + 2(x-y)]$$
$$= (3x+3y-2x+2y)\,(3x+3y+2x-2y)$$
$$= (x+5y)(5x-y)$$

28. **(C)** The first thing to notice is that 4 and 9 are perfect square secondly, they share factors with 12
$4a^2 - 12ab - c^2 + 9b^2 = (2a)^2 - 2\cdot 2a\cdot 3b - c^2 + (3b)^2$
let $p = 2a$ and $q = 3b$

$$= (2a)^2 - 2\cdot 2a\cdot 3b - c^2 + (3b)^2$$
$$= p^2 - 2\cdot p\cdot q - c^2 + q^2$$
$$= p^2 - 2pq - c^2 + q^2$$
$$= p^2 - 2pq + q^2 - c^2 = (p-q)^2 - c^2$$

Applying difference of two squares

$$(p-q)^2 - c^2 = (p-q-c)(p-q+c)$$

replacing them with their initial values

$$(2a-3b)^2 - c^2 = (2a-3b-c)(2a-3b+c)$$

29. **(B)**

$$\frac{1}{2}(3y-4x)^2 = \frac{1}{2}(3y-4x)(3y-4x)$$
$$= \frac{1}{2}(9y^2 - 12xy - 12xy + 16x^2)$$
$$= \frac{1}{2}(9y^2 - 24xy + 16x^2)$$
$$= (\frac{9}{2}y^2 - 12xy + 8x^2)$$
$$= (8x^2 - 12xy + \frac{9}{2}y^2)$$
$$= (8x^2 + (-12)xy + \frac{9}{2}y^2)$$

by direct comparison
$(8x^2 + (-12xy) + \frac{9}{2}y^2) = (8x^2 + kxy + ly^2)$
$k = -12$ and $l = \frac{9}{2}$

30. **(C)** for $x - 4 = 2, x = 6$

$$f(6-4) = f(2) = 6^2 + 2(6) + 3$$
$$= 36 + 12 + 3 = 51$$

31. **(D)** $y^3 - 4xy + xy^3 - 4y$
$= y^3 + xy^3 - 4xy - 4y$
$= y^3(1+x) - 4y(x+1)$
$= (y^3 - 4y)(x+1)$
$= y(\underbrace{y^2 - 4}_{})(x+1)$
$= y\,\underbrace{(y-2)(y+2)}_{}(x+1)$
$= y(x+1)(y+2)(y-2)$
$= (y+xy)(y+2)(y-2)$
Never forget that you might have to use difference of two square, which was what is used to evaluate $y^2 - 4$

32. **(A)**

$$g(x+1) = (x+1)^2 + 3(x+1) + 4$$
$$g(x) = x^2 + 2x + 4$$
$$g(x+1) - g(x) = (x+1)^2 - x^2 + 3(x+1)$$
$$- 3x + 4 - 4$$
$$= (x+1-x)(x+1+x)$$
$$+ 3x + 3 - 3x$$
$$= 2x + 1 + 3 = 2x + 4 = 2(x+2)$$

33. **(D)**

$$m^3 - m - 2m^2 + 2 = m(m^2-1) - 2(m^2-1)$$
$$= (m-2)(m^2 - 1^2)$$
$$= (m-2)(m-1)(m+1)$$

34. **(B)**

$$= rs - ps + tr - pt$$
$$= s(r-p) + t(r-p)$$
$$= (s+t)(r-p)$$

$\therefore \quad (r-p)$ is a factor

35. **(A)** if $x+1$ is a factor, $\therefore$ the value of the $x^3 + 3x^2 + kx + 4 = 0$ when $x = -1$

$$x^3 + 3x^2 + kx + 4 = (-1)^3 + 3(-1)^2 + k(-1) + 4$$
$$= -1 + 3 - k + 4 = 0$$
$$k = -6$$

36. Notice, $-q^2, 6qr$ and $-9r^2$ all have a q, r or both and $9p^2$ can be expressed as $(3r)^2$, the best i can think of is a difference of two squares.

$$9p^2 - q^2 + 6qr - 9r^2 = (3p)^2 - \underbrace{(9r^2 - 6qr + q^2)}_{\text{like quadratic}}$$

$9r^2 - 6qr + q^2$ can be expressed without q, $9r^2 - 6r + 1$

$$9r^2 - 6r + 1 = 9r^2 - 3r - 3r + 1$$
$$= 3r(3r-1) - (3r-1)$$
$$= (3r-1)^2$$
$$9r^2 - 6qr + q^2 = (3r-q)^2$$
$$9p^2 - q^2 + 6qr - 9r^2 = (3p)^2 - (3r-q)^2$$
$$= (3p + 3r - q)(3p - 3r + q)$$

37. **(B)** $x+1=0$ when $x=-1$

$$\begin{aligned} f(0)=f(-1+1)&=3(-1)^2-(-1)+4\\ &=3+1+4=8 \end{aligned}$$

38. $x+2=1$ at $x=-1$

$$\begin{aligned} f(1)=f(-1+2)&=3(-1)^2+4(-1)+1\\ &=3-4+1=0 \end{aligned}$$

39. **(B)** they all share factors with 2

$$\begin{aligned} 2(3x^2-7x-6)&=2(3x^2-9x+2x-6)\\ &=2\left(3x(x-3)+2(x-3)\right)\\ &=2(x-3)(3x+2) \end{aligned}$$

40. **(A)** $abx^2-4bx-2axy+8y$
$=bx(ax-4)-2y(ax-4)$
$=(ax-4)(bx-2y)$

41. **(C)** $1^2-(a-b)^2=(1+a-b)(1-a+b)$

42. **(B)**

$$\begin{aligned} -2x^2+7x+15&=-2x^2+10x-3x+15\\ &=-2x(x-5)-3(x-5)\\ &=(-2x-3)\underbrace{(x-5)}_{factor} \end{aligned}$$

43. **(A)** I'd like to take a different approach for this problem rather than long division

$$\begin{aligned} \frac{x^3-x+7x^2-7}{x^2-1}&=\frac{x(x^2-1)+7(x^2-1)}{x^2-1}\\ &=\frac{(x+7)\cancel{(x^2-1)}}{\cancel{x^2-1}}=x+7 \end{aligned}$$

44. if $x-p$ leaves remainder of 6
$2(p)^2-p(p)+p=6 \quad\Rightarrow \underbrace{p}_{2}\underbrace{(p+1)}_{3}=6$
$\therefore \quad p=2$

45. when divided by $(m-1)$ the remainder is 2
$\therefore p(1)^2+q(1)+1=2$ and $p+q=1$
when divided by $(m+1)$, remainder is 4
$p(-1)^2+q(-1)=p-q=4$

$$\begin{aligned} p+q&=2 \qquad ...(i)\\ +\ p-q&=4 \qquad ...(ii)\\ 2p&=6, \quad p=3, q=-1 \end{aligned}$$

46. **(A)** $r^2-2pr-rq+2pq=r^2-rq-2pr+2pq$
$=r(r-q)-2p(r-q)=(r-q)(r-2p)$

47. **(A)**

$$\begin{array}{r} x^2+5x+6 \\ 2x+1\ \overline{)\,2x^3+11x^2+17x+6} \\ -\ \underline{2x^3+x^2} \\ 10x^2+17x \\ -\ \underline{10x^2+5x} \\ 12x+6 \\ -\ \underline{12x+6} \\ \underline{\quad----} \end{array}$$

48. **(A)** $x^2+2xy+y^2=(x+y)^2$
$(x+y)^2+3(x+y)-18=0$ let $x+y=k$

$$\begin{aligned} k^2+3k-18&=k^2+6k-3k-18\\ &=k(k+6)-3(k+6)\\ &=(k+6)(k-3) \end{aligned}$$

replace k back $(x+y+6)(x+y-3)$

49.

$$\begin{array}{r} 2x^2+x-1 \\ 2x-1\ \overline{)\,4x^3-3x+1} \\ -\ \underline{4x^3-2x^2} \\ 2x^2-3x \\ -\ \underline{2x^2-x} \\ -2x+1 \\ -\ \underline{-2x+1} \\ \underline{\quad----} \end{array}$$

50.

51. **(B)** $-9y^2=-(3y)^2$ carries the (-ve) sign, so this is a difference of two square problem. We would rearrange

$$(4x^2+20x+25)-9y^2$$

producing a square for the left hand side

$$\begin{aligned} 4x^2+20x+25&=4x^2+10x+10x+25\\ &=2x(2x+5)+5(2x+5)\\ &=(2x+5)^2 \end{aligned}$$

$$(2x+5)^2-(3y)^2=(2x+5-3y)(2x+5+3y)$$

52. **(B)** To avoid difficulties let $a^x=p$
now divide $p^3-26p^2+156p-216$ by $p^2-24p+108$

$$\begin{array}{r} p-2 \\ p^2-24p+108\ \overline{)\,p^3-26p^2+156p-216} \\ -\ \underline{p^3-24p^2+108p} \\ -2p^2+48p-216 \\ -\ \underline{-2p^2+48p-216} \\ \underline{\quad--------} \end{array}$$

The result is $p-2=a^x-2$

53.

54. **(A)** $x = \frac{4}{3}$ and $x = -\frac{3}{5}$, $\therefore x - \frac{4}{3} = 0$ and $x + \frac{3}{5} = 0$

$$\left(x - \frac{4}{3}\right)\left(x + \frac{3}{5}\right) = x^2 + \frac{3}{5}x - \frac{4}{3}x + \left(-\frac{4}{3} \times \frac{3}{5}\right)$$
$$= x^2 + \frac{9-20}{15}x - \frac{4}{5} = 0$$
$$= x^2 - \frac{11}{15}x - \frac{4}{5} = 0$$
$$= 15x^2 - 11x - 12 = 0$$

55.

$$\begin{array}{r} 3x - 2y \\ 9x^2 + 6xy + 4y^2 \;\overline{)\; 27x^3 - 8y^3} \\ \underline{-\;27x^3 + 18x^2y + 12xy^2} \\ -18x^2y - 12xy^2 - 8y^3 \\ \underline{-\;-18x^2y - 12xy^2 - 8y^3} \\ \underline{\qquad\qquad\qquad\qquad} \end{array}$$

The other factor is $3x - 2y$

56. **(C)**
$$\frac{x(x^2+3x-10)}{2(x^2-4)} = \frac{\cancel{x(x-2)}(x+5)}{2\cancel{(x-2)}(x+2)} = \frac{x(x+5)}{2(x+2)}$$

$$x^2 + 3x - 10 = x^2 + 5x - 2x - 10$$
$$= x(x+5) - 2(x+5)$$
$$= (x-2)(x+5)$$
$$x^2 - 4 = x^2 - 2^2 = (x-2)(x+2)$$

57.

