Appendix – A
(Opinionnaire to be used to collect course content)
Faculty of Education
Osmania University, Hyderabad-500007

“DEVELOPMENT OF SELF INSTRUCTIONAL MATERIAL FOR
FOUNDATION COURSE IN MATHEMATICS FOR DISTANCE LEARNERS
OF OPEN UNIVERSITY”

(Opinionnaire used with high school teachers, Junior college lecturers, mathematics
lectures working in M.B.A., /M.C.A. colleges, Heads Departments of mathematics at
universities of Andhra Pradesh)

Respected Sir/Madam

I am doing research on “Development of Self Instructional Material for
Foundation Course in Mathematics for Distance Learners of Open University” as a
part of my Ph.D. (Education) programme. I wish to know your suggestions about the
suitability of mathematics at foundation course of undergraduate programme of
Dr.B.R.Ambedkar Open University. The important note is that the most of the students
get admission into UG programme through Eligibility Test (without any formal study,
and those who completed 18 years of age are eligible). Least percentage of the students
get admission after their 10+2 formal study. As per the norms of AICTE and APSCHE
norms the non –formal stream students of Dr.B.R.Ambedkar Open University do not
have eligibility to pursue M.B.A./M.C.A. courses after their UG programme, because
they do not have mathematics at foundation course. The norms of AICTE and APSCHE
is the graduates those who were having mathematics at SSC and 10+2 besides other
eligibility condition like local, Nationality etc. are eligible to pursue MBA/MCA
courses after their UG programme. To fill this gap along with the formal stream
students and give them opportunity to write ICET to pursue M.B.A./M.C.A. courses
after their graduation. Not only to pursue such courses and to develop the mathematical
skills among the students to use the mathematics their daily life to lead good life. Please
keep in mind the above notes, suggest me a suitable mathematics curriculum areas to
design the course.

Your co-operation will be of great help for me.

Thank you very much

Yours faithfully,

(BONDU RAJU)
Research Scholar
Dear student,

I am doing research on “DEVELOPMENT OF SELF INSTRUCTIONAL MATERIAL FOR FOUNDATION COURSE IN MATHEMATICS FOR DISTANCE LEARNERS OF OPEN UNIVERSITY” as a part of Ph.D. (Education) Programme. For my research purpose, I need your personal details, and I can assure you I will keep your personal details confidential.

1. Name of the Student: --------------------------------------------

2. Name of the Study Centre: ---------------------------------------------

3. Age (In years): --------------------------------------------

*Note: Please put the (√) mark in the appropriate box

4. Type of Admission :

<table>
<thead>
<tr>
<th>Through Eligibility Test</th>
<th>Direct</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5. Educational Qualification:

<table>
<thead>
<tr>
<th>Below SSC</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SSC</td>
<td></td>
</tr>
<tr>
<td>Intermediate failed</td>
<td></td>
</tr>
<tr>
<td>10+2 Without Mathematics</td>
<td></td>
</tr>
<tr>
<td>10+2 With Mathematics</td>
<td></td>
</tr>
</tbody>
</table>

Date: -------------- Signature of the student: --------------------------
Appendix – C

(Achievement test for entry level behaviour)

Time: 2 hours
Max. Marks: 50

Roll No. Name:

(Note: All questions are compulsory in all sections)

I. Please write your answer in the space provided

1. A bicycle was bought for Rs.240 and sold for Rs.290: Find the profit as a percentage of cost price.

2. Calculate mentally: 125% of Rs.7.80.

3. Insert the appropriate symbol in blank spaces.

   If A =\{1,2,3\}.

   (i) 1............A  (ii) 4............A.

4. Solve the equation $10 - 3x = 7$.

5. At which one of the following times is the angle between the hands of a clock exactly one right angle?

   A) 12:15  B) 03:00  C) 03:30  D) 06:45
   A) 3:35   B) 3:25   C) 2:35   D) 2:25

7. Use the slope formula to find \( \frac{d}{dx} (3x^2) \)

8. What is \( \int 3x^2 \, dx \) ?

9. What is the mean of these numbers:
   12, -1, 8, 2, -10, 0, -5, 3, 20, -2

10. How many different committees of 5 people can be chosen from 10 people?
II. Answer for the following questions  

1. Rs.5000 is invested at 8% p.a. compound interest with interest calculated annually.
   a) What will it amount to after 3 years?
   b) Find the interest earned.

2. Find the value of each expression when \( x = 3 \) and \( y = -4 \).
   a. \( 5xy \)
   b. \( 2y^2 \)

3. A farmer has a field in the shape of a regular heptagon which has a perimeter of 700 m. What is its area?

4. Is there a solution to \( x^5 - 2x^3 - 2 = 0 \) between \( x=0 \) and \( x=2 \)?

5. How many permutations of 4 different letters are there, chosen from the twenty six letters of the alphabet (repetition is not allowed)?
III. Answer for the following questions 6 × 5 = 30

1. Two tankers contain 850 litres and 680 litres of kerosene oil, respectively.
   Find the maximum capacity of a container which can measure the kerosene oil of both the tankers when used an exact number of times.

2. Which is the size of angle $x^\circ$?

3. A bag contains 3 red marbles and 4 blue marbles. Two marbles are drawn at random without replacement. If the first marble drawn is red, what is the probability the second marble is blue?
Appendix – D

Key (Achievement Test for entry level behaviour)

I.

1. Profit = selling price - cost price
   
   = Rs.290 - Rs.240
   
   = Rs.50
   
   Therefore, profit as a percentage of cost price

2. 125% means one and a quarter times: 100% + 25%.

   Now, to take a quarter of Rs.7.80, we may think of it as Rs.8.00 minus 20 paise.

   A quarter of Rs.8.00 is Rs.2.00.

   A quarter of 20 paisa is 5 paisa.

   Therefore, 125% of Rs.7.80 = Rs. 7.80 + Rs.2.00 – 5paisa

3. (i) ∈ (ii) ∈

4. 10 - 3x = 7
   
   10 - 3x - 10 = 7 - 10

   - 3x = - 3

   -3x = -3

   x = 1

5. B

6. Ans: D

   Subtract the Hours: 5 - 2 = 3

   Subtract the Minutes: 20 - 55 = -35

   The minutes are less than 0, so add 60 to Minutes (-35 + 60 = 60 - 35 = 25 Minutes)

   and subtract 1 from Hours (3 - 1 = 2 Hours) ... answer is 2:25

7. \( f(x) = 3x^2 \)

   So \( f(x + \Delta x) = 3(x + \Delta x)^2 = 3x^2 + 2x\Delta x + (\Delta x)^2 \)

   \( = 3x^2 + 6x\Delta x + 3(\Delta x)^2 \)

   Therefore \( \frac{\Delta y}{\Delta x} = \frac{f(x + \Delta x) - f(x)}{\Delta x} \)

   \( = \frac{3x^2 + 6x\Delta x + 3(\Delta x)^2 - 3x^2}{\Delta x} \)

   \( = \frac{6x\Delta x + 3(\Delta x)^2}{\Delta x} \)

   \( = 6x + 3\Delta x \)

   And then as \( \Delta x \) heads towards 0 we get \( \frac{d}{dx} (3x^2) = 6x \)
8. 

\[
\frac{d}{dx}(x^3) = 3x^2
\]

Therefore \( \int 3x^2 \, dx = x^3 + c \)

9. Put the numbers in order first: 3, 3, 4, 5, 6, 7, 10, 11, 12

The median is the middle number = 6

10. In choosing a committee, order doesn’t matter; so we need the number of combinations of 5 people chosen from 10

\[
= 10C5
\]

\[
= \frac{10!}{(5!)(5!)}
\]

\[
= \frac{(10 \times 9 \times 8 \times 7 \times 6)}{(5 \times 4 \times 3 \times 2 \times 1)}
\]

\[
= 30,240/120
\]

\[
= 252
\]

II.

1. a) The multiplier is \(108\% = 1.08\)

Therefore, value after 3 years = Rs.5000 X (1.08)^3

\[
= Rs.6298.56
\]

b) Interest earned = Rs.6298.56 - Rs.5000

\[
= Rs.1298.56
\]

2. a. This expression indicates to multiply 5 by \(x\) by \(y\):

\[
5xy = 5 \times 3 \times (-4)
\]

substituting for variables

\[
= -60
\]

Note how we used parentheses when substituting for variables. This is often a good idea to distinguish negative numbers from subtraction.

b. This expression indicates to square \(y\), then multiply by 2:

\[
2y^2 = 2 \times (-4)^2
\]

substituting for variables

\[
= 2 \times 16
\]

computing the exponent

\[
= 32
\]

3. If the perimeter is 700m, then the length of one side = 700m ÷ 7 = 100 m

Now use the formula:
Area \[= \frac{1}{4} \times n \times \frac{\text{Side}^2}{\tan \left( \frac{\pi}{n} \right)}\]

Substitute \( n = 7 \) and \( \text{Side} = 100 \text{ m} \)

\[
\text{Area} \ &= \ \frac{1}{4} \times 7 \times \frac{(100 \text{ m})^2}{\tan \left( \frac{\pi}{7} \right)} \\
&= \frac{1}{4} \times 7 \times \frac{10,000 \text{ m}^2}{\tan \left( \frac{\pi}{7} \right)} \\
&= \frac{17,500 \text{ m}^2}{\tan \left( \frac{\pi}{7} \right)} \\
&= \frac{17,500 \text{ m}^2}{\tan(0.4487...)} \\
&= \frac{17,500 \text{ m}^2}{0.4815...} \\
&= 36,339 \text{ m}^2
\]

4. At \( x=0 \):

\( 0^5 - 2 \times 0^3 - 2 = -2 \)

At \( x=2 \):

\( 2^5 - 2 \times 2^3 - 2 = 14 \)

- No at \( x=0 \), the curve is below zero
- at \( x=2 \), the curve is above zero

we know:

And, being a polynomial, the curve will be continuous, so somewhere in between, the curve must cross through \( y=0 \)

Yes, there is a solution to \( x^5 - 2x^3 - 2 = 0 \) in the interval \([0, 2]\)

5. The number of permutations of 4 digits chosen from 26 is \( 26!P_4 = 26 \times 25 \times 24 \times 23 \)

\[= 358,800 \]

III.

1. The required container has to measure both the tankers in a way that the count is an exact number of times. So its capacity must be an exact divisor of the capacities of both the tankers. Moreover this capacity should be maximum. Thus the maximum capacity of such a container will be the HCF of 850 and 680. The HCF of 850 and 680 is 170.

Therefore, maximum capacity of the required container is 170 litres. It will fill the first container in 5 and the second in 4 refills.
2. We know the opposite 4,000 and the hypotenuse 6,000, so we use sine:
\[ \sin x^\circ = \frac{\text{opposite}}{\text{hypotenuse}} = \frac{4,000}{6,000} = 0.6666... \]
\[ \Rightarrow x^\circ = \sin^{-1}(0.6666...) = 41.8^\circ \]

3. After the first marble is drawn and found to be red, there are now 6 marbles left in the bag, 4 of which are blue.

Therefore

\[ P(\text{The second marble is blue given that the first marble is red}) = \frac{4}{6} = \frac{2}{3} \]
Appendix – E
(Criterion test for try-out for Block I)

Time: 1hr 30 min. Max. Marks: 50

Roll No. Name:
(Note: All questions are compulsory in all sections)

I. Please write your answer in the space provided 10 × 2 = 20

1. What is the value of $3 + 6 ÷ 3 \times 2$?
   A) 7  B) 6  C) 4  D) 1.5

2. For the number 2768, what does the 2 mean?
   A) 2 Units  B) 2 Tens  C) 2 Hundreds  D) 2 Thousands

3. For the number 25.639, what is the place value of the digit 6?
   A) 6 tens  B) 6 units  C) 6 tenths  D) 6 hundredths

4. Write $3.76 \times 10^4$ as an ordinary number
   A) 3,760  B) 37,600  C) 376,000  D) 3,760,000

5. What is $7.895 \times 10^{-4}$?
   A) 0.0007895  B) 0.007895  C) 0.7895  D) 78.95
6. Which one of the following is not a whole number?
   A) 5   B) -3   C) 2   D) 10

7. Which one of the following numbers is prime?
   A) 18   B) 19   C) 20   D) 21

8. Which one of the following numbers is composite?
   A) 67   B) 69   C) 71   D) 73

9. The number 24 is to be written as a product of its prime factors. Which one of the following is correct?
   A) $24 = 3 \times 8$   B) $24 = 4 \times 6$   C) $24 = 2 \times 3 \times 4$   D) $24 = 2 \times 2 \times 2 \times 3$

10. 504 written as a product of its prime factors is:
    A) $7 \times 72$   B) $32 \times 7 \times 8$   C) $23 \times 7 \times 9$   D) $23 \times 32 \times 7$
II. Answer for the following questions  \[ 5 \times 3 = 15 \]

1. 237 is divisible by
   
   A) 2  B) 3  C) 7  D) 9

2. Simplify the fraction \( \frac{36}{84} \) as much as possible
   
   \[
   \begin{array}{c}
   A) \frac{5}{12} \\
   B) \frac{4}{7} \\
   C) \frac{9}{21} \\
   D) 7
   \end{array}
   \]

3. What is the greatest common factor of 6 and 15?

4. A class of 32 students has 12 girls. What is the ratio of girls to boys?

5. A car has a speed of 25 m/s. What is its speed in km/h?
III. Answer for the following questions 3 x 5 = 15

1. John borrowed Rs. 4000/- for 5 years at 6% Simple Interest rate. How much interest is that?

2. If the present value of my investment is Rs.1,000/- and the rate of interest is 10% compounded annually, what will the value be after 6 years?

3. Calculate 75% of 60
Appendix – F

Key (Criterion Test I for try-out)

I.

1. Ans: A

Order of Operations are:
* Parentheses (Brackets) first
* Exponents (Orders, Powers, Square Roots, etc.) next
* Multiplication and Division (left-to-right) next
* Addition and Subtraction (left-to-right) last

Therefore, we do the division first, then the multiplication and finally the addition:

\[
3 + 6 \div 3 \times 2 \\
= 3 + 2 \times 2 \\
= 3 + 4 \\
= 7
\]

2. Ans: D

<table>
<thead>
<tr>
<th>Thousands</th>
<th>Hundreds</th>
<th>Tens</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>7</td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>

The number 2768
Therefore the 2 means 2 Thousands

3. Ans: C

6 is the first digit to the right of the decimal point, so it is 6 tenths.

4. Ans: B

The power of 10 is 4, so move the decimal point 4 places to the right:

\[
3.76 \rightarrow 37.6 \rightarrow 376 \rightarrow 3,760 \rightarrow 37,600
\]

5. Ans: A

The power of 10 is -4, so move the decimal point 4 places to the left:

\[
7.895 \rightarrow 0.7895 \rightarrow 0.07895 \rightarrow 0.007895 \rightarrow 0.0007895
\]

6. Ans: B

The whole numbers are simply the numbers 0, 1, 2, 3, 4, 5, ... (and so on)
They do not include negative integers, such as -3

7. Ans: B

18 is composite because 18 can be written as a product of factors, not including 1 and 18: \(18 = 2 \times 9\) or \(18 = 3 \times 6\)

19 is prime because 19 doesn't have any factors except 1 and 19

20 is composite because 20 can be written as a product of factors, not including 1 and 20: \(20 = 2 \times 10\) or \(20 = 4 \times 5\)

21 is composite because 21 can be written as a product of factors, not including 1 and 21: \(21 = 3 \times 7\)

8. Ans: B

67, 71 and 73 are all prime numbers so cannot be composite.

69 = 3 \times 23 is composite.

9. Ans: D

2 and 3 are prime numbers; 4, 6 and 8 are not.

All the products are correct, but only answer D is a product of prime factors

10. Ans: D

Each of the suggested answers is equal to 504, but only \(2^3 \times 3^2 \times 7\) is written as a product of prime factors.

II.

1. Ans: B

Test for divisibility by 2

237 cannot be divisible by 2 since the last digit is odd

Test for divisibility by 3

Sum of the digits = 2 + 3 + 7 = 12

12 is divisible by 3, so 237 is also divisible by 3

Test for divisibility by 7

Double the last digit 7 is 14, 23 - 14 = 9, and 9 is not divisible by 7

Therefore 237 is not divisible by 7

Test for divisibility by 9

Sum of the digits = 2 + 3 + 7 = 12

12 is not divisible by 9, so 237 is not divisible by 9
2. Ans: D

\[ \frac{36}{84} \div 2 = \frac{18}{42} \div 2 = \frac{9}{21} \div 3 = \frac{3}{7} \]

Therefore \[ \frac{36}{84} = \frac{3}{7} \] simplified as much as possible.

Or Find the greatest common factor of 36 and 84 = 12

\[ \frac{36}{84} = \frac{36 \div 12}{84 \div 12} = \frac{3}{7} \]

<table>
<thead>
<tr>
<th>Two Numbers</th>
<th>All Factors</th>
<th>Common Factors</th>
<th>Greatest Common Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 and 15</td>
<td>6: 1, 2, 3, 6 15: 1, 3, 5, 15</td>
<td>1, 3</td>
<td>3</td>
</tr>
</tbody>
</table>

3. The number of boys in the class = 32 - 12 = 20

So the ratio of girls to boys = 12:20

Cancel the common factor 4,

Therefore ratio of girls to boys = 12:20 = 3:5

4. An hour has 3,600 seconds and a kilometer has 1,000 meters, so 25 meters per second is: 25 x 3,600 / 1,000 = 90 km/h
III.

1. Use \( I = \frac{PTR}{100} \)

   where
   
   \( I \) = Interest
   
   \( P \) = Principal = Rs. 4,000
   
   \( R \) = interest rate = 6\% = 0.06
   
   \( T \) = time = 5 years
   
   \( I = Rs. \ 4,000 \times 0.06 \times 5 = Rs.1,200/- \)

2. Use the formula:

   \( \text{Value} = P \times (1 + R)^n \)

   Substitute \( P = Rs.1,000/- \), \( R = 10\% = 0.10 \) and \( n = 6 \)
   
   \( \text{Value} = Rs.1,000 \times (1 + 0.10)^6 = Rs.1,000 \times (1.10)^6 = Rs.1,000 \times 1.771561 \)
   
   \( = Rs. \ 1,771.56 \)

   So the value after 6 years = Rs. 1,771.56

3. 

   \[ 75\% = \frac{75}{100} \]

   So:

   \[ 75\% \text{ of } 60 = \frac{75}{100} \times 60 = \frac{75 \times 60}{100} = \frac{4,500}{100} = 45 \]
Appendix – G

(Criterion test for Block II for try-out)

Time: 1hr 30 min. Max. Marks: 50

Roll No. Name:

(Note: All questions are compulsory in all sections)

I. Please write your answer in the space provided

10 × 2 = 20

1. Which one of the following sets is infinite?
   A) The set of whole numbers less than 10
   B) The set of prime numbers less than 10
   C) The set of integers less than 10
   D) The set of factors of 10

2. A is the set of factors of 12. Which one of the following is not a member of A?
   A) 3  B) 4  C) 5  D) 6

3. Which of the following is true?
   A is the set of factors of 6, B is the set of prime factors of 6
   C is the set of proper factors of 6, D is the set of factors of 3
   A) A = B  B) A = C  C) B = C  D) C = D

4. Which one of the following is the null set?
   A) The set of subsets of the null set
   B) The set of even prime numbers
   C) The set of factors of 7
   D) The set of rational expressions for π

5. If S = {-3, -2, -1, 0, 1, 2, 3, ...}, then what is S, expressed in set builder notation?
   A) S = \{x ∈ R | x ≥ -3\}
   B) S = \{x ∈ Z | -3 ≤ x ≤ 3\}
   C) S = \{x ∈ Z | x > -3\}
   D) S = \{x ∈ Z | x ≥ -3\}
6. If $x = 5$, what is the value of $x-2$?

7. Simplify $(x^{1/2})^6$?

8. Solve $3x + 2 > 8$

9. What is the degree of the polynomial $5x^3 - 8x + 3x^5 + 4x^2 - 7x^4 + 1$?

10. What is the twenty-first term of the sequence given by $S_n = 4n - 3$?
II. **Answer for the following questions**  

1. If \( A = \{a, b, c, d\} \), then how many subsets does the set \( A \) have?

2. Here is a set of ordered pairs: \{..., (-2, 7), (-1, 1), (0, -1), (1, 1), (2, 7), ...\}  
Which function satisfies them?  
   A) \( f(x) = 2x - 1 \) on the set of integers  
   B) \( f(x) = -6x - 5 \) on the set of integers  
   C) \( f(x) = x^2 + 3 \) on the set of integers  
   D) \( f(x) = 2x^2 - 1 \) on the set of integers

3. The General form of the equation of a straight line is \( 3x + 5y - 15 = 0 \). What is the slope-intercept form of the equation?

4. Which of the following is not a polynomial?  
   A) \( 5x^3 - \frac{x}{2} \)  
   B) \( 3xy - 4yz + 2xz \)  
   C) \( 52x^3 - 19y^5 \)  
   D) \( \frac{3}{x - 5} \)

5. Multiply out \((3x + 2)(4x - 5)\)
III. Answer for the following questions  

1.  1. Solve the quadratic equation $6x^2 + 7x - 3 = 0$

2. What is $\begin{bmatrix} 2 & -3 \\ -4 & 2 \end{bmatrix} + \begin{bmatrix} -1 & -5 \\ 3 & -2 \end{bmatrix}$?

3. Solve $\frac{5x - 4}{2x - 3} = \frac{10(3 - x)}{17 - 4x}$
Appendix – H

Key (Criterion test II for try-out)

I.

1. Ans: C
The set of whole numbers less than 10 = {0, 1, 2, 3, 4, 5, 6, 7, 8, 9} is finite
The set of prime numbers less than 10 = {2, 3, 5, 7} is finite
The set of integers less than 10 = {..., -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9} is infinite
since the negative integers go on for ever.
The set of factors of 10 = {1, 2, 5, 10} is finite
2. Ans: C
12 = 1×12
12 = 2×6
12 = 3×4
So A is the set of factors of 12 = {1, 2, 3, 4, 6, 12}
So 5 is not a member of A
3. Ans: C
A is the set of factors of 6 = {1, 2, 3, 6}
Only 2 and 3 are prime numbers
Therefore B = the set of prime factors of 6 = {2, 3}
The proper factors of an integer do not include 1 and the number itself
Therefore C = the set of proper factors of 6 = {2, 3}
D is the set of factors of 3 = {1, 3}
Therefore sets B and C are equal.
4. Ans: D
The null set is a subset of itself, so the set of subsets of the null set has one element
which is the null set itself.
The set of even prime numbers = {2} is not the null set.
The set of multiples of 7 = {1, 7} is not the null set.
π is an irrational number, so cannot be expressed as a rational number.
Although we often approximate π to \( \frac{22}{7} \), this is not an exact value.
So the set of rational expressions for π is the null set.
5. Ans: D
The numbers listed in S are all integers, so \( x \in \mathbb{Z} \) is correct.
The integers listed start at -3, but the "..." shows that the list continues indefinitely to \(+\infty\).
Therefore \( x \geq -3 \)
Putting \( x \in \mathbb{Z} \) and \( x \geq -3 \) together gives us answer D in set builder notation.

6. \( x^2 = \frac{1}{x^2} \)
   Now replace \( x \) by 5:
   Therefore \( 5^2 = \frac{1}{5^2} = 1/25 = 0.04 \)

7. Use the law \((x^m)^n = x^{mn}\) with \( m = \frac{1}{2} \) and \( n = 6 \)
   \( mn = \frac{1}{2} \times 6 = 3 \)
   So \((x^{\frac{1}{2}})^6 = x^3\)

8. \( 3x + 2 > 8 \)
   **Step 1** Subtract 2 from both sides:
   \[ \Rightarrow 3x + 2 - 2 > 8 - 2 \]
   \[ \Rightarrow 3x > 6 \]
   **Step 2** Divide both sides by 3, and **because we are dividing by a positive number, we do not reverse the inequality sign**
   \[ \Rightarrow \frac{3x}{3} > \frac{6}{3} \]
   \[ \Rightarrow x > 2 \]

9. 5

10. \( S_n = 4n - 3 \)
    to find the twenty-first term, replace \( n \) by 21:
    therefore \( S_{21} = 4 \times 21 - 3 = 84 - 3 = 81 \)

II.

1. A has:
   1 subset with zero elements = \( \emptyset \)
   4 subsets with one element = \( \{a\}, \{b\}, \{c\} \) and \( \{d\} \)
   6 subsets with two elements = \( \{a, b\}, \{a, c\}, \{a, d\}, \{b, c\}, \{b, d\} \) and \( \{c, d\} \)
   4 subsets with three elements = \( \{a, b, c\}, \{a, b, d\}, \{a, c, d\} \) and \( \{b, c, d\} \)
   1 subset with four elements = \( \{a, b, c, d\} \)
   Therefore A has 16 subsets altogether.

   **Note:**
   1. Remember that order doesn't matter. So, for example, \( \{a, b\} \) and \( \{b, a\} \) are the
same subset.

2. The numbers 1, 4, 6, 4 and 1 are Binomial coefficients and occur in the fifth row of Pascal's triangle.

3. $16 = 2^4$. Generally a set with $n$ elements has $2^n$ subsets.

2. Ans: D

$f(x) = 2x - 1$ satisfies two points: (0, -1) and (1, 1)

$f(x) = -6x - 5$ satisfies two points (-2, 7) and (-1, 1)

$f(x) = x^2 + 3$ satisfies two points: (-2, 7) and (2, 7)

Only $f(x) = 2x^2 - 1$ satisfies all the points

3. $3x + 5y - 15 = 0$

Subtract 3x and add 15 to both sides: $\Rightarrow 3x + 5y - 15 - 3x + 15 = 0 - 3x + 15$

$\Rightarrow 5y = -3x + 15$

Divide all terms by 5:

4. Ans: D

$rac{3}{x - 5}$ is not a polynomial, because a polynomial should not contain division by a variable. It is still a valid expression, it just isn't a polynomial.

Note: $5x^3 - x/2$ is a polynomial; you are allowed to divide by a constant.

5. Multiply each term in one polynomial by each term in the other polynomial:

So $(3x + 2)(4x - 5)$

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

$= 12x^2 - 15x + 8x - 10$

$= 12x^2 - 7x - 10$

III.