58. for $x + 3 = 0, x = -3$, subsitute $x = -3$ into the polynomial

$$3(-3)^3 + 5(-3)^2 + 11(-3) - 4 = -81 + 45 - 33 - 4$$

59. **(B)** solve it without one of the variable, i'd work without x

$$2y^2 - 15y + 18 = 2y^2 - 12y - 3y + 18$$
$$= 2y(y-6) - 3(y-6)$$
$$= (2y-3)(y-6)$$

Replace the x on those without any variable

$$(2y - 3x)(y - 6x)$$

60. if $y - 1$ is a factor then 1 is a root

$$1^3 + 4(1)^2 + k(1) - 6 = 0$$
$$3 + 4 + k - 6 \;\Rightarrow\; k = -1$$

61. **(B)**

$$6x^2 + 3x + 10x + 5 = 3x(2x+1) + 5(2x+1)$$
$$= (3x+5)(2x+1)$$

62. **(C)** if $-2, -1$ and 3 are roots, then $(x+2), (x+1)$ and $(x-3)$ are factors

$$(x+2)(x+1)(x-3) = 0$$
$$(x^2 + 2x + x + 2)(x-3) = 0$$
$$(x^2 + 3x + 2)(x-3) = 0$$
$$x^3 - 3x^2 + 3x^2 - 9x + 2x - 6 = 0$$
$$x^3 - 7x - 6 = 0$$

63. for $2x + 1 = 0, x = -\frac{1}{2}$

$$k\left(-\frac{1}{2}\right)^3 + \left(-\frac{1}{2}\right)^2 - 5\left(-\frac{1}{2}\right) - 2 = 2$$
$$-\frac{k}{8} + \frac{1}{4} + \frac{5}{2} = 4 \quad \rightarrow -k + 2 + 20 = 16 \quad \rightarrow k = 6$$

64. start with trial and error, for $x = 1$

$$(1)^3 - 2(1)^2 - 5(1) + 6 = 0$$

Since 1 is a root and $(x-1)$ is a factor
i'd take a different approach, rather than the long division using synthethic division
Divide $x^3 - 2x^2 - 5x + 6 = 0$ by $x - 1$

- hello man

65.

$$2t^2 - 5t + 6t - 15 = 2t(t+3) - 5(t-3) = (2t-5)(t+3)$$

66. **(B)** $2(4)^2 - k(4) - 12 = 32 - 4k - 12 = 0 \rightarrow k = 5$

67.

68. **(A)** Long Division works for this, so use it. let's work it out manually

$$x^3 - 2x^2 + 3x - 3 = x^3 + x - 2x^2 + 2x - 3$$
$$= x(x^2+1) - 2x^2 - 2 + 2x - 1$$
$$= x(x^2+1) - 2(x^2+1) + (2x-1)$$

So we see all the parts are divisible by $x^2 + 1$ except $2x - 1$ because we can't factor $x^2 + 1$ from it, $\therefore$ the remainder is $2x - 1$

69. **(D)** Substitute $x = -3$
$2(-3)^3 - 11(-3)^2 + 8(-3) - 1$

$$= 2(-27) - 11(9) - 24 - 1$$
$$= -54 - 99 - 24 - 1 = -178$$

70. **(A)** let $2x+3y=k$ and $2x-3y=p$, then we can rewrite it as

$$k^2+2kp+p^2=(k+p)^2=(2x+3y+2x-3y)^2$$
$$=(4x)^2=16x^2$$

71. **(D)**

5	$45a^3b$	$5ab^3$	$-30a^2b^2$
a	$9a^3b$	ab^3	$-6a^2b^2$
b	$9a^2b$	b^3	$-6a^2b^2$
	$9a^2$	b^2	$-6a^2b$

$\therefore\ 5ab(9a^2+b^2-6a^2b)$

72. **(B)** let $(a-b)=p,(b-c)=q$ and $c-a=r$

$$p^3+q^3+r^3=(p+q+r)^3-3pq(p+q+r)$$
$$-3pr(p+q+r)-3qr(p+q+r)+3pqr$$

Working on each of them
$(p+q+r)^3=(a-b+b-c+c-a)^3=0$
so every part that has $(p+q+r)=0$, except

$$3pqr=3(a-b)(b-c)(c-a)$$

if this was an exam like jamb, my first choice would have been B, because after replacement the values they would most likely retain themselves and 3 and 6 are usually the coefficient of any cubic expansion

73. **(B)** $-2a-\dfrac{2}{a}=-2\left(a+\dfrac{1}{a}\right)$

$\therefore\ a^2+\dfrac{1}{a^2}-2\left(a+\dfrac{1}{a}\right)+3$

$\left(a+\dfrac{1}{a}\right)^2=a^2+\dfrac{1}{a^2}+2a\cdot\dfrac{1}{a}=a^2+\dfrac{1}{a^2}+2$

$\therefore a^2+\dfrac{1}{a^2}=\left(a+\dfrac{1}{a}\right)^2-2$

let's compose the question as:

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

replacing the value of k back

$$(k+1)^2=\left(a+\frac{1}{a}+1\right)\left(a+\frac{1}{a}+1\right)$$

74. let $3x+5y=k$ and $2x+3y=p$

$$\therefore\ 9k^2-12kp+4p^2=9k^2-6kp-6kp+4p^2$$
$$=3k(k-p)-4p(3k-p)$$

75. **(B)** let $a-b+c=k$ and $b-c+a=p$
$\therefore k^2+2kp+p^2=k^2+kp+kp+p^2=(k+p)^2$
$\Rightarrow\ (a-b+c+b-c+a)^2=(2a)^2=4a^2$

76. $81(xy)^2-108(xy)z+36z^2$

$$=9\left(9(xy)^2-12(xy)z+4z^2\right)$$
$$=9\left(9(xy)^2-6(xy)z-6(xy)z+4z^2\right)$$
$$=9\left(3xy(3xy-2z)-2z(3xy-2z)\right)$$
$$=9\left(3xy-2z\right)\left(3xy-2z\right)=9(3xy-2z)^2$$
$$=3^2(3xy-2z)^2=(3\cdot(3xy-2z))^2=(9xy-6z)^2$$

77. **(A)** if $(x+1)$ is a factor, then -1 is a root, $\therefore f(-1)=0$

$$f(-1)=2(-1)^3-a(-1)^2-(2a-3)(-1)+2=0$$
$$=-2-a+2a-3+2=a-3=0,\ \ \therefore a=3$$

78. **(B)** If $x-2$ is a factor, then 2 is a root
$(2)^3-2a(2)^2+a(2)-1$
$$=8-8a+2a-1=-6a+7=0$$
$$\Rightarrow -6a=-7,\quad \therefore\ a=\frac{7}{6}$$

79. sustitute $p=3$ into the polynomial

$$6(3)^3-(3)^2-47(3)+30=$$

80. **(A)** $k^2-kp-kp+p^2=k(k-p)-p(k-p)=(k-p)^2$

81. **(C)** substitute $x=-1$ into the polynomial, and then equate it to zero because $x+1$ is a factor

$$(-1)^3+3(-1)^2+m(-1)+4=-1+3-m+4=0$$
$$=6-m=0,\ \therefore m=6$$

82. **(D)**

$$\begin{array}{r} x+7 \\ x^2-1\ \overline{)\ x^3+7x^2-x-7} \\ -\ \underline{x^3-x} \\ \quad 7x^2-7 \\ -\ \underline{7x^2-7} \\ \quad ---- \end{array}$$

83. then $x=-a$ is a root

$$\Rightarrow\ (-a)^3+a(-a)^2-2(-a)+a+4=0$$
$$=-a^3+a^3+2a+a+4=3a+4=0\quad \therefore a=-\frac{4}{3}$$

84. **(D)** we can rewrite the entire expression like so:
$(4x)^2-2(4x)(9y)+(9y)^2-3(4x)+3(9y)$

let $4x$ and $9y$ be a and b respectively

$$\underbrace{a^2-2ab+b^2}_{(a-b)^2}-3(a-b)=(a-b)^2-3(a-b)$$
$$=(a-b)(a-b-3)$$
$$=(4x-9y)(4x-9y-3)$$

85. **(C)** $4^2(x-y)^2 - 3^2(x+y)$

$$= [\underbrace{4(x-y)}_{a}]^2 - [\underbrace{3(x+y)}_{b}]^2$$
$$= [4(x-y) - 3(x+y)]\,[4(x-y) + 3(x+y)]$$
$$= [4x - 4y - 3x - 3y]\,[4x - 4y + 3x + 3y]$$
$$= (x - 7y)(7x - y)$$

86. **(B)**

$$a^2 + \frac{1}{4} + a = \frac{1}{4}(4a^2 + 4a + 1) = \frac{1}{4}(4a^2 + 2a + 2a + 1)$$
$$= \frac{1}{4}(2a(2a+1) + (2a+1))$$
$$= \left(\frac{1}{2}\right)^2 (2a+1)^2 = \left(a + \frac{1}{2}\right)^2$$

87. **(B)** Because $a^2 - b^2 = (a-b)(a+b)$, the question becomes

$$(a+b)^2 - 2(a+b)(a-b) + (a-b)^2$$

let $(a+b) = k$ and $a - b = r$

$$= k^2 - 2kr + r^2 = k^2 - kr - kr + r^2$$
$$= k(k-r) - r(k-r) = (k-r)^2$$
$$= (a + b - a + b)^2 = (2b)^2 = 4b^2$$

88. **(C)** let $a + b = k$ the new expression

$$= k^2 - 14ck + 49c^2 = k^2 - 7ck - 7ck + 49c^2$$
$$= k(k - 7c) - 7c(k - 7c) = (k - 7c)^2$$
$$= (a + b - 7c)^2$$

89.

90.

91.

92.

93. **(B)** let $p + q = k$ and $p - q = r$

$$= k^2 - r^2 = (k-r)(k+r)$$
$$= [(p+q) - (p-q)][(p+q) + (p-q)]$$
$$2apq = (2q)(2p) = 4pq = 2 \cdot 2pq$$

$\therefore\ a = 2$

94. **(B)** On the numerator $(a-b)^3 = (a-b)^2(a-b)$

$(a^2 + b^2)(a-b) - (a-b)^2(a-b)$

$$= (a-b)[a^2 + b^2 - (a-b)^2]$$
$$= (a-b)(a^2 + b^2 - (a^2 + 2ab + b^2))$$
$$= (a-b)(a^2 + b^2 - a^2 - 2ab - b^2)$$
$$= -2ab(a-b)$$

On the denominator $a^2b - ab^2 = ab(a-b)$

$$\therefore\ \frac{-2ab(a-b)}{ab(a-b)} = -2$$

95.

96.

97. **(E)**

$(x+2)(x+b) = x^2 + 2x + bx + 2b = x^2 + (2+b)x + 2b$

$\therefore\ 2b = 6, b = 3$ and $2 + b = c, 2 + 3 = 5 = c$

98. **(D)** It equals $x^3 + \frac{1}{x^3} + 3\left(x + \frac{1}{x}\right)$

$$x^3 + \frac{1}{x^3} = \left(x + \frac{1}{x}\right)^3 - 3\left(x + \frac{1}{x}\right)$$

$$x^3 + 3x + \frac{3}{x} + \frac{1}{x^3} = \left(x + \frac{1}{x}\right)^3 - 3\left(x + \frac{1}{x}\right) + 3\left(x + \frac{1}{x}\right)$$
$$= \left(x + \frac{1}{x}\right)^3$$

99. **(D)** $x^{\frac{3}{2}} = (x^{\frac{1}{2}})^3$, $y^{\frac{3}{2}} = (y^{\frac{1}{2}})^3$ and $x = x^{\frac{2}{2}} = (x^{\frac{1}{2}})^2$
let $x^{\frac{1}{2}} = k$ and $y^{\frac{1}{2}} = p$, make all replacement and we have

$$\begin{array}{r} k^2 + p^2 \\ k - p\ \overline{)\ k^3 - k^2p + kp^2 - p^3} \\ -\ \underline{k^3 - k^2p} \\ \qquad\qquad kp^2 - p^3 \\ \qquad -\ \underline{kp^2 - p^3} \\ \qquad\qquad\ \ ---- \end{array}$$

The result is $k^2 + p^2 = (x^{\frac{1}{2}})^2 + (y^{\frac{1}{2}})^2 = x + y$

100. **(A)** If it is divided by the $ax - b = 0$, then the value of x to be substituted into the function is $x = \frac{b}{a}$, $\therefore$ the remainder is $f\left(\frac{b}{a}\right)$

2.2 Indices and Standard Form

2.2.1 Questions

1. If $(25)^{x-1} = 64\left(\frac{5}{2}\right)^6$, then x has the value
   A. 7
   B. 4
   C. 32
   D. 5
   E. 64
2. Simplify $\frac{5^x \times 25^{x-1}}{125^{x+1}}$
   A. 5^{x+2}
   B. 5^{2x-1}
   C. 5^{x+1}
   D. 5^3
   E. 5^{-5}
3. Express 37.05×0.0042 in standard form
   A. 15.561×10^2
   B. 1.556×10^1
   C. 1.5561×10^{-4}
   D. 1.5561×10^{-1}
   E. 1.5561×10^2
4. Simplify: $\sqrt[3]{(64r^{-6})^{\frac{1}{2}}}$
   A. $\frac{1}{2r}$
   B. $\frac{2}{r}$
   C. 2
   D. $\frac{1}{2}$
5. What are the value of y satisfying this equation:
   $$9^y - 4(3^y) + 3 = 0$$
   A. -1 and 0
   B. 1 and 3
   C. 0 and 1
   D. -1 and 1
6. Simplify: $\frac{9^{\frac{1}{3}} \times 27^{-\frac{1}{2}}}{3^{-\frac{1}{6}} \times 3^{-\frac{2}{3}}}$
   A. $\frac{1}{3}$
   B. $\frac{1}{9}$
   C. 3
   D. 1
   E. 9
7. if $\sqrt{3^x} = \sqrt[3]{9}$
   A. $\frac{3}{4}$ C. $\frac{1}{3}$ E. $\frac{1}{2}$
   B. $\frac{4}{3}$ D. $\frac{2}{3}$
8. Find the value of $\left(4^{\frac{1}{2}}\right)^6$
   A. 6 C. 1 E. 8
   B. 2 D. 4
9. Simplify: $\frac{3(2^{n-1}) - 4(2^{n-1})}{2^{n+1} - 2^n}$
   A. -2^{n-1}
   B. 2^{n+1}
   C. -2^1
   D. -2^{-1}
10. Evaluate: $\frac{27^{\frac{1}{3}} - 8^{\frac{2}{3}}}{16^{\frac{2}{4}} \times 2}$
    A. $-\frac{1}{8}$ C. $\frac{23}{5}$ E. $-\frac{23}{6}$
    B. $\frac{21}{7}$ D. $-\frac{23}{5}$
11. If $\frac{4^{x+3}}{16^{2x-3}} = 1$, find x
    A. 1 C. -3 E. -3
    B. -1 D. 3
12. Evaluate without using tables: $(0.008)^{-\frac{1}{3}} \times (0.16)^{-\frac{3}{2}}$
    A. $\frac{8}{625}$
    B. 8
    C. $\frac{625}{8}$
    D. $\frac{1}{8}$
13. Simplify: $\frac{3^n - 3^{n-1}}{3^3 \times 3^n - 27 \times 3^{n-1}}$
    A. 0

B. $\frac{1}{27}$

C. $3^n - 3^{n-1}$

D. 1

E. $\frac{2}{27}$

14. Evaluate and leave your answer in standar form:

$$\sqrt{\frac{0.0048 \times 0.81 \times 10^{-7}}{0.027 \times 0.04 \times 10^{6}}}$$

A. 6×10^{-14}

B. 6×10^{-7}

C. 6×10^{7}

D. 6×10^{14}

15. $3^{2y} - 6(3^y) = 27$ find y

A. 3

B. -1

C. 2

D. -3

E. 1

16. If it is give that $5^{x+1} + 5^x = 150$, then the value of x is equal to

A. 2

B. 3

C. $\frac{1}{2}$

D. 1

E. 4

17. Given that $10^{2n+1} = 0.0000001$, find n

A. -7

B. -6

C. $-\frac{3}{4}$

D. 4

E. -4

18. The result of dividing $\left(\frac{x^a}{x^b}\right)^{a-b}$ by $\left(\frac{x^{a+b}}{x^{a-b}}\right)^{\frac{a^2}{b}}$

A.

B.

C.

D.

19. if $\sqrt[3]{81} = 3^x$ find the value of x

A. $\frac{4}{3}$

B. $-\frac{4}{3}$

C. $\frac{3}{4}$

D. $-\frac{3}{4}$

20. Simplify: $\frac{x(x+1)^{-\frac{1}{2}} - (x+1)^{\frac{1}{2}}}{(x+1)^{\frac{1}{2}}}$

A. $\frac{1}{x+1}$

B. $-\frac{1}{x+1}$

C. $\frac{1}{x}$

D. $-\frac{1}{\sqrt{x+1}}$

21. Express in standard form

$$\frac{0.8 \times 0.8 \times 0.8 - 0.5 \times 0.5 \times 0.5}{0.8 \times 0.8 + 0.8 \times 0.5 + 0.5 \times 0.5}$$

A. 8×10^{-1}

B. 4×10^{-1}

C. 3×10^{-1}

D. 1.3×10^{-1}

22. Express in standard form

$$\frac{69842 \times 69842 - 30158 \times 30158}{69842 - 30158}$$

A. 3.0158×10^{-4}

B. 10^{-4}

C. 6.9842×10^{-5}

D. 10^{-5}

E. 10^{5}

23. The value of $\frac{9^2 \times 18^4}{3^{16}}$ is:

A. $\frac{2}{3}$

B. $\frac{4}{9}$

C. $\frac{32}{243}$

D. $\frac{16}{81}$

24. if m and n are whole numbers such that $m^n = 121$ then $(m-1)^{n+1} = ?$

A. 10

B. 10^2

C. 10^3

D. 10^4

25. Simplify: $\dfrac{a^{\frac{1}{2}}+a^{-\frac{1}{2}}}{1-a}+\dfrac{1-a^{\frac{1}{2}}}{1+\sqrt{a}}$

A. $\dfrac{a}{a-1}$

B. $\dfrac{a-1}{2}$

C. $\dfrac{2}{a-1}$

D. $\dfrac{2}{1-a}$

26. Simplify: $\left(\dfrac{1}{64}\right)^{0}+(64)^{-\frac{1}{2}}+(-32)^{\frac{4}{5}}$

A. $17\frac{1}{8}$

B. $11\frac{7}{8}$

C. $17\frac{3}{8}$

D. $17\frac{7}{8}$

27. If $\left(\dfrac{x}{y}\right)^{5a-3}=\left(\dfrac{y}{x}\right)^{17-3a}$, what is the value of a

A. -7

B. -5

C. 0

D. 3

28. Evaluate: $\dfrac{(0.064-0.008)(0.16-0.04)}{(0.16+0.08+0.04)(0.4+0.2)^3}$

A. $\dfrac{1}{3}$

B. 3

C. $\dfrac{3}{2}$

D. $\dfrac{2}{3}$

29. The value of $\left[\left(\sqrt[n]{x^2}\right)^{n/2}\right]^2$

A. $\dfrac{1}{x^2}$

B. x

C. x^2

D. $x^{\frac{n}{2}}$

30. Solve for x if $3^x-3^{x-1}=486$

A. 5

B. 6

C. 7

D. 9

31. if $5\sqrt{5}\times 5^3\div 5^{-\frac{3}{2}}=5^{a+2}$, then the value of a is

A. 4

B. 5

C. 6

D. 8

32. If $\left(\sqrt{3}\right)^5\times 9^2=3^n\times 3\sqrt{3}$, then find n

A. 2

B. 3

C. 4

D. 5

33. The value of $\dfrac{243^{\frac{n}{5}}\times 3^{2n+1}}{9^n\times 3^{n-1}}$

A. 3

B. 6

C. 9

D. 12

34. if $k^ak^bk^c=1$, then the value of $a^3+b^3+c^3$ is:

A. 9

B. $a+b+c$

C. abc

D. $3abc$

35. The value of $\dfrac{81^{3.6}\times 9^{2.7}}{81^{4.2}\times 3}$ is

A. 3

B. 6

C. 9

D. 8.2

36. Simplify $\dfrac{6^{2n+1}\times 9^n\times 4^{2n}}{18^n\times 2^n\times 12^{2n}}$

A. 3^{2n}

B. $3\times 2^{n+1}$

C. $2n$

D. 6

E. 1

37. Solve the systems of equations: $2^{x+y}=32$ and $3^{3y-x}=27$, find (x,y) respectively

A. $(-3,2)$

B. $(-3,-2)$

C. $(3,2)$

D. $(2,2)$

E. $(3,-2)$

38. A.

B.
C.
D.

39. A.
B.
C.
D.

40. A.
B.
C.
D.

41. A.
B.
C.
D.

42. A.
B.
C.
D.

43. A.
B.
C.
D.

44. A.
B.
C.
D.

45. A.
B.
C.
D.

46. A.
B.
C.
D.

47. A.
B.
C.
D.

48. A.
B.
C.
D.

49. A.
B.
C.
D.

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2.2.2 Answers

1. **(B)** First we separete the powers, and notice $2^6 = 64$, so it cancels out
$25^{x-1} = \cancel{64}\left(\frac{5^6}{\cancel{2^6}}\right) \rightarrow 25^{x-1} = 5^6$, rewrite 25 as 5^2 and resolve $(5^2)^{x-1} = 5^{2(x-1)}$

$$\cancel{5}^{2(x-1)} = \cancel{5}^6$$
$$2x - 2 = 6 \rightarrow x = 4$$

2. **(E)** The least number for which all the number can be written is 5,
$25^{x-1} = (5^2)^{x-1} = 5^{2(x-1)} = 5^{2x-2}$
$125^{x+1} = (5^3)^{x+1} = 5^{3(x+1)} = 5^{3x+3}$

$$\frac{5^x \times 5^{2x-2}}{5^{3x+3}} = \frac{5^{x+2x-2}}{5^{3x+3}} = 5^{3x-2-(3x+3)} = 5^{-5}$$

3. **(D)** Express them individually in standard form

$$(3.705 \times 10^1) \times (4.2 \times 10^{-3})$$

rearrange and combine powers

$$\begin{aligned} 3.705 \times 4.2 \times 10^{-2} &= 15.561 \times 10^{-2} \\ &= 1.5561 \times 10^{-1} \end{aligned}$$

4. **(B)** notice $64 = 2^6$ making it possible to group 64 and r^{-6}, $64r^{-6} = 2^6 \cdot r^{-6} = 2^6 \cdot (r^{-1})^6$
Using the property:

$$a^k \cdot b^k = (ab)^k \Rightarrow 2^6 \cdot (r^{-1})^6 = (2r^{-1})^6$$

hence, $\sqrt[3]{(64r^{-6})^{\frac{1}{2}}} = \sqrt[3]{((2r^{-1})^6)^{\frac{1}{2}}} = \sqrt[3]{(2r^{-1})^{\frac{6}{2}}} = \sqrt[3]{(2r^{-1})^3}$

$$\sqrt[m]{a^n} = a^{\frac{m}{n}} \Rightarrow (2r^{-1})^{\frac{3}{3}} = 2r^{-1} = \frac{2}{r}$$

5. **(C)** Rewrite 9^y as $(3^2)^y = (3^y)^2$ let $3^y = p$

$$\begin{aligned} 9^y - 4(3^y) + 3 \Rightarrow p^2 - 4p + 3 &= 0 \\ &= p^2 - 3p - p + 3 \\ &= p(p-3) - 1(p-3) \\ &= (p-1)(p-3) \\ &= (3^y - 1)(3^y - 3) = 0 \end{aligned}$$

for $3^y - 1 = 0$	for $3^y - 3 = 0$
$\cancel{3}^y = 1 = \cancel{3}^0$	$\cancel{3}^y = \cancel{3}^1$
$\therefore \quad y = 0$	$\therefore \quad y = 1$

6. Working on the numerator:

$$9^{\frac{1}{3}} \times 27^{\frac{1}{2}} = 3^{\frac{2}{3}} \times 3^{\frac{3}{2}} = 3^{\frac{2}{3}+\frac{3}{2}}$$

7. **(B)** $3^{\frac{x}{2}} = 9^{\frac{1}{3}} \Rightarrow \cancel{3}^{\frac{x}{2}} = \cancel{3}^{\frac{2}{3}} \therefore x = \frac{4}{3}$

8. $4^{\frac{1}{2}} = \sqrt{4} = 2 \qquad \therefore 2^6 = 64$

9. **(D)** If we let $2^{n-1} = k$ then the numerator

$$3k - 4k = -k = -2^{n-1} = -2^n \cdot 2^{-1}$$

We can also resolve the denominator if rewrite 2^{n+1} as $2 \cdot 2^n$ and let $2^n = p$

$$2 \cdot 2^n - 2^n = 2p - p = p = 2^n$$

$$\therefore \qquad \frac{-\cancel{2^n} \cdot 2^{-1}}{\cancel{2^n}} = -2^{-1}$$

10. **(A)** $27^{\frac{1}{3}} = 3, 8^{\frac{2}{3}} = (2^3)^{\frac{2}{3}} = 4, 16^{\frac{2}{4}} = 4$

$$\frac{27^{\frac{1}{3}} - 8^{\frac{2}{3}}}{16^{\frac{2}{4}} \times 2} = \frac{3-4}{4 \times 2} = -\frac{1}{8}$$

11. **(E)** $16^{2x+3} = 4^{2(2x-3)}$
$\frac{4^{x+3}}{4^{2(2x-3)}} = 1 \Rightarrow \cancel{4}^{x+3-(4x-6)} = \cancel{4}^0$

$$\begin{aligned} \Rightarrow \quad x + 3 - 4x + 6 &= 0 \\ -3x + 9 &= 0 \qquad \therefore x = -3 \end{aligned}$$

12.

$$\begin{aligned} (0.008)^{-\frac{1}{3}} = (8 \times 10^{-3})^{-\frac{1}{3}} &= 8^{-\frac{1}{3}} \times (10^{-3})^{-\frac{1}{3}} \\ &= (8^{\frac{1}{3}})^{-1} \times 10 \\ &= 2^{-1} \times 10 = \frac{10}{2} \\ (0.16)^{-\frac{3}{2}} = (16 \times 10^{-2})^{-\frac{3}{2}} &= 16^{-\frac{3}{2}} \times (10^{-2})^{-\frac{3}{2}} \\ &= (16^{-\frac{1}{2}})^3 \times 10^3 \\ &= 4^{-3} \times 10^3 = \frac{1000}{4} \end{aligned}$$

13. **(E)** On the numerator: $3^{n-1} = \frac{3^n}{3}$, can be simplified to

$$3^n - 3^{n-1} = 3^n - \frac{3^n}{3} = 3^n\left(1 - \frac{1}{3}\right) = 3^n \cdot \frac{2}{3}$$

on the denominator $27 = 3^3$

$$3^3 \times 3^n - 3^3 \times 3^n \cdot \frac{2}{3} = 3^n \times 3^3\left(1 - \frac{2}{3}\right) = 3^n \times 3^3 \frac{1}{3}$$

$$= \frac{\cancel{3^n} \cdot \frac{2}{3}}{\cancel{3^n} \times 3^3 \times \frac{1}{3}} = \frac{1}{3^3} \times \frac{\frac{2}{3}}{\frac{1}{3}} = \frac{2}{27}$$

14. **(B)** Express all in index form
$0.0048 = 48 \times 10^{-4} = 2^4 \times 3 \times 10^{-4}$, $0.81 = 81 \times 10^{-2} = 3^4 \times 10^{-2}$, $0.027 = 27 \times 10^{-3} = 3^3 \times 10^{-3}$ and $0.04 = 4 \times 10^{-2} = 2^2 \times 10^{-2}$
The expression as it appears can be rewritten as:

$$= \sqrt{\frac{(2^4 \times 3 \times 10^{-4}) \times (3^4 \times 10^{-2}) \times 10^{-7}}{(3^3 \times 10^{-3}) \times (2^2 \times 10^{-2}) \times 10^6}}$$
$$= \sqrt{\frac{2^4}{2^2}\left(\frac{3^4 \times 3}{3^3}\right)\left(\frac{10^{-4} \times \cancel{10^{-2}} \times 10^{-7}}{10^{-3} \times \cancel{10^{-2}} \times 10^6}\right)}$$
$$= \sqrt{2^2 \times 3^2 \times 10^{-14}} = 2 \times 3 \times 10^{-7} = 6 \times 10^{-7}$$

15. **(C)**

$$3^{2y} - 6(3^y) = (3^y)^2 - 6(3^y) = 27$$

let $3^y = k$, $k^2 - 6k = 27$

$$\Rightarrow k^2 - 6k - 27 = 0$$
$$= k^2 - 9k + 3k - 27 = 0$$
$$= k(k-9) + 3(k-9) = 0$$
$$= (k+3)(k-9) = (3^y + 3)(3^y - 9) = 0$$

for $3^y + 3 = 0$	for $3^y - 9 = 0$
$3^y = -3$	$3^y = 9 = 3^2$
	$y = 2$

16. **(A)** Rewrite $5^{x+1} = 5^x \cdot 5$ and factor the expression
$\Rightarrow \ 5^x \cdot 5 + 5^x = 5^x(5+1) = \dfrac{5^x \times \cancel{6}}{\cancel{6}} = \dfrac{150}{6}$
$5^x = 25 = 5^2, \ \therefore x = 2$

17. **(E)** Just count the number of zeros you see
$0.0000001 = 10^{-7} \ \ \therefore 2n + 1 = -7, n = -4$

18.