1. Coefficients are: $a = 6$, $b = 7$, $c = -3$

**Quadratic Formula:**

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

**Substitute a,b,c:**

$$x = \frac{-7 \pm \sqrt{7^2 - 4 \times 6 \times (-3)}}{2 \times 6}$$

**Solve:**

$$x = \frac{-7 \pm \sqrt{49 + 72}}{12}$$

$$= \frac{-7 \pm \sqrt{121}}{12}$$

$$= \frac{-7 \pm 11}{12}$$

$$= \frac{1}{3} \text{ or } -1.5$$
2. To add two matrices, just add the numbers in the matching positions:

These are the calculations:

\[ 2 + (-1) = 1 \quad -3 + (-5) = -8 \]
\[ -4 + 3 = -1 \quad 2 + (-2) = 0 \]

3.

\[
\frac{5x - 4}{2x - 3} = \frac{10(3 - x)}{17 - 4x}
\]

Multiply both sides by \( \frac{(2x - 3)(17 - 4x)}{1} \):

\[
\frac{5x - 4}{2x - 3} \times \frac{2x - 3}{1} = \frac{10(3 - x)}{17 - 4x} \times \frac{2x - 3}{1}
\]

Cancel the factor \((2x - 3)\) on the left side of the equation and the factor \((17 - 4x)\) on the right side of the equation:

\[ \Rightarrow (5x - 4)(17 - 4x) = 10(3 - x)(2x - 3) \]
\[ \Rightarrow (5x - 4)(17 - 4x) = (30 - 10x)(2x - 3) \]

Expand the brackets:

\[ 85x - 20x^2 - 68 + 16x = 60x - 90 - 20x^2 + 30x \]
\[ \Rightarrow 101x - 20x^2 - 68 = 90x - 90 - 20x^2 \]

Add \(20x^2\) to both sides:

\[ \Rightarrow 101x - 68 = 90x - 90 \]

Subtract \(90x\) from both sides and add \(68\) to both sides:

\[ \Rightarrow 101x - 90x = 68 - 90 \]
\[ \Rightarrow 11x = -22 \]

Divide both sides by \(11\)

\[ \Rightarrow x = -2 \]
Appendix – I
(Criterion test for Block III for try-out)

Time: 1hr 30 min. Max. Marks: 50

Roll No. Name:

(Note: All questions are compulsory in all sections)

I. Please write your answer in the space provided 10 × 2 = 20

1. In Geometry, what is the meaning of the following symbol? ~
   A) Is perpendicular to B) Is parallel to C) Is similar to D) Is congruent to

2. In Geometry what is the meaning of the following symbol? ≅
   A) Is perpendicular to B) Is parallel to C) Is similar to D) Is congruent to

3. If \( \mathbf{a} = (3, 2) \) and \( \mathbf{b} = (-5, 3) \), what is \( \mathbf{a} + \mathbf{b} \)?

4. If \( \mathbf{a} = (1, -3, 2) \) and \( \mathbf{b} = (3, 4, -5) \), what is \( \mathbf{b} - \mathbf{a} \)?

5. What is the cross product of \( \mathbf{a} = (1, 2, 3) \) and \( \mathbf{b} = (4, 5, 6) \)?
6. The length of a ruler is 30 cm. How many millimetres is that?
   A) 3 mm B) 300 mm C) 3,000 mm D) 30,000 mm

7. How many feet are there in 5 miles?
   A) 2,640 feet B) 8,800 feet C) 17,600 feet D) 26,400 feet

8. What is 23:07 on the AM/PM clock?
   A) 23:07 PM  B) 23:07 AM C) 11:07 PM  D) 11:07 AM

9. Do this question without using a calculator. Given that \( \sin 40^\circ = 0.6428 \), what is the value of \( \sin 140^\circ \)?
   A) -0.6428 B) -0.3572 C) 0.3572 D) 0.6428

10. The mass of a bicycle is 15kg. How many grams is this?
    A) 150 g B) 1,500 g C) 15,000 g D) 150,000 g
II. \textbf{Answer for the following questions} \hspace{1cm} 5 \times 3 = 15

1. A triangle has angles in the ratio 2 : 3 : 4, What is the size of the smallest of the three angles?

2. What is the length of the diagonal of a rectangle of length 3 and width 2?

3. What is the magnitude of the vector $\mathbf{a} = (-3, 5)$?

4. Vector $\mathbf{a}$ has magnitude 3, vector $\mathbf{b}$ has magnitude 4 and the angle between $\mathbf{a}$ and $\mathbf{b}$ is 60°. What is the value of $\mathbf{a} \cdot \mathbf{b}$?

5. Vector $\mathbf{a}$ has magnitude 3, vector $\mathbf{b}$ has magnitude 4, the angle between $\mathbf{a}$ and $\mathbf{b}$ is 30° and $\mathbf{n}$ is the unit vector at right angles to both $\mathbf{a}$ and $\mathbf{b}$. What is $\mathbf{a} \times \mathbf{b}$?
III. Answer for the following questions $3 \times 5 = 15$

1. What is the area of the circle? Use $\frac{22}{7}$ as an approximation for $\pi$

2. A rectangular field is 300 m long and 270 m wide. It is planted with cabbages, each of which requires on average an area of 900 cm$^2$. How many cabbage plants can the field hold?

3. If $\sin \theta = \frac{3}{5}$ and $\theta$ is acute, what is the value of $\sec \theta$?
Appendix – J

Key (Criterion Test III for try-out)

I.

1. Ans: C
   The symbol means 'is similar to'
   Example: ΔABC ~ ΔMNO
   ("The triangle ABC is similar to the triangle MNO")

2. Ans: D
   The symbol means 'Is congruent to'
   Example: ΔPQR ≅ ΔXYZ
   "Triangle PQR is congruent to triangle XYZ"

3. \(a + b = (3, 2) + (-5, 3) = (3 + (-5), 2 + 3) = (-2, 5)\)

4. \(b - a = (3, 4, -5) - (1, -3, 2) = (3 - 1, 4 - (-3), -5 - 2) = (2, 7, -7)\)

5. \(a_x = 1, a_y = 2\) and \(a_z = 3\)
   \(b_x = 4, b_y = 5\) and \(b_z = 6\)
   Then
   • \(c_x = a_yb_z - a_zb_y = 2 \times 6 - 3 \times 5 = 12 - 15 = -3\)
   • \(c_y = a_zb_x - a_xb_z = 3 \times 4 - 1 \times 6 = 12 - 6 = 6\)
   • \(c_z = a_xb_y - a_yb_x = 1 \times 5 - 2 \times 4 = 5 - 8 = -3\)
   Answer: \(a \times b = (-3, 6, -3)\)

6. Ans: B
   1 cm = 10 mm
   Therefore, 30 cm = 30 \times 10 mm = 300 mm

7. 1 mile = 5,280 feet
   So 5 miles = 5 \times 5,280 feet = 26,400 feet

8. Ans: C
   23 is more than 12, so we know the time is in the afternoon or evening (PM)
   23 - 12 = 11
   So 23:07 = 11:07 PM
9. $140^\circ$ is in the second quadrant

\[
\begin{array}{c|c|c|c}
\text{II} & \text{I} & \text{III} & \text{IV} \\
\hline
\text{Sine} & \text{Cosine} & \text{Tangent} & \text{Angle}
\end{array}
\]

and in the second quadrant sine is positive.

$140^\circ$ is related to the acute angle $40^\circ$

\[
\therefore \sin 140^\circ = +\sin 40^\circ = 0.6428
\]

10. Ans: C

$1 \text{ kg} = 1,000 \text{ g}$

So $15 \text{ kg} = 15,000$

II.

1. $2 + 3 + 4 = 9$

So we have to divide $180^\circ$ into 9 equal parts:

$180^\circ \div 9 = 20^\circ$

The smallest angle is 2 parts $= 2 \times 20^\circ = 40^\circ$

2. The rectangle can be divided up into two right-angled triangles, as shown in the diagram.

We can find the length of the diagonal, $d$, by using Pythagoras' theorem in one triangle:
\[ d^2 = 3^2 + 2^2 = 9 + 4 = 13 \]
\[ \Rightarrow d = \sqrt{13} \]

3. \(|a| = \sqrt{x^2 + y^2} = \sqrt{((-3)^2 + 5^2)} = \sqrt{9 + 25} = \sqrt{34}\]

4. Use the formula \(a \cdot b = |a| \times |b| \times \cos(\theta)\)
   with \(|a| = 3, |b| = 4\) and \(\theta = 60^\circ\)
   So \(a \cdot b = 3 \times 4 \times \cos(60^\circ) = 12 \times 0.5 = 6\).

5. Use the formula \(a \times b = |a| \times |b| \times \sin(\theta) \times n\)
   with \(|a| = 3, |b| = 4\) and \(\theta = 30^\circ\)
   Therefore \(a \times b = 3 \times 4 \times \sin(30^\circ) \times n = 12 \times 0.5 \times n = 6n\)

III.

1. Use the formula \(A = \pi \times r^2\), where \(r\) is the radius.
\[ r = 21 \text{ and } \pi = \frac{22}{7} \]
Therefore \(A = \frac{22}{7} \times 21^2 = \frac{22}{7} \times 441 = 1,386\)
Area \(= 1,386 \text{ cm}^2\)

2. Area of the field \(= 300 \text{ m} \times 270 \text{ m}\)
\((= 81,000 \text{ m}^2)\)
There are 10,000 \text{ cm}^2 in a \text{ m}^2:
\((= 81,000 \times 10,000 \text{ cm}^2)\)
\((= 810,000,000 \text{ cm}^2)\)
Each plant needs 900 \text{ cm}^2:
So the number of plants \(= 810,000,000 \div 900 = 900,000\)

3. First use the identity: \(\sin^2 \theta + \cos^2 \theta = 1\) and substitute the value \(\sin \theta = \frac{3}{5}\)
Therefore \((\frac{3}{5})^2 + \cos^2 \theta = 1\)
\[ \Rightarrow \frac{9}{25} + \cos^2 \theta = 1 \]
\[ \Rightarrow \cos^2 \theta = 1 - \frac{9}{25} = \frac{16}{25} \]
\[ \Rightarrow \cos \theta = \sqrt{\frac{16}{25}} = \frac{4}{5} \]
Now we know the value of \(\cos \theta\), to find \(\sec \theta\) we just take the reciprocal.
Therefore \(\sec \theta = \frac{5}{4}\)
Appendix – K

(Criterion test for Block IV for try-out)

Time: 1hr 30 min. Max. Marks: 50

Roll No. Name:

(Note: All questions are compulsory in all sections)

I. Please write your answer in the space provided 10 × 2 = 20

1. What is \( \lim_{x \to \infty} \frac{1}{x - 1} \) ?
   A) -1  B) 0  C) 1  D) \( \infty \)

2. What is \( \lim_{x \to \infty} 3x^2 \) ?
   A) -\( \infty \)  B) 0  C) 3  D) \( \infty \)

3. Evaluate: \( \lim_{x \to 6} \frac{x}{3} \)
   A) 0.5  B) 1  C) 2  D) 6

4. Use the slope formula to find \( \frac{d}{dx} (2x^3) \)

5. Use the slope formula to find \( \frac{d}{dx} (x^4) \)
6. What is \( \int x^5 dx \)?
   A) \( 6x^5 + c \) B) \( \frac{1}{6} x^7 + c \) C) \( \frac{1}{7} x^7 + c \) D) \( x^7 + c \)

7. Which is equal to \( \int 4x^7 dx \)?
   A) \( \frac{1}{5} x^8 + c \) B) \( \frac{1}{3} x^8 + c \) C) \( 2x^8 + c \) D) \( 28x^6 + c \)

8. Which is \( \int 3\cos(x) dx \)?
   A) \( 3\sin(x) + c \) B) \( -3\sin(x) + c \) C) \( \frac{1}{3} \sin(x) + c \) D) \( -\frac{1}{3} \sin(x) + c \)

9. Which is the value of the definite integral:
   \( \int_1^3 2x \, dx \)?
   A) 2 B) 4 C) 8 D) 10

10. Which is \( \frac{d}{dx} (e^{x^3}) \)?
    A) \( 3x^2 e^{x^3} \) B) \( x^3 e^{x^3} \) C) \( x^3 e^{3x^2} \) D) \( e^{3x^2} \)
II. Answer for the following questions  \[ 5 \times 3 = 15 \]

1. Between which of the following two values does the equation \(3x^3 + 5x - 11 = 0\) have a solution?
   A) Between -2 and -1  B) Between -1 and 0  C) Between 0 and 1  D) Between 1 and 2

2. Use Integration by Substitution to find \( \int \sin(x^2) \cdot 2x \, dx \).

3. Which is the value of the definite integral:
   \[ \int_{-2}^{3} 3x^2 \, dx \]?
   A) 15  B) 19  C) 29  D) 35

4. Which is \( \frac{d}{dx} (x^4 + x^3) \)?
   A) \(4x^3 - 3x^2\)  B) \(4x^3 + 3x^2\)  C) \(4x^2 + 3x^3\)  D) \(4x^3 + 3x\)

5. If \(f(x) = x^4\), what is \(f'(x)\)? (\(f'(x)\) is the second derivative of \(f(x)\).)
   A) \(4x^3\)  B) \(9x^2\)  C) \(12x^2\)  D) \(16x^2\)
III. Answer for the following questions $\quad 3 \times 5 = 15$

1. How many zeros does $f(x) = 55x^3 - 60x^2 + 20x - 2$ have between $x = 0$ and $x = 0.6$?
   A) 1    B) 2    C) 3

2. Use Integration by Parts to find $\int x \sin(x) dx$.

3. Which is $\frac{d}{dv} (6v^4 - 3v^5 + 5v^6)$?
Appendix – L

Key (Criterion Test IV for try-out)

I.

1. Ans: B

Let’s see what happens as x gets bigger and bigger:

<table>
<thead>
<tr>
<th>x</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>0.33333</td>
</tr>
<tr>
<td>10</td>
<td>0.11111</td>
</tr>
<tr>
<td>100</td>
<td>0.01010</td>
</tr>
<tr>
<td>1,000</td>
<td>0.00101</td>
</tr>
<tr>
<td>10,000</td>
<td>0.00010</td>
</tr>
</tbody>
</table>

We can see that as x gets larger, \( \frac{1}{x-1} \) tends towards 0.

So \( \lim_{x \to \infty} \frac{1}{x-1} = 0 \).