19. **(A)** Rewrite 81 using 3,
$\sqrt[3]{81} = 81^{\frac{1}{3}} = (3^4)^{\frac{1}{3}} = 3^{\frac{4}{3}} = 3^x, x = \dfrac{4}{3}$

20. **(B)** Simplifying: $x(x+1)^{-\frac{1}{2}} = \dfrac{x}{(x+1)^{\frac{1}{2}}} = \dfrac{x}{\sqrt{x+1}}$

$$\text{Rationalizing: } \frac{x}{\sqrt{x+1}} = \frac{x}{\sqrt{x+1}} \times \frac{\sqrt{x+1}}{\sqrt{x+1}}$$
$$= \frac{x\sqrt{x+1}}{x+1} = \frac{x(x+1)^{\frac{1}{2}}}{x+1}$$

The question can be rewritten as

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

21. **(C)** Approaching this problem directly is really slow and time consuming, instead you'll like to let $0.8 = a$ and $0.5 = b$
$\Rightarrow \dfrac{a \times a \times a - b \times b \times b}{a \times a + a \times b + b \times b} = \dfrac{a^3 - b^3}{a^2 + ab + b^3} = a - b$
$\therefore \ 0.8 - 0.5 = 0.3 = 3 \times 10^{-1}$

Workings:

$$\begin{array}{r} a - b \\ a^2 + ab + b^2 \ \overline{)a^3 - b^3} \\ \underline{-\ a^3 + a^2b + ab^2} \\ -a^2b - ab^2 - b^3 \\ \underline{-a^2b - ab^2 - b^3} \\ \hline \end{array}$$

On the day of the exam you would avoid the long division if you remember it just like

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

22. **(E)** Apply same technique as before, let $a = 69842$ and $b = 30158$

$$\frac{a \times a - b \times b}{a - b} = \frac{a^2 - b^2}{a - b} = \frac{(a-b)(a+b)}{(a-b)} = a + b$$

$a + b = 69842 + 30158 = 100000 = 10^5$

23. **(D)** $\dfrac{(3^2)^2 \times (2 \times 3^2)^4}{3^{16}} = 2^4 \cdot \dfrac{3^4 \times 3^8}{3^{16}} = \dfrac{2^4}{3^4} = \dfrac{16}{81}$

24. **(C)** 121 can be expressed in only two forms

$m^n = 121 = 121^1$	$m^n = 121 = 11^2$
$m = 121, n = 1$	$m = 11, n = 2$
$(m-1)^{n+1}$	
$= (121-1)^{1+1} = 120^2$	$= (11-1)^{2+1} = 10^3$

25. rewrite $a^{-\frac{1}{2}} = \dfrac{1}{a^{\frac{1}{2}}} = \dfrac{1}{\sqrt{a}}$, then you rationalize $\dfrac{1}{\sqrt{a}} \cdot \dfrac{\sqrt{a}}{\sqrt{a}} = \dfrac{\sqrt{a}}{a}$
Rationalize: $\dfrac{1-\sqrt{a}}{1+\sqrt{a}} \cdot \dfrac{1-\sqrt{a}}{1-\sqrt{a}} = \dfrac{1 - 2\sqrt{a} + a}{1-a}$, Since both expression share same base, we can rewrite the expression as:

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

26. **(A)**

- $\left(\dfrac{1}{64}\right)^0 = 1$
- $64^{-\frac{1}{2}} = (64^{\frac{1}{2}})^{-1} = (\sqrt{64})^{-1} = 8^{-1} = \dfrac{1}{8}$

- $(-32)^{\frac{4}{5}} = ((-32)^4)^{\frac{1}{5}} = (32^4)^{\frac{1}{5}} = (32^{\frac{1}{5}})^4 = \left(\sqrt[5]{32}\right)^4 = 2^4 = 16$

The resulting solution:

$$1 + \frac{1}{8} + 16 = 17 + \frac{1}{8} = 17\frac{1}{8}$$

NOTE: *the reason* $(-32)^4 = 32^4$ *is because 4 is even, which is* $-32\times-32\times-32\times-32, \therefore -\times-\times-\times- = +$ if the index was an odd number like 3, $(-32)^3 = -32 \times -32 \times -32, \therefore - \times - \times - = -$

27. **(A)** if $a^{-1} = \frac{1}{a}$ and $\left(\frac{1}{b}\right)^{-1} = b$, $\left(\frac{a}{b}\right)^{-1} = \left(a \times \frac{1}{b}\right)^{-1} = a^{-1} \times \left(\frac{1}{b}\right)^{-1} = \frac{1}{a} \times b = \frac{b}{a}$

$$\boxed{\therefore \left(\frac{a}{b}\right)^{-1} = \frac{b}{a}}$$

$$\left(\frac{x}{y}\right)^{5a-3} = \left(\frac{x}{y}\right)^{-(17-3a)}, 5a-3 = 3a-17, a = -7$$

28. When this kind of expression is being posed, i've said your best bet isn't to solve it directly, rather you should thing of a way to cancel out some number using some possible identity, with the most basic one being

$$a^2 - b^2 = (a+b)(a-b)$$

with nothing to think of, my eyes took me to $(0.4 + 0.2)^3$, because of the index 3 i decided to look at $(0.064 - 0.008)$, where $64 = 4^3$ and $8 = 2^3$

$$\begin{aligned}(0.064 - 0.008) &= (64 \times 10^{-3}) - (8 \times 10^{-3}) \\ &= (4^3 \times (10^{-1})^3) - (2^3 \times (10^{-1})^3) \\ &= (4 \times 10^{-1})^3 - (2 \times 10^{-1})^3 \\ &= 0.4^3 - 0.2^3\end{aligned}$$

So i just believe every other number contains at least a 0.4 or 0.2, $0.16 = (0.4)^2, 0.08 = 0.4 \times 0.2, 0.04 = (0.2)^2$
Rewrite the question as:

$$\frac{(0.4^3 - 0.2^3)(0.4^2 - 0.2^2)}{(0.4^2 + 0.4 \times 0.2 + 0.2^2)(0.4 + 0.2)^3}$$

let $0.4 = a$ and $0.2 = b$, then pair

$$\frac{(a^3 - b^3)(a^2 - b^2)}{(a^2 + ab + b^2)(a+b)^3}$$

$$= \frac{\cancel{[(a^2 + ab + b^2)}(a-b)]}{\cancel{a^2 + ab + b^2}} \cdot \frac{\cancel{[(a+b)}(a-b)]}{\cancel{(a+b)^3}(a+b)^2}$$

$$= \frac{(a-b)(a-b)}{(a+b)^2} = \frac{(a-b)^2}{(a+b)^2} = \frac{a^2 - 2ab + b^2}{a^2 + 2ab + b^2} = \frac{0.16 - 2(0.08) + 0.04}{0.16 + 2(0.08) + 0.04} = \frac{0.04}{0.36} = \frac{1}{9}$$

29. *(C)*

from inside $\sqrt[n]{x^2} = x^{\frac{2}{n}}$

$$(\sqrt[n]{x^2})^{\frac{n}{2}} = (x^{\frac{2}{n}})^{\frac{n}{2}} = x^{\frac{2}{n} \cdot \frac{n}{2}} = x$$

then just raise what's inside to the power of $2 \rightarrow x^2$

30. *(B)*

$$3^x - 3^{x-1} = 3^x - \frac{3^x}{3} = 3^x\left(1 - \frac{1}{3}\right) = 3^x \cdot \frac{2}{3} = 486$$

$$\rightarrow \quad 3^x = \frac{\cancel{486} \times 3}{2} = 243 \times 3 = 3^5 \times 3 = 3^6, x = 6$$

31. - $5\sqrt{5} = 5^1 \times 5^{\frac{1}{2}} = 5^{\frac{3}{2}}$
- $5^3 \div 5^{-\frac{3}{2}} = \frac{5^3}{5^{-\frac{3}{2}}} = 5^3 \times \frac{1}{5^{-\frac{3}{2}}} = 5$

32. **(D)** $(\sqrt{3})^5 = (3^{\frac{1}{2}})^5 = 3^{\frac{5}{2}}$, $9^2 = (3^2)^2 = 3^4$ and $3\sqrt{3} = 3^1 \times 3^{\frac{1}{2}} = 3^{\frac{3}{2}}$

$$3^{\frac{5}{2}} \times 3^4 = 3^n \times 3^{\frac{3}{2}} \quad \Rightarrow 3^{\frac{5}{2}+4} = 3^{n+\frac{3}{2}}$$

$$\frac{5}{2} + 4 = n + \frac{3}{2} \Rightarrow \therefore \quad n = \frac{5}{2} - \frac{3}{2} + 4 = 1 + 4 = 5$$

33. **(C)** $243^{\frac{n}{5}} = (3^5)^{\frac{n}{5}} = 3^n$ and $9^n = (3^2)^n = 3^{2n} = \frac{3^n \times 3^{2n+1}}{3^{2n} \times 3^{n-1}} = \frac{3^{n+2n+1}}{3^{2n+n-1}} = \frac{3^{3n+1}}{3^{3n-1}} = 3^{3n+1-(3n-1)} = 3^2 = 9$

34. $k^a k^b k^c = \cancel{k}^{a+b+c} = 1 = \cancel{k}^0, \therefore a + b + c = 0$

$$\begin{aligned}(a+b+c)^3 &= a^3 + 3a^2(b+c) + 3a(b+c)^2 + (b+c)^3 \\ &= a^3 + 3a^2(b+c) + 3a(b^2 + 2bc + c^2) + b^3 \\ &\quad + 3b^2c + 3bc^2 + c^3 \\ &= a^3 + 3a^2b + 3a^2c + 3ab^2 + 6abc + 3ac^2 \\ &\quad + b^3 + 3b^2c + 3bc^2 + c^3 \\ &= a^3 + b^3 + c^3 + (3a^2c + 3abc + 3ac^2) \\ &\quad + (3a^2b + 3ab^2 + 3abc) + (\square + 3b^2c + 3bc^2) \\ &= a^3 + b^3 + c^3 + 3ac(a+b+c) + 3ab(a+b+c) \\ &\quad + 3bc(a+b+c) - 3abc\end{aligned}$$

$$(a+b+c)^3 - 3ac(a+b+c) = a^3 + b^3 + c^3$$
$$-3ab(a+b+c) - 3bc(a+b+c) + 3abc$$

So, if $a + b + c = 0$
$0^3 - 3ac(0) - 3ab(0) - 3bc(0) + 3abc = 3abc$

35. **(C)**

- $81^{3.6} = (3^4)^{3.6} = 3^{4\times3.6} = 3^{14.4}$
- $9^{2.7} = (3^2)^{2.7} = 3^{2\times2.7} = 3^{5.4}$

$$\therefore \quad 3^{14.4} \times 3^{5.4} = 3^{14.4+5.4} = 3^{19.8}$$

- $81^{4.2} = (3^4)^{4.2} = 3^{16.8}$

$\therefore \quad 3^{16.8} \times 3^1 = 3^{16.8+1} = 3^{17.8}$

$$\frac{3^{19.8}}{3^{17.8}} = 3^{19.8-17.8} = 3^2 = 9$$

36.

$$6^{2n+1} = (2 \times 3)^{2n+1} = 2^{2n+1} \times 3^{2n+1}$$
$$= 2^{2n} \cdot 2 \times 3^{2n} \cdot 3$$

$18^n = (9 \times 2)^n = (3^2 \times 2)^n = 3^{2n} \times 2^n$
$12^{2n} = (2 \times 3)^{2n} = 2^{2n} \times 3^{2n}$

$$\therefore \frac{(\cancel{2^{2n}} \times 2 \times \cancel{3^{2n}} \times 3) \times \cancel{3^{2n}} \times 2^{4n}}{(\cancel{3^{2n}} \times 2^n) \times 2^n \times (\cancel{2^{2n}} \times \cancel{3^{2n}})} = \frac{2^{4n+1} \times 3}{2^{2n}}$$
$= 2^{4n-2n+1} \times 3 = 2^{2n+1} \times 3$