2. Because the sign is positive

\[ \lim_{x \to \infty} 3x^2 = +\infty \]

3. This one can simply be found by substitution:

\[ \lim_{x \to 6} \frac{x}{3} = \frac{6}{3} = 2 \]

4. \( 6x^2 \)

5. \( f(x) = x^4 \)

So \( f(x + \Delta x) = (x + \Delta x)^4 = x^4 + 4x^3 \Delta x + 6x^2(\Delta x)^2 + 4x(\Delta x)^3 + (\Delta x)^4 \)

Then \( \frac{\Delta y}{\Delta x} = \frac{f(x + \Delta x) - f(x)}{\Delta x} = \frac{x^4 + 4x^3 \Delta x + 6x^2(\Delta x)^2 + 4x(\Delta x)^3 + (\Delta x)^4 - x^4}{\Delta x} = \frac{4x^3 \Delta x + 6x^2(\Delta x)^2 + 4x(\Delta x)^3 + (\Delta x)^4}{\Delta x} \)

\[ = 4x^3 + 6x^2 \Delta x + 4x(\Delta x)^2 + (\Delta x)^3 \]

And then as \( \Delta x \) heads towards 0 we get \( \frac{d}{dx} (x^4) = 4x^3 \)

xxxviii
6. \[ \int x^6 \, dx = \frac{1}{1+6} x^{1+6} + c = \frac{1}{7} x^7 + c \]

7. \[ \frac{d}{dx}(x^8) = 8x^7 = 2 \times 4x^7 \]

Then \[ \int 4x^7 \, dx = \frac{1}{2} x^8 + c. \]

8. \[ \frac{d}{dx}(\sin(x)) = \cos(x) \]

\[ \Rightarrow \frac{d}{dx}(3\sin(x)) = 3\cos(x) \]

Then \[ \int 3\cos(x) \, dx = 3\sin(x) + c. \]

9. Ans: C

\[ \int 2x \, dx = x^2 + c \]

So \[ \int_1^3 2x \, dx \]

\[ = \left[ x^2 \right]_1^3 \]

\[ = 3^2 - 1^2 \]

\[ = 9 - 1 \]

\[ = 8 \]

10. Ans: A

II.

1. Let \( f(x) = 3x^3 + 5x - 11 \)

Therefore

\[ f(-2) = 3 \times (-2)^3 + 5 \times (-2) - 11 = -24 - 10 - 11 = -45 < 0 \]

\[ f(-1) = 3 \times (-1)^3 + 5 \times (-1) - 11 = -3 - 5 - 11 = -19 < 0 \]

\[ f(0) = 3 \times 0^3 + 5 \times 0 - 11 = 0 - 0 - 11 = -11 < 0 \]

\[ f(1) = 3 \times 1^3 + 5 \times 1 - 11 = 3 + 5 - 11 = -3 < 0 \]

\[ f(2) = 3 \times 2^3 + 5 \times 2 - 11 = 24 + 10 - 11 = 23 > 0 \]

Since \( f(1) < 0 \) and \( f(2) > 0 \) and \( f \) is a polynomial, the Intermediate Value Theorem tells us that \( f(x) = 0 \) for some value of \( x \) between 1 and 2.
2. It is in the right form to do the substitution:

\[
\int \sin (x^2) \cdot 2x \, dx
\]

Now integrate:
\[
\int \sin (u) \, du = -\cos (u) + c
\]
And finally put \( u = x^2 \) back again:
So \( \int \sin (x^2) \cdot 2x \, dx = -\cos (x^2) + c \)

3. Ans: D
\[
\int 3x^2 \, dx = x^3 + c
\]
So \( \int_{-2}^{3} 3x^2 \, dx \)
\[
= \left[ x^3 \right]_{-2}^{3}
\]
\[
= 3^3 - (-2)^3
\]
\[
= 27 - (-8)
\]
\[
= 35
\]

4. The Sum Rule says:
the derivative of \( f + g = f' + g' \)
So we can work out each derivative separately and then add them.
Using the Power Rule:
\[
\frac{d}{dx} (x^4) = 4x^{4-1} = 4x^3
\]
\[
\frac{d}{dx} (x^3) = 3x^{3-1} = 3x^2
\]
And so:
\[
\frac{d}{dx} (x^4 + x^3) = 4x^3 + 3x^2
\]

5. \( f(x) = x^4 \)
Differentiate the first time using the Power Rule:
\( f'(x) = 4x^{4-1} = 4x^3 \)
Differentiate a second time, again using the Power Rule:
\( f''(x) = 4 \times 3x^{3-1} = 12x^2 \)
III.

1. \( f(x) = 55x^3 - 60x^2 + 20x - 2 \)

Therefore:
\[
f(0) = 55 \times 0^3 - 60 \times 0^2 + 20 \times 0 - 2 = 0 - 0 + 0 - 2 = -2
\]
\[
f(0.1) = 55 \times (0.1)^3 - 60 \times (0.1)^2 + 20 \times (0.1) - 2 = 0.055 - 0.6 + 2 - 2 = -0.545
\]
\[
f(0.2) = 55 \times (0.2)^3 - 60 \times (0.2)^2 + 20 \times (0.2) - 2 = 0.44 - 2.4 + 4 - 2 = 0.04
\]
\[
f(0.3) = 55 \times (0.3)^3 - 60 \times (0.3)^2 + 20 \times (0.3) - 2 = 1.485 - 5.4 + 6 - 2 = 0.085
\]
\[
f(0.4) = 55 \times (0.4)^3 - 60 \times (0.4)^2 + 20 \times (0.4) - 2 = 3.52 - 9.6 + 8 - 2 = -0.08
\]
\[
f(0.5) = 55 \times (0.5)^3 - 60 \times (0.5)^2 + 20 \times (0.5) - 2 = 6.875 - 15 + 10 - 2 = -0.125
\]
\[
f(0.6) = 55 \times (0.6)^3 - 60 \times (0.6)^2 + 20 \times (0.6) - 2 = 11.88 - 21.6 + 12 - 2 = 0.28
\]

Since \( f(0) \) and \( f(0.1) < 0 \), \( f(0.2) \) and \( f(0.3) > 0 \), \( f(0.4) \) and \( f(0.5) < 0 \) and \( f(0.6) > 0 \),

the Intermediate Value Theorem tells us that \( f(x) = 0 \) for:

• some value of \( x \) between 0.1 and 0.2
• some value of \( x \) between 0.3 and 0.4
• some value of \( x \) between 0.5 and 0.6

\( \therefore \) \( f \) has three zeros between \( x = 0 \) and \( x = 0.6 \)

2. First choose \( u \) and \( v \):
   • \( u = x \)
   • \( v = \sin(x) \)

Differentiate \( u \): \( u' = x' = 1 \)

Integrate \( v \):
\[
\int v \, dx = \int \sin(x) \, dx = -\cos(x)
\]

Now put it together:
\[
\int x \sin(x) \, dx
\]

Simplify and solve:
\[
-x\cos(x) + \int \cos(x) \, dx
\]
\[
= -x\cos(x) + \sin(x) + c
\]
3. Using the Power Rules:

\[
\frac{d}{dv}(v^4) = 4v^{4-1} = 4v^3, \text{ so } \frac{d}{dv}(6v^4) = 6 \times 4v^3 = 24v^3
\]

\[
\frac{d}{dv}(v^5) = 5v^{5-1} = 5v^4, \text{ so } \frac{d}{dv}(3v^5) = 3 \times 5v^4 = 15v^4
\]

\[
\frac{d}{dv}(v^6) = 6v^{6-1} = 6v^5, \text{ so } \frac{d}{dv}(5v^6) = 5 \times 6v^5 = 30v^5
\]

And so:

\[
\frac{d}{dv}(6v^4 - 3v^5 + 5v^6) = 24v^3 - 15v^4 + 30v^5
\]
Appendix – M

(Criterion test for block V for try-out)

Time: 1hr 30 min. Max. Marks: 50

Roll No. Name:

(Note: All questions are compulsory in all sections)

I. Please write your answer in the space provided 10 × 2 = 20

1. Which one of the following is NOT quantitative data?
   A) The snake is 7 feet long    B) The snake has two eyes
   C) The snake is green and black D) The snake has no legs

2. A sample collects information about:
   A) All members of the population. B) All adult members of the population.
   C) None of the population.    D) Some, but not all, of the population.

3. What is the mean of the numbers 8, 9, 13 and 18?

4. What is the median of the numbers 4, 2, 11, 6, 2?

5. What is the mode for the numbers 7, 6, 5, 8, 7, 5, 9, 3, 5 and 4?
6. What is the range for the following set of numbers?
15, 21, 57, 43, 11, 39, 56, 83, 77, 11, 64, 91, 18, 37

7. If \( P(A) = \frac{3}{4} \), what is the value of \( P(A') \)?

8. How many permutations of 3 different digits are there, chosen from the ten digits 0 to 9 inclusive?

9. A bag contains 3 red marbles and 4 blue marbles. Two marbles are drawn at random without replacement. If the first marble drawn is red, what is the probability the second marble is blue?

10. A password consists of two letters of the alphabet followed by three digits chosen from 0 to 9. Repeats are allowed. How many different possible passwords are there?
II. Answer for the following questions 5 × 3 = 15

1. For the numbers 13, 16, 12, 11, 8, 14, 12 and 18. Which of the following is true?
   A) median > mean > mode B) mean > median > mode
   B) C) mean > mode > median D) median > mode > mean

2. A die is thrown once. What is the probability that the score is a factor of 6?

3. In a class of 29 children, 15 like history and 21 like math. They all like at least one of the two subjects. What is the probability that a child chosen at random from the class likes math but not history?

4. How many different committees of 5 people can be chosen from 10 people?

5. A coin is tossed three times. Find the probability of getting at least two heads.
III. Answer for the following questions \(3 \times 5 = 15\)

1. What is the population standard deviation for the numbers: 75, 83, 96, 100, 121 and 125?

2. Two cards are chosen at random from a pack of 52 playing cards. What is the probability that at least one of them is a picture card (Jack, Queen or King)?

3. 95% of students at school weigh between 62 kg and 90 kg.
   Assuming this data is normally distributed, what are the mean and standard deviation?
Appendix – N

Key (Criterion Test for block V for try-out)

I.

1. Ans: C
The snake is green and black is qualitative because it is descriptive.
The other three are all quantitative because they tell us about quantity. Even D tells
us that the number of legs is zero, so is quantitative.

2. Ans: D
A Sample is when you collect data just for selected members of the group. This can be
some, but not all, of the population.

3. Add the numbers: $8 + 9 + 13 + 18 = 48$
   Divide by how many numbers (i.e. we added 4 numbers)
   Therefore $48 \div 4 = 12$

4. Put the numbers in order first: 2, 2, 4, 6, 11
   The median is the middle number = 4

5. Put the numbers in order first: 3, 4, 5, 5, 5, 6, 7, 7, 8, 9
   5 occurs most often, so the mode is 5

6. The range is the difference between the lowest and highest values.
   The highest value is 91.
   The lowest value is 11.
   Therefore the range = 91 - 11 = 80

7. $P(A')$ means "Probability of the complement of Event A": all outcomes that are NOT
   the event.
   $P(A) + P(A') = 1$
   So $P(A') = 1 - P(A)$
   $= 1 - \frac{3}{4} = \frac{1}{4}$

8. The number of permutations of 3 digits chosen from 10 is $^{10}P_3 = 10 \times 9 \times 8 = 720$

9. After the first marble is drawn and found to be red, there are now 6 marbles left in
   the bag, 4 of which are blue.
   Therefore
   
   $P(\text{The second marble is blue given that the first marble is red}) = \frac{4}{6} = \frac{2}{3}$
10. The number of ways of choosing the letters = $26 \times 26 = 676$
   The number of ways of choosing the digits = $10 \times 10 \times 10 = 1,000$
   So the number of possible passwords = $676 \times 1,000 = 676,000$

II.

1. Ans: B
   The mean = $(13+16+12+11+8+14+12+18) \div 8 = 104 \div 8 = 13$
   To easily find the median and mode, arrange the numbers in order first:
   8, 11, 12, 12, 13, 14, 16, 18
   There are two "middle numbers", so the median is the average of 12 and 13 = $(12 + 13) \div 2 = 25 \div 2 = 12.5$
   And 12 occurs most often so the mode is 12
   Therefore mean > median > mode

2. Probability of an event happening = \[ \frac{\text{Number of ways it can happen}}{\text{Total number of outcomes}} \]
   The factors of six are 1, 2, 3 and 6, so the Number of ways it can happen = 4
   There are six possible scores when a die is thrown, so the Total number of outcomes = 6
   So the probability that the score is a factor of six = $4/6 = 2/3$

3. Let's say b is the number of children who like both:
   • children liking history only must be 15 - b
   • children liking math only must be 21 - b
   And we get:
   
   ![Venn Diagram](image)

   And we know there are 29 children, so:
   $\Rightarrow (15 - b) + b + (21 - b) = 29 \Rightarrow 36 - b = 29 \Rightarrow b = 7$
   And we can put in the correct numbers:
So we now know:

\[ P(\text{Like math but not history}) = \frac{14}{29} \]

4. In choosing a committee, order doesn’t matter; so we need the number of combinations of 5 people chosen from 10

\[ = \binom{10}{5} \]

\[ = \frac{10!}{5!(5!)} \]

\[ = \frac{(10 \times 9 \times 8 \times 7 \times 6)}{(5 \times 4 \times 3 \times 2 \times 1)} \]

\[ = 30,240/120 \]

\[ = 252 \]

5. The set of possible outcomes

\[ = \{(H, H, H), (H, T, H), (H, H, T), (T, H, H), (T, H, T), (T, T, H), (H, T, T), (T, T, T)\} \]

There are 8 possible outcomes.

The set of favorable outcomes

\[ = \{(H, H, T), (H, T, H), (T, H, H), (H, H, H)\} \]

There are 4 favorable outcomes.

Therefore,

\[ P(\text{At least two heads}) = \frac{4}{8} = \frac{1}{2} \]

III.

1. 1. Firstly find the mean:

\[ \text{Mean} = (75 + 83 + 96 + 100 + 121 + 125) ÷ 6 = 600 ÷ 6 = 100 \]

2. Next find the variance. To calculate the Variance, take each difference, square it, and then average the result:

\[ (75 - 100)^2 + (83 - 100)^2 + (96 - 100)^2 + (100 - 100)^2 + (121 - 100)^2 + (125 - 100)^2 \]

\[ = (-25)^2 + (-17)^2 + (-4)^2 + (0)^2 + (21)^2 + (25)^2 \]

\[ = 625 + 289 + 16 + 0 + 441 + 625 \]

\[ = 1,996 \]

So the Variance = 1,996 ÷ 6 = 332.66...
3. The Standard Deviation is just the square root of the Variance
   \[ \sqrt{332.66...} = 18.2 \] correct to 1 decimal places

2. In a pack, there are 12 picture cards and 40 non-picture cards.
   It is easier to calculate the complement of 'At least one of them is a picture card'
   first, in other words 'Neither of them is a picture card':
   
   \[ P(\text{The first card chosen is not a picture card}) = \frac{40}{52} = \frac{10}{13} \]
   
   \[ P(\text{The second card chosen is also not a picture card}) = \frac{39}{51} = \frac{13}{17} \]
   
   \[ \Rightarrow P(\text{Neither of them is a picture card}) = \frac{10}{13} \times \frac{13}{17} = \frac{10}{17} \]
   
   \[ \Rightarrow P(\text{At least one of them is a picture card}) = 1 - \frac{10}{17} = \frac{7}{17} \]

3. The mean is halfway between 62 kg and 90 kg:
   \[ \text{Mean} = \frac{62 \text{ kg} + 90 \text{ kg}}{2} = 76 \text{ kg} \]

   95\% is 2 standard deviations either side of the mean (a total of 4 standard deviations) so:

   \[ 1 \text{ standard deviation} = \frac{90 \text{ kg} - 62 \text{ kg}}{4} = 28 \text{ kg}/4 = 7 \text{ kg} \]

   And this is the result:
Appendix – O

ITEM-WISE ANALYSIS (Criterion test I for try-out)

<table>
<thead>
<tr>
<th>Student No.</th>
<th>Section I</th>
<th>Section II</th>
<th>Section III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1  2  3  4  5  6  7  8  9  10</td>
<td>1  2  3  4  5</td>
<td>1  2  3</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| No. of correct responses | -  19  5  15  9  6  21  12  8  18 | 3  16  6  5  4  1 - - |
| No. of wrong responses   | 34  15  4  19  1  2  8  21  26  16 | 11  14  4  3  24  20  1 - |
| No. of partially right responses | 26  -  19  24  6  -  -  -  7  5  16  17  7  5  -  1 |
| No. of omissions         | 1  1 -  1  6  3 -  2  1  1  14 -  9  10 -  9  34  34 |

Key: √ correct response, X wrong response, √ partially correct, - omission
# Appendix – P

ITEM-WISE ANALYSIS (Criterion test II for try-out)

<table>
<thead>
<tr>
<th>Student No.</th>
<th>Section I</th>
<th>Section II</th>
<th>Section III</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td>1 2 3 4 5</td>
<td>1 2 3</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No. of correct responses</td>
<td>17 9 4 16 9 6 21 12 8 18</td>
<td>7 14 8 3</td>
<td>- 3 -</td>
</tr>
<tr>
<td>No. of wrong responses</td>
<td>13 15 5 17 1 4 8 21 26 16</td>
<td>13 16 2 5</td>
<td>34 17 1</td>
</tr>
<tr>
<td>No. of partially right responses</td>
<td>1 10 16 2 19 24 6</td>
<td>- - -</td>
<td>4 5 16 10</td>
</tr>
<tr>
<td>No. of omissions</td>
<td>4 1 10</td>
<td>- 6 3</td>
<td>- 2 1 1</td>
</tr>
</tbody>
</table>

Key: √ correct response, X wrong response, √ partially correct, - omission
# Appendix – Q

ITEM-WISE ANALYSIS (Criterion test III for try-out)

<table>
<thead>
<tr>
<th>Student No.</th>
<th>Section I</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Section II</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th>Section III</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>15</td>
<td>19</td>
<td>5</td>
<td>16</td>
<td>9</td>
<td>6</td>
<td>18</td>
<td>12</td>
<td>8</td>
<td>21</td>
<td>3</td>
<td>1</td>
<td>6</td>
<td>5</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>-</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>19</td>
<td>15</td>
<td>4</td>
<td>14</td>
<td>1</td>
<td>2</td>
<td>16</td>
<td>21</td>
<td>26</td>
<td>8</td>
<td>11</td>
<td>29</td>
<td>4</td>
<td>3</td>
<td>34</td>
<td>15</td>
<td>5</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **No. of correct responses:**
  - Section I: 15, 19, 5, 16, 9, 6, 18, 12, 8, 21
  - Section II: 3, 1, 6, 5
  - Section III: 1, 1

- **No. of wrong responses:**
  - Section I: 19, 15, 4, 14, 1, 2, 16, 21, 26, 8
  - Section II: 11, 29, 4, 3, 34
  - Section III: 15, 5, 2

- **No. of partially right responses:**
  - Section I: -
  - Section II: -
  - Section III: -

- **No. of omissions:**
  - Section I: 1, 1, -
  - Section II: 6, 3, 1, 2, 1
  - Section III: 14, 5, 9, 10, 1, 12, 27, 33

**Key:** ✓ correct response, ✗ wrong response, ✓✓ partially correct, - omission
## Appendix – R

ITEM-WISE ANALYSIS (Criterion test IV for try-out)

<table>
<thead>
<tr>
<th>Student No.</th>
<th>Section I</th>
<th></th>
<th>Section II</th>
<th></th>
<th>Section III</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td>1 2 3 4 5</td>
<td>1 2 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| No. of correct responses | 17 14 7 19 8 6 20 11 8 14 | 4 1 4 3 1 | - - - |
| No. of wrong responses   | 13 11 4 15 3 6 - 17 26 13 | 10 14 16 15 21 | - - - |
| No. of partially right responses | 2 3 24 - 15 3 6 7 - 7 | 5 5 6 10 3 | - - - |
| No. of omissions         | 3 7 - 1 9 24 9 - 1 1 | 16 15 9 7 10 34 35 35 |

Key: √ correct response, X wrong response, √ partially correct, - omission
## Appendix – S

ITEM-WISE ANALYSIS (Criterion test V for try-out)

<table>
<thead>
<tr>
<th>Student No.</th>
<th>Section I</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>35</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of correct responses</th>
<th>12</th>
<th>15</th>
<th>14</th>
<th>5</th>
<th>13</th>
<th>2</th>
<th>21</th>
<th>21</th>
<th>8</th>
<th>15</th>
<th>3</th>
<th>13</th>
<th>5</th>
<th>9</th>
<th>1</th>
<th>2</th>
<th>-</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of wrong responses</td>
<td>4</td>
<td>19</td>
<td>4</td>
<td>17</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>10</td>
<td>16</td>
<td>11</td>
<td>17</td>
<td>9</td>
<td>3</td>
<td>14</td>
<td>12</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>No. of partially right responses</td>
<td>10</td>
<td>-</td>
<td>16</td>
<td>3</td>
<td>7</td>
<td>24</td>
<td>8</td>
<td>4</td>
<td>6</td>
<td>-</td>
<td>7</td>
<td>5</td>
<td>16</td>
<td>5</td>
<td>8</td>
<td>8</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>No. of omissions</td>
<td>9</td>
<td>1</td>
<td>1</td>
<td>10</td>
<td>8</td>
<td>3</td>
<td>-</td>
<td>2</td>
<td>11</td>
<td>4</td>
<td>14</td>
<td>-</td>
<td>5</td>
<td>18</td>
<td>12</td>
<td>13</td>
<td>35</td>
<td>32</td>
</tr>
</tbody>
</table>

Key: √ correct response, X wrong response, √ partially correct, - omission
Appendix – T
(Criterion test for Block I for experiment)

Time: 1hr 30 min. Max. Marks: 50

Roll No. Name:
(Note: All questions are compulsory in all sections)

I. Please write your answer in the space provided

10 × 2 = 20

1. Write the place value of the digit in the number 636?

2. Write the four rules of arithmetic?

3. Match the items in column 1 with the items in column 2:

   Column 1               Column 2
   (i) 35                 (a) Multiple of 8
   (ii) 15                (b) Multiple of 7
   (iii) 16               (c) Multiple of 70
   (iv) 20                (d) Factor of 30
   (v) 25                 (e) Factor of 50

4. Add the following fractions

   5/8 + 1/8 = ? = ?
   2/4 + ½ = ?

5. Fill in the blanks in the following:

   (a) A number which has only two factors is called a ______.
   (b) A number which has more than two factors is called a ______.
   (c) 1 is neither ______ nor ______.
   (d) The smallest prime number is ______.
   (e) The smallest composite number is ______.
   (f) The smallest even number is ______.

Ivi
6. State whether the following statements are True or False:
   (a) The sum of three odd numbers is even.
   (b) The sum of two odd numbers and one even number is even.
   (c) If an even number is divided by 2, the quotient is always odd.
   (d) All prime numbers are odd.

7. A bicycle was bought for Rs.240 and sold for Rs.290: Find the profit as a percentage of cost price.

8. Jane drives at an average speed of 45 mph on a journey of 135 miles. How long does the journey take?

9. Convert a speed of 8 m/s to mph.

10. Calculate mentally: 125% of Rs.7.80.
II. Answer for the following questions  

5 \times 3 = 15

1. Write the different types of numbers with notation?

2. Fareeda buys a vessel marked at Rs. 85 but only pays Rs. 69.70. What percentage discount was she given?

3. A handbag bought for Rs. 125 was then sold for Rs. 160. Find the profit as a percentage of the cost price.

4. Rs. 5000 is invested at 8% p.a. compound interest with interest calculated annually.
   a) What will it amount to after 3 years?
   b) Find the interest earned.

5. A bus travels at a speed of 40 km/h. Calculate the speed of the bus in:
   (a) m/s
   (b) mph.
III. Answer for the following questions 3 x 5 = 15

1. Write the methods of calculation?

2. Two tankers contain 850 litres and 680 litres of kerosene oil, respectively. Find the maximum capacity of a container which can measure the kerosene oil of both the tankers when used an exact number of times.

3. Calculate the monthly repayments on a loan of Rs.15,000 at 7% p.a. flat rate over 4 years.
Appendix – U

Key (Criterion Test for block I for experiment)

I.
1. The two sixes in the number 636 do not have the same value – the one on the left stands for six hundreds (600) whilst the one on the right stands for 6 ones (6).
2. The four basic actions or operations are addition, subtraction, multiplication and division (often called the ‘4 rules of arithmetic’). The way the operations are represented in mathematical notation (+, -, x and ÷, and = etc.)
3. (i) a   (ii) d   (iii) a   (iv) f   (v) e
4. \( \frac{3}{4} = 0.75, 1 \)
5. a) Prime number b) Composite number c) Prime, Composite d) 2 e) 4 f) 2
6. a) F   b) T   c) F   d) F
7. Profit = selling price - cost price
   \[ = Rs.290 - Rs.240 \]
   \[ = Rs.50 \]
   Therefore, profit as a percentage of cost price
8.
   Time = \( \frac{\text{distance}}{\text{speed}} \)
   \[ = \frac{135}{45} \]
   \[ = 3 \text{ hours} \]
9.
   \[ 8 \text{ m/s} = 8 \times 3600 \text{ m/h} \]
   \[ = 28800 \text{ m/h} \]
   \[ = 28.8 \text{ km/h} \]
   \[ 28.8 \times \frac{5}{8} = 18 \text{ mph} \]
10. 125% means one and a quarter times: 100% + 25%.
    Now, to take a quarter of Rs.7.80, we may think of it as Rs.8.00 minus 20 paise.
    A quarter of Rs.8.00 is Rs.2.00.
A quarter of 20 paisa is 5 paisa.

Therefore, 125% of Rs.7.80 = Rs. 7.80 + Rs.2.00 – 5 paisa

II.

1. Natural numbers (N); Whole numbers (W); Integers (Z); Rational numbers (Q); Irrational numbers; Real Numbers ®.

2. Discount = Rs.85 – Rs.69.70
   = Rs.15.30
   Therefore, % discount = discount / marked price X 100%
   = Rs. 15.30 / 85 X 100
   = 18%
   So, Fareeda was given 18% discount.

3. Profit = S.P – C.P
   Rs. 160-Rs.125 = Rs.35
   % of Profit = Profit/C.P X 100%
   = 35/125 X 100% = 28%

4. a) The multiplier is 108% = 1.08
   Therefore, value after 3 years = Rs.5000 X (1.08)3
   = Rs.6298.56
   b) Interest earned = Rs.6298.56 - Rs.5000
   = Rs.1298.56

5.

(a) 1 km = 1000 m

40 km/h = 1000 × 40 m/hr

1 hour = 60 × 60

= 3600 seconds

40 km/h = \(
\frac{1000 \times 40}{3600}
\)

= 11.1 m/s to 1 decimal place

(b) 1 km = \(\frac{5}{8}\) mile

So 40 km/h = \(\frac{5}{8}\) × 40

= 25 mph
III.

1. (i) Information and data which includes figures, diagrams, lists, tables, charts, graphs, we need to interpret and make sense of this information and data.

(ii) Probability and predicting

2. The required container has to measure both the tankers in a way that the count is an exact number of times. So its capacity must be an exact divisor of the capacities of both the tankers. Moreover this capacity should be maximum. Thus the maximum capacity of such a container will be the HCF of 850 and 680. The HCF of 850 and 680 is 170.

Therefore, maximum capacity of the required container is 170 litres. It will fill the first container in 5 and the second in 4 refills.

3. Step 1: Calculate the interest on the loan.

\[ P = 15,000 \]
\[ R = \frac{7}{100} = 0.07 \]
\[ T = 4 \]

Now \[ I = PTR \]

Therefore, \[ I = 15,000 \times 0.07 \times 4 \]

Therefore, interest = Rs.4200

Step 2: Calculate the total amount to be repaid.

Total repayment = Rs.15,000 (principal) + Rs.4200 (Interest)

= Rs.19,200

Step 3: Repayments are made each month.

So, in 4 years we have \[ 4 \times 12 = 48 \text{ months}. \]

Step 4: Monthly repayment = Rs.19,200/48

= Rs.400
Appendix – V

(Criterion test for Block II for experiment)

Time: 1hr 30 min. Max. Marks: 50

Roll No. Name:

(Note: All questions are compulsory in all sections)

I. Please write your answer in the space provided $10 \times 2 = 20$

1. Insert the appropriate symbol in blank spaces.
   If $A = \{1,2,3\}$.
   (i) $1........A$  (ii) $4........A$.

2. Which of the following sets are finite and which are infinite?
   (i) Set of lines which are parallel to a given line.
   (ii) Set of animals on the earth.
   (iii) Set of Natural numbers less than or equal to fifty.