37. **(C)** $\cancel{2^{x+y}} = \cancel{2^5}, x + y = 5 \mid \cancel{3^{3y-x}} = \cancel{3^3}, 3y - x = 3$

$$x + y = 5 \quad ...(i)$$
$$+ \ 3y - x = 3 \quad ...(ii)$$
$$4y = 8, y = 2$$

if $x + y = 5$, $y = 2$, $x + 2 = 5$, $x = 3$

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2.3 Logarithms

2.3.1 Questions

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2.3.2 Answers

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Chapter 3

Geometry

3.1

3.1.1 Questions

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3.1.2 Answers

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3.2 Co-ordinate Geometry

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3.2.2 Answers

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Chapter 4

Calculus

4.1 Differentiation

4.1.1 Questions

1. The minimum point on the curve $y = x^2 - 6x + 5$ is at?
   A. (1,5)
   B. (2,3)
   C. (3,4)
   D. (-3,4)
   E. (3,-4)
2. At what value of x is the function $y = x^2 + x + 1$ minimum?
   A. -1
   B. $-\frac{1}{2}$
   C. $\frac{1}{2}$
   D. 1
3. At what value of x is the function $y = x^2 - 2x - 3$ minimum?
   A. 1
   B. -1
   C. -4
   D. 4
4. Find the maximum value of $y = x^2 - 2x - 3$
   A. -4
   B. -1
   C. 1
   D. 4
5. Find the maximum value of $y = 3x^2 - x^3$
   A. 2
   B. 4
   C. 6
   D. 0
6. Find the minimum value of $y = x^3 + x^2 - x + 1$
   A. -1
   B. 1
   C. 2
   D. -2
7. Find the value of x for which the function $f(x) = 2x^3 - x^2 - 4x + 4$ has a maximum value.
   A. $\frac{2}{3}$
   B. 1
   C. -1
   D. $-\frac{2}{3}$
8. Find the value of x for which the function $f(x) = 3x^3 - 9x^2$ is minimum
   A. 2
   B. 0
   C. 5
   D. 3
9. Find the maximum value of the function $f(x) = 2 + x - x^2$
   A. $\frac{9}{4}$
   B. $\frac{7}{4}$
   C. $\frac{3}{2}$

D. $\frac{1}{2}$

10. Find the maximum value of y in the equation: $y = 1 - 2 - 3x^2$
    A. $\frac{4}{3}$
    B. $\frac{5}{4}$
    C. $\frac{3}{4}$
    D. $\frac{5}{3}$

11. The minimum value of y in the equation: $y = x^2 - 6x + 8$ is
    A. 8
    B. 3
    C. 0
    D. -1

12. Obtain the maximum value of the function: $f(x) = x^3 - 12x + 11$
    A. -5
    B. -2
    C. 2
    D. 27

13. Find the value of h if the maximum value of $y = 1 + hx - 3x^2$ is 13.
    A. 10
    B. 11
    C. 12
    D. 13

14. A trader realizes $10x - x^2$ naira profit from the sale of x bags of corn. How many bags will give him the maximum profit?
    A. 4
    B. 5
    C. 6
    D. 7

15. Find the value of x for which the function $y = x^3 - x$ has a minimum value.
    A. $\frac{\sqrt{3}}{3}$
    B. -$\frac{\sqrt{3}}{3}$
    C. $\sqrt{3}$
    D. -$\sqrt{3}$

16. If $f(x) = x^2 - 2x - 3$, find the least value of $f(x)$ and the corresponding value of x.
    A. $f(x) = -3, x = 1$
    B. $f(x) = -3, x = 3$
    C. $f(x) = 1, x = -4$
    D. $f(x) = 1, x = -4$

17. If $y = 3\cos\left(\frac{x}{3}\right)$, find $\frac{\mathrm{d}y}{\mathrm{d}x}$ when $x = \frac{3\pi}{2}$.
    A. -1
    B. 1
    C. 2
    D. 3

18. What is the rate of change of the volume v of a hemisphere with respect to its radius r when $r = 2$?
    A. 2π
    B. 4π
    C. 8π
    D. 16π

19. If $y = (1 - 2x)^3$, find the value of $\frac{\mathrm{d}y}{\mathrm{d}x}$ at $x = -1$.
    A. 22
    B. 57
    C. -6
    D. -54

20. Find the derivative of $y = \sin\big(2x^3 + 3x - 4\big)$.
    A. $\cos\big(2x^2 + 3x - 4\big)$
    B. $-\cos\big(2x^2 + 3x - 4\big)$
    C. $-(6x^2 + 3)\cos\big(2x^2 + 3x - 4\big)$
    D. $(6x^2 + 3)\cos\big(2x^2 + 3x - 4\big)$

21. The radius r of a circular disc is increasing at the rate of 0.5 cm/sec. At what rate is the area of the disc increasing when its radius is 6 cm?
    A. 3π cm^2/sec
    B. 18π cm^2/sec
    C. 6π cm^2/sec
    D. 36π cm^2/sec

22. Find $\frac{\mathrm{d}y}{\mathrm{d}x}$, if $y = \cos x$.
    A. $\sin x$
    B. $-\sin x$
    C. $\tan x$
    D. $-\tan x$

23. Differentiate: $(\cos\theta - \sin\theta)^2$ with respect to θ.
    A. $1 - 2\cos 2\theta$
    B. $-2\sin 2\theta$
    C. $-2\cos 2\theta$

D. $1 - 2\sin 2\theta$

24. Differentiate: $\left(x^2 + \frac{1}{x}\right)^2$ with respect to x.

A. $4x^3 - 2 + \frac{2}{x^3}$

B. $4x^3 - 2 - \frac{2}{x^3}$

C. $4x^3 - 4x - \frac{2}{x}$

D. $4x^3 - 3x + \frac{2}{x}$

25. Find the point x, y on the Euclidean plane where the curve $y = 2x^2 - 2x + 3$ has 2 as the gradient.

A. $(1, 4)$

B. $(2, 2)$

C. $(3, 4)$

D. $(3, 2)$

26. For what value of x is the tangent to the curve $y = x^2 - 4x + 3$ parallel to the x-axis?

A. 0

B. 1

C. 2

D. 3

27. If $y = x\sin x$, find $\frac{d^2y}{dx^2}$.

A. $2\cos x - \sin x$

B. $\sin x + \cos x$

C. $\sin x - \cos x$

D. $\cos x - 2\sin x$

28. Differentiate: $\frac{6x^3 - 5x^2 + 1}{3x^2}$ with respect to x

A. $2 + \frac{2}{3x^3}$

B. $2 + \frac{1}{6x}$

C. $\sin x - \cos x$

D. $\cos x - 2\sin x$

29. If $y = (1 + x)^2$, find $\frac{\mathrm{d}y}{\mathrm{d}x}$.

A. $x + 1$

B. $2x - 1$

C. $2 + 2x$

D. $1 + 2x$

30. Differentiate: $3x^3 + 2x^2 + 3x + 1$ with respect to x

A. $9x^2 + 4x + 3$

B. $9x^2 + 4x - 3$

C. $9x^2 - 4x - 3$

D. $9x^2 - 4x + 3$

31. Differentiate: $\frac{2}{3}x^3 - \frac{4}{x}$

A. $2x^2 + \frac{4}{x^2}$

B. $2x^2 - \frac{4}{x}$

C. $3x^2 - \frac{4}{x}$

D. $3x^2 + \frac{4}{x^2}$

32. Find the derivative of $\frac{\sin x}{\cos x}$

A. $\tan x \cos x$

B. $\csc x \sec x$

C. $\sec^2 x$

D. $\cot^2 x$

33. If $y = x^2 - 3x + 4$, find $\frac{\mathrm{d}y}{\mathrm{d}x}$ at $x = 5$.

A. 9

B. 7

C. 5

D. 3

34. If $y = 2x\cos 2x - \sin 2x$, find $\frac{\mathrm{d}y}{\mathrm{d}x}$ when $x = \frac{\pi}{2}$

A.

B.

C.

D.

35. If $y = 3\cos 4x$, find $\frac{\mathrm{d}y}{\mathrm{d}x}$

A. $-24\sin 4x$

B. $12\sin 4x$

C. $-12\sin 4x$

D. $6\sin 8x$

36. Find the derivative of $(2 + 3x)(1 - x)$ with respect to x.

A. $6x - 1$

B. $1 - 6x$

C. -3

D. 6

37. Find $\frac{\mathrm{d}y}{\mathrm{d}x}$, if $y = -3x^3 + 2x^2 - 3x + 1$.

A. $-9x^2 + 4x + 3$

B. $-9x^2 + 4x - 3$

C. $-9x^2 - 4x + 3$

D. $-9x^2 - 4x - 3$

38. If $y = 2x^3 + 6x^2 + 6x + 1$, find $\frac{\mathrm{d}y}{\mathrm{d}x}$.

A. $6x^2 + 12x + 1$

B. $6x^2 - 12x + 1$

C. $6x^2 + 12x + 6$

D. $6x^2 + 6x + 6$

39. Find the derivative of $y = \left(\frac{1}{3}x + 6\right)^2$.

A. $2\left(\frac{1}{3}x + 6\right)$

B. $\frac{2}{3}\left(\frac{1}{3}x + 6\right)$

C. $\frac{1}{3}\left(\frac{1}{3}x + 6\right)^2$

D. $\frac{2}{3}\left(\frac{1}{3}x + 6\right)^2$

40. If $y = x^2 - 3x + 4$, find $\frac{\mathrm{d}y}{\mathrm{d}x}$ at $x = 2$.

A. -1

B. 1

C. 2

D. -2

41. If $y = x^2 + \sqrt{x}$, find $\frac{\mathrm{d}y}{\mathrm{d}x}$.

A. $2x - \frac{1}{2}x^{\frac{1}{2}}$

B. $2x - \frac{1}{2}x^{-\frac{1}{2}}$

C. $2x + x^{-\frac{1}{2}}$

D. $2x + \frac{1}{2}x^{-\frac{1}{2}}$

42. Find $\frac{\mathrm{d}y}{\mathrm{d}x}$, if $y = \frac{2}{3}x^3 - \frac{4}{x}$

A. $3x^2 - \frac{4}{x}$

B. $3x^2 + \frac{4}{x^2}$

C. $2x^2 - \frac{4}{x}$

D. $2x^2 + \frac{4}{x^2}$

43. If $y = \cos 3x$, find $\frac{\mathrm{d}y}{\mathrm{d}x}$.

A. $\frac{1}{3}\sin 3x$

B. $3\sin 3x$

C. $-\frac{1}{3}\sin 3x$

D. $-3\sin 3x$

44. Find $\frac{\mathrm{d}y}{\mathrm{d}x}$, if $y = \cos x$

A. $\sin x$

B. $-\sin x$

C. $\tan x$

D. $-\tan x$

45. Find the slope of the curve: $y = 2x^3 + 5x - 3$ at $(1, 4)$.

A. 4

B. 6

C. 7

D. 9

46. Find the derivative of $y = \sin^2(5x)$ with respect to x.

A. $5\sin 5x \cos 5x$

B. $2\sin 5x \cos 5x$

C. $15\sin 5x \cos 5x$

D. $10\sin 5x \cos 5x$

47. The slope of the tangent to the curve: $y = 3x^2 - 2x + 5$ at the point $(1, 6)$ is

A. 1

B. 4

C. 5

D. 6

48. If the gradient of the curve $y = 2kx^2 + x + 1$ at $x = 1$ is 9, find the value of k

A. 2

B. -2

C. 4

D. -4

49. The distance travelled by a particle from a fixed point is given as $s = \left(t^3 - t^2 - t + 5\right)$ cm. Find the minimum distance that the particle can cover from the fixed point.