3. Write domain and range for each of the following functions:
   (a) $\{(\sqrt{2},2), (\sqrt{5},-1), (\sqrt{5},5)\}$
   (b) $\{(-3,\frac{1}{2}), (-2,\frac{1}{2}), (-1,\frac{1}{2})\}$
   (c) $\{(1,1), (0,0), (2,2), (-1,-1)\}$
   (d) $\{(Deepak,16), (Sandeep,28), (Rajan,24)\}$

4. Solve the equation $5x + 10 = 5(x + 2)$. 

5. Solve the following equations.
   a) $x + 5 = 9$           b) $12 - x = 7$           c) $5x = 3$
   d) $4x + 10 = 2$
6. Insert the appropriate symbol in the blank spaces, given that $A = \{1, 3, 5, 7, 9\}$
   (i) $f \ldots \ldots \ldots A$
   (ii) $\{2, 3, 9\} \ldots \ldots \ldots A$
   (iii) $3 \ldots \ldots \ldots A$
   (iv) $10 \ldots \ldots \ldots \ldots A$

7. Write down $S_1, S_2, \ldots, S_n$ for the sequences
   (a) $1, 3, 5, 7, 9, 11$
   (b) $4, 2, 0, -2, -4$

8. Write down the 10th and 19th terms of the APs
   (i) $8, 11, 14, \ldots$
   (ii) $8, 5, 2 \ldots$

9. Solve the equation $10 - 3x = 7$.

10. Determining Whether an Ordered Pair Is a Solution of a System, determine whether $(-5, -6)$ is a solution of the system $2x - y = -4$;
II. Answer for the following questions

5 \times 3 = 15

1. Write each of the following sets are in the set builder form?
   
   (i) \ A = \{2, 4, 6, 8, 10\} \quad (ii) \ B = \{3, 6, 9,..., \infty\}
   
   (iii) \ C = \{2, 3, 5, 7\} \quad (iv) \ D = \{-\sqrt{2}, \sqrt{2}\}

   Are A and B disjoints sets?

2. Given that A = \{a, b\}, how many elements P(A) has?

3. For #1-5, find the degree, leading coefficient, and leading term of the given polynomials.
   
   1.) \ 2x^3 - x^2 + 7x - 4
   
   2.) \ -x^2 + \pi x
   
   3.) \ x - 7
   
   4.) \ 23x^5 - 100 + 3x^{17}
   
   5.) \ -4x + 2

4. Solve the following equations.
   
   a) \ 6x + 2 = 29 - 3x \quad b) \ \frac{1}{3}x + 4 = \frac{4x - 1}{5} \quad c) \ \frac{3x}{4} = \frac{2}{5}

5. Find the value of each expression when x = 3 and y = -4.
   
   a. \ 5xy
   
   b. \ 2y^2
III. Answer for the following questions

1. Find the inverse of the following matrix

\[
A = \begin{pmatrix}
1 & 3 & 3 \\
1 & 4 & 3 \\
1 & 3 & 4
\end{pmatrix}
\]

2. Find the sum of the first 50 terms of the sequence

1, 3, 5, 7, 9, . . . .

3. Solve the equation

\[(x + 1)(2x + 1) = (x + 3)(2x + 3) - 14\]
Appendix – W

Key (Criterion test for block II for experiment)

I.

1. (i) $\notin$ (ii) $\notin$

2. (i) Infinite (ii) Finite (iii) Finite

3. a) Domain = $\{\sqrt{2}, \sqrt{5}, \sqrt{3}\}$, Range = $\{2, -1, 5\}$
   b) Domain = $\{-3, -2, -1\}$, Range = $\{1/2\}$
   c) Domain = $\{1, 0, 2, -1\}$, Range = $\{1, 0, 2, -1\}$
   d) Domain = $\{\text{Deepak, Sandeep, Rajan}\}$, Range = $\{16, 28, 24\}$

4.

\[
\begin{align*}
5x + 10 &= 5(x + 2) & \text{*Remove ( ) by using dist. prop.} \\
5x + 10 &= 5x + 10 \\
5x + 10 - 5x &= 5x + 10 - 5x \\
10 &= 10
\end{align*}
\]

5. a) 4  b) 5  c) 3/5  d) -2

6. (i) $\notin$ (ii) $\notin$ (iii) $\in$ (iv) $\notin$

7.

(a) 1, 4, 9, 16, 25, 36
(b) 4, 6, 6, 4, 0

8. (i) -35, 62 (ii) -19, -46

9.

\[
\begin{align*}
10 - 3x &= 7 \\
10 - 3x - 10 &= 7 - 10 \\
-3x &= -3 \\
\frac{-3x}{-3} &= \frac{-3}{-3} \\
x &= 1
\end{align*}
\]

10. Because $-5$ is the x–coordinate and $-6$ is the y–coordinate of $(-5, -6)$, we replace $x$ with $-5$ and $y$ with $-6$.

\[
\begin{align*}
2x - y &= -4 \\
2(-5) - (-6) &= -4 \\
-10 + 6 &= -4 \\
-4 &= -4, \text{ true}
\end{align*}
\]
II.

1. (i) A = \{x/x \text{ is an even, } x \leq 10\}  
   (ii) B = \{x/x \text{ is a multiple of 3, } x \leq \infty\}
   
   C = \{x/x \text{ is a prime, } x \leq 7\}  
   (iv) D = \{x/x \text{ is a rational, } x = -\sqrt{2}, +\sqrt{2}\} Yes

2. 4 Elements, Ø, \{a\}, \{b\}, \{a,b\}

3.

<table>
<thead>
<tr>
<th>No.</th>
<th>Degree</th>
<th>Leading Coefficient</th>
<th>Leading Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>2</td>
<td>$2x^3$</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>-1</td>
<td>$-x^2$</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>1</td>
<td>$x^1$</td>
</tr>
<tr>
<td>4</td>
<td>5</td>
<td>23</td>
<td>$23x^5$</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>-4</td>
<td>$-4x$</td>
</tr>
</tbody>
</table>

4. a) 3    b) 9    c) 8/15

5. a. This expression indicates to multiply 5 by $x$ by $y$:

\[5xy = 5 (3) (-4)\]

substituting for variables

\[-60\] multiplying

Note how we used parentheses when substituting for variables. This is often a good idea to distinguish negative numbers from subtraction.

b. This expression indicates to square $y$, then multiply by 2:

\[2y2 = 2 (-4)2\]

substituting for variables

\[= 2 (16)\]

computing the exponent

\[= 32\] multiplying
III.

1. First of all finding the determinant by expanding by column 1:

\[ \text{Det} \ (A) = 1 \times (16 - 9) - 1 \times (12 - 9) + 1 \times (9 - 12) = 1 \]

Then finding the nine cofactors:

\[
\begin{align*}
A_{11} &= +(16 - 9) = 7 \\
A_{21} &= -(12 - 9) = -3 \\
A_{31} &= +(9 - 12) = -3 \\
A_{12} &= -(4 - 3) = -1 \\
A_{22} &= +(4 - 3) = 1 \\
A_{32} &= -(3 - 3) = 0 \\
A_{13} &= +(3 - 4) = -1 \\
A_{23} &= -(3 - 3) = 0 \\
A_{33} &= +(4 - 3) = 1 \\
\end{align*}
\]

Putting these in-order forms the **adjugate** matrix:

\[
\begin{pmatrix}
A_{11} & A_{12} & A_{13} \\
A_{21} & A_{22} & A_{23} \\
A_{31} & A_{32} & A_{33}
\end{pmatrix}
= 
\begin{pmatrix}
7 & -1 & -1 \\
-3 & 1 & 0 \\
-3 & 0 & 1
\end{pmatrix}
\]

Then taking the transpose of the adjugate matrix to form the **adjoint** matrix:

\[
\begin{pmatrix}
A_{11} & A_{21} & A_{31} \\
A_{12} & A_{22} & A_{32} \\
A_{13} & A_{23} & A_{33}
\end{pmatrix}
= 
\begin{pmatrix}
7 & -3 & -3 \\
-1 & 1 & 0 \\
-1 & 0 & 1
\end{pmatrix}
\]

This was a very straight forward task due to the symmetry of the adjugate matrix.

The inverse is therefore:

\[
A^{-1} = \frac{1}{\text{Det} \ (A)} \begin{pmatrix}
A_{11} & A_{21} & A_{31} \\
A_{12} & A_{22} & A_{32} \\
A_{13} & A_{23} & A_{33}
\end{pmatrix}
= \frac{1}{1} \begin{pmatrix}
7 & -3 & -3 \\
-1 & 1 & 0 \\
-1 & 0 & 1
\end{pmatrix}
= \begin{pmatrix}
7 & -3 & -3 \\
-1 & 1 & 0 \\
-1 & 0 & 1
\end{pmatrix}
\]

2. This is an arithmetic progression, and we can write down

\[
a = 1, \quad d = 2, \quad n = 50.
\]

We now use the formula, so that

\[
S_n = \frac{1}{2}n(2a + (n - 1)d)
\]

\[
S_{50} = \frac{1}{2} \times 50 \times (2 \times 1 + (50 - 1) \times 2)
= 25 \times (2 + 49 \times 2)
= 25 \times (2 + 98)
= 2500.
\]
3. We begin by removing the brackets.

\[ 2x^2 + x + 2x + 1 = 2x^2 + 3x + 6x + 9 - 14 \]

So \[ 2x^2 + 3x + 1 = 2x^2 + 9x - 5 \]

Remember we stated that we are dealing in this unit with linear equations, so there should be no \( x^2 \) terms. In fact, they all cancel out:

There is a term \( 2x^2 \) on both sides. We can subtract \( 2x^2 \) from both sides to leave

\[ 3x + 1 = 9x - 5 \]

We can now proceed as in the earlier examples.

\[ 3x + 1 = 9x - 5 \]
\[ 1 = 6x - 5 \]
\[ 6 = 6x \]
\[ 1 = x \]

So the solution is \( x = 1 \). As before, we can substitute it back into the original equation as a check.

On the left:

\[ (x + 1)(2x + 1) = (1 + 1)(2 + 1) = (2)(3) = 6 \]

On the right

\[ (x + 3)(2x + 3) - 14 = (1 + 3)(2 + 3) - 14 = (4)(5) - 14 = 20 - 14 = 6 \]

So both sides equal 6 and the equations balance when \( x = 1 \). The solution is \( x = 1 \).
Appendix – X

(Criterion test for Block III for experiment)

Time: 1hr 30 min.                          Max. Marks: 50

Roll No.                                Name:

(Note: All questions are compulsory in all sections)

I. Please write your answer in the space provided  10 × 2 = 20

1. At which one of the following times is the angle between the hands of a clock exactly one right angle?
   A) 12:15   B) 03:00   C) 03:30   D) 06:45

2. How many degrees are there in one straight angle?
   A) 90°   B) 100°   C) 180°   D) 360°

3. A polygon has 35 diagonals. How many sides does it have?

4. Determine whether a scalar quantity, a vector quantity or neither would be appropriate to describe each of the following situations.
   a) A car is speeding eastward.
   b) The rock has a density of 5 gm/cm³.
   c) A bulldozer moves the rock eastward 15m.
   d) The wind is blowing at 20 km/hr from the south.

5. How many milliliters are there in 4½ liters?
   A) 450 ml   B) 4,050 ml   C) 4, 500ml D) 45, 000ml
6. The freezing point of water in degrees Celsius is:
   A) -32°C  B) 0°C  C) 32°C  D) 100°C

7. Ran ran for 40 km. How many meters is that?
   A) 400 m  B) 4,000 m  C) 40,000 m  D) 400,000 m

8. Time: What is 5:20 - 2:55?
   A) 3:35  B) 3:25  C) 2:35  D) 2:25

9. How many months are there in a Leap Year?
   A) 11  B) 12  C) 13  D) 29

10. The values of sin 45°, cos 45°, tan 45°?
II. Answer for the following questions

1. What is the area of triangle ABC?
   A) 17.4 units$^2$  B) 18 units$^2$  C) 21.75 units$^2$
   D) 27 units$^2$

2. A farmer has a field in the shape of a regular heptagon which has a perimeter of 700 m. What is its area?

3. Let $\mathbf{u} = (2, 1, 3), \mathbf{v} = (3, 1, -2)$ and $\mathbf{w} = (4, -1, 1)$.

   Find the following vectors.
   a. $\mathbf{u} + \mathbf{v}$  b. $\mathbf{u} - \mathbf{v}$  c. $2\mathbf{w}$  d. $2\mathbf{u} - 3\mathbf{v}$  e. $\mathbf{u} + 2\mathbf{v} - 3\mathbf{w}$  f. $2\mathbf{u} + 3\mathbf{v} - \mathbf{w}$

4. If $\sin \theta = \frac{3}{5}$ and $\theta$ is acute, what is the value of $\sec \theta$?

5. If $\tan \theta = \frac{1}{4}$, what is the exact value of $\tan 2\theta$?
III. Answer for the following questions

3 × 5 = 15

1. Let \( u = (1, 3, 2, 4), v = (5, 3, 0, 1), \) and \( w = (3, 2, -1, 4). \)

Find
a. \( ||u|| \)
b. \( ||v + w|| \)
c. \( ||u - v|| \)

2. (i) What is 9:00 AM on the 24 hour clock?
   A) 9:00 AM  B) 9:00 PM  C) 9:00  D) 21:00

   (ii) What is 3:00 PM on the 24 hour clock?
   A) 3:00 AM  B) 3:00 PM  C) 3:00  D) 15:00

   (iii) What is 7:15 PM on the 24 hour clock?
   A) 7:15  B) 19:15  C) 7:15 AM  D) 7:15 PM

   (iv) What is 18:00 on the AM/PM clock?
   A) 6:00 AM  B) 6:00 PM  C) 18:00 AM  D) 18:00 PM

   (v) What day is five days after Saturday?
   A) Monday  B) Wednesday  C) Thursday  D) Friday

3. Which is the size of angle \( x^\circ \)?
Appendix – Y

Key (Criterion Test for block III for experiment)

I.

1. B
2. C

Use the formula: \( d = \frac{n(n - 3)}{2} \) with \( d = 35 \)

Therefore \( 35 = \frac{n(n - 3)}{2} \)

3. \( \Rightarrow n(n - 3) = 35 \times 2 = 70 \)
   \( \Rightarrow n^2 - 3n - 70 = 0 \)

Now, we need to solve that quadratic equation.

It can be factored into this: \( (n - 10)(n + 7) = 0 \)

With solutions \( n = 10 \) or \( n = -7 \)

\( \Rightarrow n \) must be positive, so \( n = 10 \)

The polygon has 10 sides.

4. a, c, d are vectors; b, is scalar

5. Ans: C

1 liter = 1,000 ml

So 4½ liters = 4½ \times 1,000 ml = 4.5 \times 1,000 ml = 4,500 ml

6. Ans : B

The freezing point of water is 0°C

In degrees Fahrenheit, the freezing point is 32°F

100°C is the boiling point of water.

7. Ans: C

1 km = 1,000 m
So 40 km = 40,000 m

8. Ans: D

Subtract the Hours: 5 - 2 = 3

Subtract the Minutes: 20 - 55 = -35

The minutes are less than 0, so add 60 to Minutes (-35 + 60 = 60 - 35 = 25 Minutes) and subtract 1 from Hours (3 - 1 = 2 Hours) ... answer is 2:25

9. Ans : B

There are still 12 months in a Leap Year, but the month of February has an extra day

10. \( \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{2}}, 1 \)
II.

1. A

2. If the perimeter is 700m, then the length of one side $= 700m ÷ 7 = 100m$
   
   Now use the formula:
   
   \[
   \text{Area} = \frac{1}{4} \times n \times \frac{\text{Side}^2}{\tan \left( \frac{\pi}{n} \right)}
   \]

   Substitute $n = 7$ and Side $= 100m$

   \[
   \text{Area} = \frac{1}{4} \times 7 \times \frac{(100 \text{ m})^2}{\tan \left( \frac{\pi}{7} \right)}
   \]

   \[
   = \frac{1}{4} \times 7 \times \frac{10,000 \text{ m}^2}{\tan \left( \frac{\pi}{7} \right)}
   \]

   \[
   = \frac{17,500 \text{ m}^2}{\tan \left( \frac{\pi}{7} \right)}
   \]

   \[
   = \frac{0.4815... \text{ m}^2}{17,500 \text{ m}^2}
   \]

   \[
   = 36,339 \text{ m}^2
   \]

3. a) $u + v = (2, 1, 3) + (3, 1, -2) = (2+3, 1+1, 3-2) = (5, 2, 1)$
   
   b) $u - v = (2, 1, 3) - (3, 1, 2) = (2-3, 1-1, 3+2) = (-1, 0, 5)$
   
   c) $2w = 2(4, -1, 1) = (8, -2, 2)$
   
   d) $2u - 3v = 2(2,1,3) - 3(3,1,-2) = (4,2,6) - (9,3,-6) = (-5, -1, 12)$
   
   e) $u + 2v - 3w = (2,1,3) + 2(3,1,-2) - 3(4,-1,1) = (2,1,3)+(6,2,-4)-(12,-3,3)$

   \[
   = (-4, 6, -4)
   \]

   e) $2u + 3v - w = 2(2,1,3)+3(3,1,-2)-(4,-1,1) = (9,6,-1)$

4. First use the identity: $\sin^2\theta + \cos^2\theta = 1$ and substitute the value $\sin\theta = \frac{3}{5}$

   Therefore $\left(\frac{3}{5}\right)^2 + \cos^2\theta = 1$

   \[
   \Rightarrow \frac{9}{25} + \cos^2\theta = 1
   \]

   \[
   \Rightarrow \cos^2\theta = 1 - \frac{9}{25} = \frac{16}{25}
   \]

   \[
   \Rightarrow \cos\theta = \sqrt{\frac{16}{25}} = \frac{4}{5}
   \]

   Now we know the value of $\cos\theta$, to find $\sec\theta$ we just take the reciprocal.

   Therefore $\sec\theta = \frac{5}{4}$
5.

Use the identity: \( \tan 2\theta = \frac{2\tan \theta}{1 - \tan^2 \theta} \)

Substitute \( \tan \theta = \frac{1}{4} \)

Therefore \( \tan 2\theta = \frac{2 \times \frac{1}{4}}{1 - \left(\frac{1}{4}\right)^2} = \frac{\frac{1}{2}}{1 - \frac{1}{16}} = \frac{\frac{1}{2}}{\frac{15}{16}} = \frac{1}{2} \times \frac{16}{15} = \frac{8}{15} \)

III.

1. a) \( \| u \| = \sqrt{1+9+4+16} = \sqrt{30} \)
   b) \( \| v + w \| = \sqrt{64+25+1+25} = \sqrt{115} \)
   c) \( \| u - v \| = \sqrt{16+0+4+9} = \sqrt{29} \)

2. (i) Ans: C
   9:00 AM is 9 in the morning, so we don't need to add 12
   \( \Rightarrow 9:00 \text{ AM} = 9:00 \text{ on the 24 hour clock} \)
   
   (ii) Ans: D
   3:00 PM is 3 in the afternoon, so we do need to add 12
   \( 3 + 12 = 15 \)
   \( \Rightarrow 3:00 \text{ PM} = 15:00 \text{ on the 24 hour clock} \)
   
   (iii) Ans: B
   7:15 PM is in the evening, so we do need to add 12
   \( 7 + 12 = 19 \)
   \( \Rightarrow 7:15 \text{ PM} = 19:15 \text{ on the 24 hour clock} \)
   
   (iv) Ans: B
   18 > 12, so we know the time is in the afternoon or evening (PM)
   \( 18 - 12 = 6 \)
   \( \therefore 18:00 = 6:00 \text{ PM} \)
   
   (v) Ans: C
   Counting on from Saturday, the next five days are Sunday, Monday, Tuesday, Wednesday and Thursday.
   So, Thursday is five days after Saturday.

3. We know the opposite 4,000 and the hypotenuse 6,000, so we use sine:
   \( \sin x^\circ = \frac{\text{opposite}}{\text{hypotenuse}} = \frac{4,000}{6,000} = 0.6666... \)
   \( \Rightarrow x^\circ = \sin^{-1}(0.6666...) = 41.8^\circ \)
Appendix – Z

(Criterion test for Block IV for experiment)

Time: 1hr 30 min. Max. Marks: 50

Roll No. Name:

(Note: All questions are compulsory in all sections)

I. Please write your answer in the space provided 10 × 2 = 20

1. What is \( \lim_{x \to -3} \frac{x^2 - 9}{x + 3} \)?

2. Write True or False

\[
\lim_{x \to 1} \frac{x^2 - 1}{x - 1} \quad \Rightarrow \quad (1-1)/(1-1) = 0/0
\]

\[
\lim_{x \to 10} \frac{x}{2} \quad \Rightarrow \quad 10/2 = 5
\]

3.

\[
\lim_{x \to 1} \frac{x^2 - 1}{x - 1}
\]

4. Use the slope formula to find \( \frac{d}{dx} (3x^2) \)

5. Use the slope formula to find \( \frac{d}{dx} (\sin(x)) \)
6. What is \( \int 3x^2 \, dx \) ?

7. What is \( \int e^x \, dx \) ?

8. What is \( \int \sin(x) \, dx \) ?

9. What is \( \int \frac{1}{x} \, dx \) ?

What is the value of the definite integral:

10. \( \int_1^3 2x \, dx \) ?
II. Answer for the following questions 5 × 3 = 15

1. What is \( \lim_{x \to 2} \frac{x^2 - 4}{x - 2} \)?

2. Is there a solution to \( x^5 - 2x^3 - 2 = 0 \) between \( x=0 \) and \( x=2 \)?

3. What is \( \int 4x^7 \, dx \)?

4. Use Integration by Substitution to find \( \int \left( \frac{x^2}{x^3 + 1} \right) \, dx \)

What is the value of the definite integral:

5. \( \int_{-4}^{-2} e^{-x} \, dx \)?
III. Answer for the following questions

1. What is \( \lim_{{x \to -\infty}} \frac{{(x - 1)(3x + 2)}}{{x(x - 5)(2x - 3)}} \)?

2. What is \( \frac{d}{{dx}} (x^4 + x^3) \)?

3. Use Integration by Parts to find \( \int (x^2 \cos(x)) \, dx \)
Appendix – AA

Key (Criterion Test for block IV for experiment)

I.

1. Let's try approaching \( x = -3 \) closer and closer:

<table>
<thead>
<tr>
<th>( x )</th>
<th>( \frac{x^3 - 9}{x + 3} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-2.5</td>
<td>-5.50000</td>
</tr>
<tr>
<td>-2.9</td>
<td>-5.90000</td>
</tr>
<tr>
<td>-2.99</td>
<td>-5.99000</td>
</tr>
<tr>
<td>-2.999</td>
<td>-5.99900</td>
</tr>
<tr>
<td>-2.9999</td>
<td>-5.99990</td>
</tr>
<tr>
<td>-2.99999</td>
<td>-5.99999</td>
</tr>
</tbody>
</table>

But we need to check the other side too:

<table>
<thead>
<tr>
<th>( x )</th>
<th>( \frac{x^3 - 9}{x + 3} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3.5</td>
<td>6.50000</td>
</tr>
<tr>
<td>-3.1</td>
<td>-6.10000</td>
</tr>
<tr>
<td>-3.01</td>
<td>-6.01000</td>
</tr>
<tr>
<td>-3.001</td>
<td>-6.00100</td>
</tr>
<tr>
<td>-3.0001</td>
<td>-6.00010</td>
</tr>
<tr>
<td>-3.00001</td>
<td>-6.00001</td>
</tr>
</tbody>
</table>

We can see, as \( x \) gets close to -3 from both sides, that \( \frac{x^3 - 9}{x + 3} \) gets close to -6.

So \( \lim_{x \to -3} \frac{x^3 - 9}{x + 3} = -6 \)

2. (i) False, (ii) True

3. By factoring \((x^2-1)\) into \((x-1)(x+1)\) we get:

\[
\lim_{x \to 1} \frac{x^3 - 1}{x - 1} = \lim_{x \to 1} \frac{(x - 1)(x + 1)}{x - 1} = \lim_{x \to 1} (x + 1)
\]

Now we can just substitute \( x=1 \) to get the limit:

\[
\lim_{x \to 1} (x + 1) = 1 + 1 = 2
\]

4. \( f(x) = 3x^2 \)

So \( f(x + \Delta x) = 3(x + \Delta x)^2 = 3(x^2 + 2x\Delta x + (\Delta x)^2) \)

\[= 3x^2 + 6x\Delta x + 3(\Delta x)^2 \]

Therefore \( \frac{\Delta y}{\Delta x} = \frac{f(x + \Delta x) - f(x)}{\Delta x} \)

\[= \frac{3x^2 + 6x\Delta x + 3(\Delta x)^2 - 3x^2}{\Delta x} \]

\[= \frac{6x\Delta x + 3(\Delta x)^2}{\Delta x} \]

\[= 6x + 3\Delta x \]

And then as \( \Delta x \) heads towards 0 we get \( \frac{d}{dx} (3x^2) = 6x \)
5. 
\[ f(x) = \sin(x) \]

So \( f(x + \Delta x) = \sin(x + \Delta x) = \sin(x) \cos(\Delta x) + \cos(x) \sin(\Delta x) \)

Therefore
\[
\frac{\Delta y}{\Delta x} = \frac{f(x + \Delta x) - f(x)}{\Delta x}
= \frac{\sin(x) \cos(\Delta x) + \cos(x) \sin(\Delta x) - \sin(x)}{\Delta x}
\]

But as \( \Delta x \) heads for 0, \( \cos(\Delta x) \) can be approximated by 1, and \( \sin(\Delta x) \) can be approximated by \( \Delta x \)

Therefore
\[
\frac{\sin(x) \cos(\Delta x) + \cos(x) \sin(\Delta x) - \sin(x)}{\Delta x}
\approx \frac{\sin(x) \times 1 + \cos(x) \times \Delta x - \sin(x)}{\Delta x}
= \frac{\sin(x) + \cos(x) \Delta x - \sin(x)}{\Delta x}
= \cos(x)
\]

So as \( \Delta x \) heads towards 0 we get
\[
\frac{d}{dx} (\sin(x)) = \cos(x)
\]

6. 
\[
\frac{d}{dx} (x^3) = 3x^2
\]

7. 
Therefore
\[
\int 3x^2 \,dx = x^3 + c
\]

\[
\frac{d}{dx} (e^x) = e^x
\]

Therefore
\[
\int e^x \,dx = e^x + c
\]

8. 
\[
\frac{d}{dx} (\cos(x)) = -\sin(x)
\]

Therefore
\[
\int \sin(x) \,dx = -\cos(x) + c
\]

9. 
\[
\frac{d}{dx} (\ln|x|) = \frac{1}{x}
\]

Therefore
\[
\int \frac{1}{x} \,dx = \ln|x| + c
\]
10. \[ \int 2x \, dx = x^2 + c \]
So \[ \int_{1}^{3} 2x \, dx \]
\[ = \left[ x^2 \right]_{1}^{3} \]
\[ = 3^2 - 1^2 \]
\[ = 9 - 1 \]
\[ = 8 \]

II.