A. 2.3 cm

B. 4.0 cm

C. 5.2 cm

D. 6.0 cm

50. Differentiate $(2x + 5)^2(x - 4)$ with respect to x.

A. $4(2x + 5)(x - 4)$

B. $4(2x + 5)(4x - 3)$

C. $(2x + 5)(6x - 11)$

D. $(2x + 5)(2x - 13)$

51. Find the rate of change of the volume of v of a sphere with respect to its radius r when $r = 1$

A. 24π

B. 12π

C. 4π

D. 8π

52. If $y = 2x\cos 2x - \sin 2x$, find $\frac{\mathrm{d}y}{\mathrm{d}x}$ when $x = \frac{\pi}{4}$
    A. $\frac{\pi}{4}$
    B. $\frac{\pi}{2}$
    C. $-\pi$
    D. $-\frac{\pi}{2}$

53. Differentiate $\frac{x}{\cos x}$ with respect to x
    A. $1 + \sec^2 x$
    B. $1 + x\tan x\sec x$
    C. $\cos x + x\tan x$
    D. $\sec x + x\tan x\sec x$

54. If $y = 243(4x+5)^{-2}$, find $\frac{\mathrm{d}y}{\mathrm{d}x}$ when $x = 1$
    A. $\frac{-8}{9}$
    B. $\frac{9}{8}$
    C. $\frac{-8}{3}$
    D. $\frac{3}{8}$

55. What is the derivative of $t^2\sin(3t-5)$ with respect to the variable t?
    A. $2t\sin(2t-5) + 3t^2\cos(3t-5)$
    B. $2t\sin(2t-5) - 3t^2\cos(3t-5)$
    C. $6t\cos(2t-5)$
    D. $2t\sin(2t-5) + t^2\cos(3t)$

56. A circle with radius 5 cm has its radius increasing at the rate of $0.2cm^2$. What will be the corresponding increase in area?
    A. π
    B. 2π
    C. 4π
    D. 5π

57. Find the dimensions of the rectangle of greatest area which has a fixed perimeter p.
    A. Square of sides $\frac{p}{2}$
    B. Square of sides p
    C. Square of sides $\frac{p}{4}$
    D. Square of sides $2p$

58. The gradient of a curve is $2x + 7$ and the curve passes through the point $(2, 0)$. Find the equation of the curve.
    A. $y = x^2 + 7x - 18$
    B. $y = x^2 + 7x + 18$
    C. $y = x^2 + 7x - 9$
    D. $y = x^2 + 7x + 9$

59. Differentiate $y = \sqrt[3]{x^2}(2x - x^2)$
    A. $\frac{10x^{\frac{5}{3}}}{3} - \frac{8x^{\frac{5}{3}}}{3}$
    B. $\frac{10x^{\frac{2}{3}}}{3} - \frac{8x^{\frac{5}{3}}}{3}$
    C. $\frac{10x^{\frac{5}{3}}}{3} - \frac{8x^{\frac{2}{3}}}{3}$
    D. $\frac{10x^{\frac{2}{3}}}{3} - \frac{8x^{\frac{2}{3}}}{3}$

60. The slope of the tangent to the curve: $y = 5x^2 - 3x + 5$ at the point $(1, 6)$ is
    A. 19
    B. 7
    C. 4
    D. 3

61. Find the derivative of the function $y = 2x^2(2x-1)$ at the point $x = -1$
    A. 18
    B. -4
    C. 16
    D. -6

62. Find the derivative of $y = \log\left(4x^3 - 2x\right)$
    A. $\frac{4x^2 - 2}{7x + 6}$
    B. $\frac{12x - 2}{4x^2}$
    C. $\frac{43x^2 - 2x}{7x}$
    D. $\frac{12x^2 - 2}{4x^3 - 2x}$

63. If $f'(x) = \sqrt{x} - \frac{1}{\sqrt{x}}$, find the value of $f''(4)$
    A. $\frac{15}{128}$
    B. $\frac{21}{128}$
    C. $\frac{7}{128}$
    D. $\frac{11}{128}$

64. Find the second derivative of $y = 8x^3 - 3x^2 + 7x - 1$
    A. $11x^2 + 6x - 7$
    B. $24x^2 - 6x + 7$
    C. $48x - 6$
    D. $32x + 7$

65. For what value of x is the tangent to the curve $y = x^2 + 6x + 8$ parallel to the x-axis?
    A. -3
    B. 3
    C. 4
    D. -4

66. Find the second derivative of $y = x\sin(x)$
    A. $2\cos(x) - x\sin(x)$
    B. $\sin(x) - x\cos(x)$
    C. $\sin(x) + x\cos(x)$
    D. $x\sin(x) - 2\cos(x)$

67. Differentiate $\dfrac{2x}{\sin(x)}$ with respect to x
    A. $2\cot x \sec x(1 + \tan x)$
    B. $2\csc x - x\cot x$
    C. $2x\csc x + \tan x$
    D. $2\csc x(1 - x\cot x)$

68. Find the point (x, y) on the Euclidean plane where the curve $y = 2x^2 - 2x + 3$ has 2 as gradient
    A. $(1, 3)$
    B. $(2, 7)$
    C. $(3, 15)$
    D. $(0, 3)$

69. Find the equation of the tangent at the point $(2, 0)$ to the curve $y = x^2 - 2x$
    A. $y = 2x - 4$
    B. $y = 2x + 4$
    C. $y = 2x + 2$
    D. $y = 2x - 2$

70. Differentiate $y = 20x^{-4} + 9$.
    A. $-80x^{-5}$
    B. $-80x^5$
    C. $80x^{-5}$
    D. $80x^5$

71. Differentiate $y = \log_7(2x - 3)$
    A. $\dfrac{2}{\log_7(2x-3)}$
    B. $\dfrac{1}{\log_7(2x-3)}$
    C. $\dfrac{7}{\log_7(2x-3)}$
    D. $\dfrac{2x}{\log_7(2x-3)}$

72. Find the derivative of the function $y = 2x^2(2x - 1)$ at the point $x = -1$?
    A. 18
    B. 16
    C. -4
    D. -6

73. $\dfrac{d}{dx}\log(4x^3 - 2x)$ is equal to ?
    A. $\dfrac{12x - 2}{4x^2}$
    B. $\dfrac{43x^3 - 2x}{7x}$
    C. $\dfrac{4x^2 - 2}{7x + 6}$
    D. $\dfrac{12x^2 - 2}{4x^3 - 2x}$

74. If $f(x) = 3x^3 + 4x^2 + x - 8$, what is the value of $f(-2)$?
    A. -24
    B. 30
    C. -18
    D. -50

75. If $y = (1 - 2x)^3$, find the value of $\frac{\mathrm{d}y}{\mathrm{d}x}$ at $x = -1$
    A. 57
    B. 27
    C. -6
    D. -54

76. A.
    B.
    C.
    D.

77. A.
    B.
    C.
    D.

78. A.
    B.
    C.
    D.

79. A.
    B.
    C.
    D.

80. A.

B.
C.
D.

81. A.
B.
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82. A.
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83. A.
B.
C.
D.

84. A.
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85. A.
B.
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D.

86. A.
B.
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D.

87. Differentiate
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C.
D.

88. A.
B.
C.
D.

89. A.
B.
C.
D.

90. A.
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91. A.
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92. A.
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93. A.
B.
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D.

94. A.
B.
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95. A.
B.
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D.

96. A.
B.
C.
D.

97. A.
B.
C.
D.

98. Find the derivative of
A.
B.
C.
D.

99. Find the derivative of
A.
B.
C.

D.

100. The derivative of

A.

B.

C.

D.

4.1.2 Answers

1. The minimum point can be gotten by getting the first derivative
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99.
100.

4.2 Integration

4.2.1 Questions

1. Find the integral of $y = 3x^2 - 2x - 1$
   A. $x^3 - x^2 - x$
   B. $x^3 + x^2 - x$
   C. $x^3 + x^2 + x$
   D. $x^3 - x^2 + x$
2. Integrate the expression $6x^2 - 2x + 1$
   A. $3x^3 - 2x^2 + x + c$
   B. $2x^3 - x^2 + x + c$
   C. $2x^3 - 3x^2 + c$
   D. $x^3 + x^2 - x + c$
3. Integrate $\frac{1}{x} + \cos x$ with respect to x
   A. $x - \sin x + k$
   B. $x + \sin x - k$
   C. $-\frac{1}{x^2} + \sin x + k$
   D. $-\frac{1}{x^2} - \sin x + k$
4. If the expression $ax^2 + bx + c$ equals 5 at $x = 1$. If its derivative is $2x + 1$, what are the values of a,b, c respectively?
   A. $1, 1, 3$
   B. $1, 3, 1$
   C. $1, 2, 1$
   D. $2, 1, 1$
5. Integrate the expression $(2x + 1)^3$
   A. $\frac{(2x+1)^3}{8} + k$
   B. $\frac{(2x+1)^4}{8} + k$
   C. $\frac{(2x+1)^4}{6} + k$
   D. $\frac{(2x+1)^2}{8} + k$
6. Evaluate $\int 4x^{-3} - 7x^2 + 5x - 6 \, \mathrm{d}x$
   A. $-2x^{-2} - \frac{7}{3}x^3 + \frac{5}{2}x^2 - 6x$
   B. $2x^2 + \frac{7}{3}x^3 + 5x^2 - 6$
   C. $12x^2 + 14x - 5$
   D. $-12x^{-4} - 14x + 5$
7. Evaluate $\int_{-1}^{2} \left(2x^2 + x\right) \, \mathrm{d}x$
   A. $4\frac{1}{2}$
   B. $3\frac{1}{2}$
   C. $7\frac{1}{2}$
   D. $5\frac{1}{4}$
8. Integrate $\frac{x^2 - \sqrt{x}}{x}$ with respect to x
   A. $\frac{x^2}{2} - 2\sqrt{x} + k$
   B. $\frac{2(x^2 - x)}{3x} + k$
   C. $\frac{x^2}{2} - \sqrt{x} + k$
   D. $\frac{x^2 - x}{3x} + k$
9. Integrate the expression $(x + 2)^3$
   A.
   B.
   C.
   D.
10. Integrate the expression x^3
    A.
    B.
    C.
    D.
11. Evaluate $\int_{1}^{2} \left(6x^2 - 2x\right) \, \mathrm{d}x$
    A.
    B.
    C.
    D.
12. Evaluate $\int_{-1}^{2} \left(2x^2 + x\right) \, \mathrm{d}x$
    A.
    B.
    C.
    D.
13. A.
    B.
    C.

D.

14. A.
B.
C.
D.

15. A.
B.
C.
D.

16. A.
B.
C.
D.

17. A.
B.
C.
D.

18. A.
B.
C.
D.

19. A.
B.
C.
D.

20. A.
B.
C.
D.

21. A.
B.
C.
D.

22. A.
B.
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D.

23. A.
B.
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D.

24. A.
B.
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D.

25. A.
B.
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D.

26. A.
B.
C.
D.

27. A.
B.
C.
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28. A.
B.
C.
D.

29. A.
B.
C.
D.

30. A.
B.
C.
D.

31. A.
B.
C.
D.

32. A.
B.
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D.

33. A.
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C.
D.

34. A.
    B.
    C.
    D.
35. A.
    B.
    C.
    D.
36. A.
    B.
    C.
    D.
37. A.
    B.
    C.
    D.
38. A.
    B.
    C.
    D.
39. A.
    B.
    C.
    D.
40. A.
    B.
    C.
    D.
41. A.
    B.
    C.
    D.
42. A.
    B.
    C.
    D.
43. A.
    B.
    C.
    D.
44. A.
    B.
    C.
    D.
45. A.
    B.
    C.
    D.
46. A.
    B.
    C.
    D.
47. A.
    B.
    C.
    D.
48. A.
    B.
    C.
    D.
49. A.
    B.
    C.
    D.
50. A.
    B.
    C.
    D.
51. A.
    B.
    C.
    D.
52. A.
    B.
    C.
    D.
53. A.
    B.
    C.
    D.
54. A.

B.
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D.

55. A.
B.
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56. A.
B.
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57. A.
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58. A.
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59. A.
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60. A.
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61. A.
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62. A.
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63. A.
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64. A.
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65. A.
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66. A.
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67. A.
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68. A.
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69. A.
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70. A.
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71. A.
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72. A.
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73. A.
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74. A.
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75. A.
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76. A.
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77. A.
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78. A.
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79. A.
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80. A.
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81. A.
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82. A.
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83. A.
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84. A.
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85. A.
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86. A.
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87. A.
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88. A.
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89. A.
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90. A.
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91. A.
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92. A.
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93. A.
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94. A.
B.
C.

D.

95. A.
B.
C.
D.

96. A.
B.
C.
D.

97. A.
B.
C.
D.

98. A.
B.
C.
D.

99. A.
B.
C.
D.

100. A.
B.
C.
D.

4.2.2 Answers

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Chapter 5

Combinatorics

5.1 Combination & Permutation

5.1.1 Questions

1. Ralia has 7 different posters to be hung in her bedroom, living room, and kitchen. Assuming she has plans to plant at least a poster in each of the 3 rooms, how many choices does she have?
   A. 49
   B. 170
   C. 210
   D. 21
2. In how many ways can a committee of 2 women and 3 men be chosen from 6 men and 5 women?
   A. 200
   B. 100
   C. 50
   D. 30
3. In how many ways can the letters of the word MATHEMATICS be arranged?
   A. $\frac{11!}{9!2!}$
   B. $\frac{11!}{9!2!2!}$
   C. $\frac{11!}{2!2!2!}$
   D. $\frac{11!}{2!2!}$
4. In how many ways can the letters of the word ACCEPTANCE be arranged?
   A. $\frac{10!}{2!2!3!}$
   B. $\frac{10!}{2!2!}$
   C. $10!$
   D. $\frac{10!}{2!3!}$
5. Five people are to be arranged in a row for a group photograph. How many arrangements are there if a married couple in the group insist on sitting next to each other?
   A. 48
   B. 12
   C. 7
   D. 10
6. In how many ways can 6 subjects be selected from 10 subjects for an examination
   A. 215
   B. 218
   C. 216
   D. 210
7. In how many ways can a delegation of 3 be chosen from 5 men and 3 women, if atleast 1 man and 1 woman must be included?
   A. 28
   B. 30
   C. 15
   D. 45
8. Find the number of ways of selecting 6 out of 10 subjects for an examination
   A. 218
   B. 216
   C. 210
   D. 215
9. In how many ways can the letters of the word ELATION be arranged?

A. $6!$

B. $7!$

C. $5!$

D. $8!$

10. In how many ways can the letters of the word CALCULUS be arranged?

A. 1680

B. 2100

C. 5040

D. 1760

11. In how many ways can the letters of the word COMBINATION be arranged?

A.

B.

C.

D.

12. In how many ways can 7 directors sit round a table?

A. 24

B. 5040

C. 120

D. 120

13. In how many ways can the letters of the word TOTALITY be arranged?

A. 6720

B. 6270

C. 6207

D. 6027

14. How many numbers greater than 1000 can be made from the digits 1, 2, 3, 4, and 5 without repeating any one of them?

A. 152

B. 210

C. 216

D. 144

15. In how many ways can a team of 3 girls be selected from 7 girls?

A. $\dfrac{7!}{5!2!}$

B. $\dfrac{7!}{3!}$

C. $\dfrac{7!}{3!4!}$

D. $\dfrac{7!}{4!}$

16. In how many ways can a student select 2 subjects from 5 subjects?

A. $\dfrac{5!}{3!2!}$

B. $\dfrac{5!}{2!2!}$

C. $\dfrac{5!}{2!3!}$

D. $\dfrac{5!}{2!}$

17. In how many ways can five people sit round a circular table?

A. 24

B. 60

C. 12

D. 120

18. How many two-digit numbers can be formed from the digits 0, 1, 2, and 3 if a digit can be repeated and no number may begin with 0?

A. 4

B. 12

C. 16

D. 20

19. In how many ways can 9 people be seated if 3 chairs are available?

A. 720

B. 504

C. 336

D. 210

20. A final examination requires that a student answer any 4 out of 6 questions. In how many ways can this be done?

A. 15

B. 20

C. 45

D. 30

21. In how many ways can 6 coloured chalks be arranged if 2 are of the same colour?

A. 60

B. 240

C. 120

D. 360

22. How many possible ways are there of seating seven people P,Q,R,S,T,U, and V at a circular table?

A. 720

B. 2520

C. 5040

D. 360

23. A committee of six is to be formed by a state governor from nine state commissioners and three members of the State House of Assembly. In how many ways can the members of the committee be chosen so as to inlcude one member of the House of the Assembly?
    A. 924 ways
    B. 524 ways
    C. 462 ways
    D. 378 ways
24. How many two-digit numbers can be formed from the digits 0,1, 2, and 3 if a digit can be repeated and no number may begin with 0?
    A. 4
    B. 12
    C. 16
    D. 20
25. Find the number of committees of three that can be formed consisting of two men and one woman from four men and three women
    A. 3
    B. 6
    C. 18
    D. 24
26. A.
    B.
    C.
    D.
27. A.
    B.
    C.
    D.
28. A.
    B.
    C.
    D.
29. A.
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97. A.
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99. A.
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100. A.
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5.1.2 Answers

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Chapter 6

Statistics

6.1 Measures of Central Tendency

6.1.1 Questions

1. A.
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6.1.2 Answers

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Chapter 7

Values To Memorize

7.1 Square Roots

- $\sqrt{1} = 1$
- $\sqrt{2} = 1.4142$
- $\sqrt{3} = 1.7321$
- $\sqrt{4} = 2$
- $\sqrt{5} = 2.2361$
- $\sqrt{6} = 2.4495$
- $\sqrt{7} = 2.6458$
- $\sqrt{8} = 2.8284$
- $\sqrt{9} = 3$
- $\sqrt{10} = 3.1623$

7.2 Squares

- $1^2 = 1$
- $2^2 = 4$
- $3^2 = 9$
- $4^2 = 16$
- $5^2 = 25$
- $6^2 = 36$
- $7^2 = 49$
- $8^2 = 64$
- $9^2 = 81$
- $10^2 = 100$
- $11^2 = 121$
- $12^2 = 144$
- $13^2 = 169$
- $14^2 = 196$
- $15^2 = 225$
- $16^2 = 256$
- $17^2 = 289$
- $18^2 = 324$
- $19^2 = 361$
- $20^2 = 400$
- $21^2 = 441$
- $22^2 = 484$
- $23^2 = 529$
- $24^2 = 576$
- $25^2 = 625$
- $26^2 = 676$
- $27^2 = 729$
- $28^2 = 784$
- $29^2 = 841$
- $30^2 = 900$

7.3 Cubes

- $1^3 = 1$
- $2^3 = 8$
- $3^3 = 27$
- $4^3 = 64$
- $5^3 = 125$
- $6^3 = 216$
- $7^3 = 343$
- $8^3 = 512$
- $9^3 = 729$
- $10^3 = 1000$
- $11^3 = 1331$
- $12^3 = 1728$
- $13^3 = 2197$
- $14^3 = 2744$
- $15^3 = 3375$
- $16^3 = 4096$
- $17^3 = 4913$
- $18^3 = 5832$
- $19^3 = 6859$
- $20^3 = 8000$
- $21^3 = 9261$
- $22^3 = 10648$
- $23^3 = 12167$
- $24^3 = 13824$
- $25^3 = 15625$
- $26^3 = 17576$
- $27^3 = 19683$
- $28^3 = 21952$
- $29^3 = 24389$
- $30^3 = 27000$

7.4 Logarithms

- $\log_{10} 1 = 0$
- $\log_{10} 2 = 0.3010$
- $\log_{10} 3 = 0.4771$
- $\log_{10} 4 = 0.6020$
- $\log_{10} 5 = 0.699$
- $\log_{10} 6 = 0.778$
- $\log_{10} 7 = 0.845$
- $\log_{10} 8 = 0.903$
- $\log_{10} 9 = 0.954$
- $\log_{10} 10 = 1$