1. Let's try approaching \( x = 2 \) closer and closer:

<table>
<thead>
<tr>
<th>( x )</th>
<th>( x^2 - 4 )</th>
<th>( \frac{x^2 - 4}{x - 2} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5</td>
<td>3.50000</td>
<td>3.00000</td>
</tr>
<tr>
<td>1.9</td>
<td>3.90000</td>
<td>3.95000</td>
</tr>
<tr>
<td>1.99</td>
<td>3.99000</td>
<td>3.99500</td>
</tr>
<tr>
<td>1.999</td>
<td>3.99900</td>
<td>3.99950</td>
</tr>
<tr>
<td>1.9999</td>
<td>3.99990</td>
<td>3.99995</td>
</tr>
<tr>
<td>1.99999</td>
<td>3.99999</td>
<td>3.99999</td>
</tr>
</tbody>
</table>

But we need to check the other side too:

<table>
<thead>
<tr>
<th>( x )</th>
<th>( x^2 - 4 )</th>
<th>( \frac{x^2 - 4}{x - 2} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5</td>
<td>4.50000</td>
<td>4.50000</td>
</tr>
<tr>
<td>2.1</td>
<td>4.10000</td>
<td>4.10000</td>
</tr>
<tr>
<td>2.01</td>
<td>4.01000</td>
<td>4.01000</td>
</tr>
<tr>
<td>2.001</td>
<td>4.00100</td>
<td>4.00100</td>
</tr>
<tr>
<td>2.0001</td>
<td>4.00010</td>
<td>4.00010</td>
</tr>
<tr>
<td>2.00001</td>
<td>4.00001</td>
<td>4.00001</td>
</tr>
</tbody>
</table>

We can see, as \( x \) gets close to 2 from both sides, that \( \frac{x^2 - 4}{x - 2} \) gets close to 4.

So \( \lim_{x \to 2} \frac{x^2 - 4}{x - 2} = 4 \)

2. At \( x = 0 \):

\( 0^5 - 2 \times 0^3 - 2 = -2 \)

At \( x = 2 \):

\( 2^5 - 2 \times 2^3 - 2 = 14 \)

- No at \( x = 0 \), the curve is below zero
- at \( x = 2 \), the curve is above zero

we know:
And, being a polynomial, the curve will be continuous, so somewhere in between, the curve must cross through $y=0$.

Yes, there is a solution to $x^3 - 2x - 2 = 0$ in the interval $[0, 2]$.

3.

$$\frac{d}{dx}(x^8) = 8x^7 = 2 \times 4x^7$$

Therefore $\int 4x^7\,dx = \frac{1}{2}x^8 + c$

4. The derivative of $x^3 + 1$ is $3x^2$ ... so how about we rearrange it like this:

$$\int \left( \frac{x^2}{x^3 + 1} \right)\,dx = \frac{1}{3} \int \left( \frac{3x^2}{x^3 + 1} \right)\,dx$$

Then we have:

$$\frac{1}{3} \int \frac{3x^2}{x^3 + 1}\,dx = \frac{1}{3} \int \frac{1}{u}\,du$$

Then integrate:

$$\frac{1}{3} \int \frac{1}{u}\,du = \frac{1}{3} \ln |u| + c$$

Now put $u = x^3 + 1$ back again:

So $\int \left( \frac{x^2}{x^3 + 1} \right)\,dx = \frac{1}{3} \ln |x^3 + 1| + c$

5.

$$\int e^{-x}\,dx = -e^{-x} + c$$

So $\int_{-4}^{-2} e^{-x}\,dx$

$$= \left[ -e^{-x} \right]_{-4}^{-2}$$

$$= -e^2 - (-e^4)$$

$$= e^4 - e^2$$
III.

1. This is a rational function of the form \( \frac{P(x)}{Q(x)} \)

\[ P(x) = (x - 1)(3x + 2) \text{ has degree 2} \]

\[ Q(x) = x(x - 5)(2x - 3) \text{ has degree 3} \]

So \( \deg(P) < \deg(Q) \)

Therefore \( \lim_{x \to \infty} \frac{(x - 1)(3x + 2)}{x(x - 5)(2x - 3)} = 0 \)

2. The Sum Rule says:

the derivative of \( f + g = f' + g' \)

So we can work out each derivative separately and then add them.

Using the Power Rule:

\[ \frac{d}{dx} (x^4) = 4x^{4-1} = 4x^3 \]

\[ \frac{d}{dx} (x^3) = 3x^{3-1} = 3x^2 \]

And so:

\[ \frac{d}{dx} (x^4 + x^3) = 4x^3 + 3x^2 \]

3. First choose \( u \) and \( v \):

- \( u = x^2 \)
- \( v = \cos(x) \)

Differentiate \( u \): \( u' = (x^2)' = 2x \)

Integrate \( v \): \( \int v \, dx = \int \cos(x) \, dx = \sin(x) \)

Now put it together:

\[ \int x^2 \cos(x) \, dx \]

\[ x^2 \sin(x) - \int 2x \sin(x) \, dx \]
Simplify:
\[ x^2 \sin(x) - \int 2x \sin(x) \, dx \ldots (1) \]
Now we have to use integration by parts again to find \( \int 2x \sin(x) \, dx \)
Choose another \( u \) and \( v \):
- \( u = 2x \)
- \( v = \sin(x) \)
Differentiate \( u \): \( u' = (2x)' = 2 \)
Integrate \( v \): \( \int v \, dx = \int \sin(x) \, dx = -\cos(x) \)
Now put it together:
\[
\int 2x \sin(x) \, dx = 2x (-\cos(x)) - \int 2(-\cos(x)) \, dx
\]
Simplify and solve:
\[
2x (-\cos(x)) + \int 2 \cos(x) \, dx
\]
\[
= -2x \cos(x) + 2 \sin(x)
\]
Put it back into equation (1)
\[
x^2 \sin(x) - \int 2x \sin(x) \, dx
\]
\[
= x^2 \sin(x) - (-2x \cos(x) + 2 \sin(x)) + c
\]
\[
= x^2 \sin(x) + 2x \cos(x) - 2 \sin(x) + c
\]
\[
= (x^2 - 2) \sin(x) + 2x \cos(x) + c
\]
Appendix – AB
(Criterion test for Block V for experiment)

Time: 1hr 30 min.  Max. Marks: 50

Roll No.  Name:

(Note: All questions are compulsory in all sections)

I. Please write your answer in the space provided  10 × 2 = 20

1. Identify for the following data as qualitative or quantitative?
   i. He has long hair
   ii. He has lots of energy
   iii. He has four legs
   iv. He has two brothers

2. Which one of the following is discrete data?
   A) She is 45.2 cm long. B) She is 22.3 cm high. C) She weighs 5.4 kg.
   D) She has 30 teeth.

3. What is the mean of these numbers:
   12, -1, 8, 2, -10, 0, -5, 3, 20, -2

4. What is the median of the first eleven prime numbers?

5. What is the mode for the numbers 7, 6, 5, 8, 7, 5, 9, 3, 5 and 7?
6. What is the range for the following set of numbers?
   57, -5, 11, 39, 56, 82, -2, 11, 64, 18, 37, 15, 68

7. How many different committees of 5 people can be chosen from 10 people?

8. A password consists of two letters of the alphabet followed by three digits chosen from 0 to 9. Repeats are allowed. How many different possible passwords are there?

9. A die is thrown once. What is the probability that the score is a factor of 6?

10. If \( P(A) = \frac{3}{4} \), what is the value of \( P(A') \)?
II. Answer for the following questions

1. 60 students sat a test. The frequency distribution is shown in the following table:

<table>
<thead>
<tr>
<th>Mark</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

How many students scored greater than or equal to 4, but less than or equal to 7?

2. In his end of year exams, John scored the following:
   Science 34%, English 90%, History 87%, Math 34%, Geography 55%
   What was the mean, median, mode?

3. What is the standard deviation for the numbers: 75, 83, 96, 100, 121 and 125?

4. How many permutations of 4 different letters are there, chosen from the twenty six letters of the alphabet (repetition is not allowed)?

5. A card is chosen at random from a pack of 52 playing cards.
   What is the probability of a King or a Queen?
III. Answer for the following questions 3 × 5 = 15

1. The students in a class of 30 were given a spelling test consisting of 10 words.
   The numbers of words they each got correct were as follows:
   3, 5, 7, 0, 2, 6, 2, 10, 5, 9, 4, 1, 5, 2, 4, 5, 2, 2, 1, 0, 4, 7, 0, 2, 1, 2, 0, 9, 3
   Construct a frequency table. Use your table to calculate the mean score.

2. 95% of students at school weigh between 62 kg and 90 kg.
   Assuming this data is normally distributed, what are the mean and standard deviation?

3. A bag contains 3 red marbles and 4 blue marbles. Two marbles are drawn at random without replacement. If the first marble drawn is red, what is the probability the second marble is blue?
Appendix – AC

Key (Criterion Test for block V for experiment)

I.
1. (i), (ii) Qualitative and (iii), (iv) Quantitative
2. Discrete data can only take certain values (like whole numbers).
   Continuous data can take any value (within a range).
   The number of teeth has to be a whole number, so is discrete.
3. The sum of these numbers is
   \[ 12 + (-1) + 8 + 2 + (-10) + 0 + (-5) + 3 + 20 + (-2) = 27 \]
   There are 10 numbers.
   The mean is equal to \( 27 \div 10 = 2.7 \)
4. Put the numbers in order first: 3, 3, 4, 5, 6, 7, 10, 11, 12
   The median is the middle number = 6
5. Put the numbers in order first: 3, 5, 5, 5, 6, 7, 7, 7, 8, 9
   5 occurs three times and so does 7. So there are two modes: 5 and 7
6. The range is the difference between the lowest and highest values.
   The highest value is 82.
   The lowest value is -5.
   Therefore the range = 82 - (-5) = 82 + 5 = 87
7. In choosing a committee, order doesn't matter; so we need the number of combinations of 5 people chosen from 10
   \[ = 10C5 \]
   \[ = \frac{10!}{(5!)(5!)} \]
   \[ = \frac{(10 \times 9 \times 8 \times 7 \times 6)}{(5 \times 4 \times 3 \times 2 \times 1)} \]
   \[ = 30,240/120 \]
   \[ = 252 \]
8. The number of ways of choosing the letters = 26 × 26 = 676
   The number of ways of choosing the digits = 10 × 10 × 10 = 1,000
   So the number of possible passwords = 676 × 1,000 = 676,000
9. Probability of an event happening = \( \frac{\text{Number of ways it can happen}}{\text{Total number of outcomes}} \)
   The factors of six are 1, 2, 3 and 6, so the Number of ways it can happen = 4
   There are six possible scores when a die is thrown, so the Total number of
outcomes = 6
So the probability that the score is a factor of six = 4/6 = 2/3
10. P(A') means "Probability of the complement of Event A": all outcomes that are
NOT the event.
\[ P(A) + P(A') = 1 \]
So \[ P(A') = 1 - P(A) \]
\[ = 1 - \frac{3}{4} = \frac{1}{4} \]

II.
1. Greater than or equal to 4, but less than or equal to 7 includes 4, 5, 6 and 7
   8 students scored 4
   11 students scored 5
   8 students scored 6
   7 students scored 7
So \[ 8 + 11 + 8 + 7 = 34 \] scored greater than or equal to 4, but less than or equal to 7.
2. Mean = \[ \frac{(34\% + 90\% + 55\% + 34\% + 87\%)}{5} = \frac{300\%}{5} = 60\% \]
   To find the median, first arrange the scores in order:
   English 90\%, History 87%, Geography 55%, Math 34\%, Science 34\%
   The median is the middle one, which was 55\% for Geography.
   The mode is the most frequently occurring score, which was 34\% for Science and Math.
3. Firstly find the mean:
   \[ \text{Mean} = \frac{(75 + 83 + 96 + 100 + 121 + 125)}{6} = 600 ÷ 6 = 100 \]
   2. Next find the variance. To calculate the Variance, take each difference, square it, and then average the result:
\[ (75 - 100)^2 + (83 - 100)^2 + (96 - 100)^2 + (100 - 100)^2 + (121 - 100)^2 + (125 - 100)^2 \]
\[ = (-25)^2 + (-17)^2 + (-4)^2 + (0)^2 + (21)^2 + (25)^2 \]
\[ = 625 + 289 + 16 + 0 + 441 + 625 \]
\[ = 1,996 \]
So the Variance = \[ 1,996 ÷ 6 = 332.66... \]
4. The number of permutations of 4 digits chosen from 26 is\
\[ ^{26}P_4 = 26 \times 25 \times 24 \times 23 \]
\[ = 358,800 \]
5. Choosing a King and Choosing a Queen are mutually exclusive events.
Use \[ P(A \text{ or } B) = P(A) + P(B) \]
There are 4 Kings in the 52 cards, so

\[
P(\text{King}) = \frac{1}{13} \quad \text{and} \quad P(\text{Queen}) = \frac{1}{13}
\]

Therefore, \( P(\text{King or Queen}) = \frac{1}{13} + \frac{1}{13} = \frac{2}{13} \)

III.

1. The frequency table is constructed using a tally:

<table>
<thead>
<tr>
<th>Mark</th>
<th>Tally</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Represent the marks by \( x \) and the frequencies by \( f \). Complete the frequency table as follows:

<table>
<thead>
<tr>
<th>( x )</th>
<th>( f )</th>
<th>( fx )</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>12</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
<td>14</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>2</td>
<td>18</td>
</tr>
<tr>
<td>10</td>
<td>1</td>
<td>10</td>
</tr>
</tbody>
</table>

\( \Sigma f = 30 \quad \Sigma fx = 108 \)

\( \frac{\Sigma fx}{\Sigma f} = \frac{108}{30} = 3.6 \)

Therefore the mean mark was 3.6
2. The mean is halfway between 62 kg and 90 kg:
Mean = (62 kg + 90 kg)/2 = 76 kg
95% is 2 standard deviations either side of the mean (a total of 4 standard deviations) so:
1 standard deviation = (90 kg - 62 kg)/4 = 28 kg/4 = 7 kg

3. After the first marble is drawn and found to be red, there are now 6 marbles left in
the bag, 4 of which are blue.
Therefore

\[ P(\text{The second marble is blue given that the first marble is red}) = \frac{4}{6} = \frac{2}{3} \]
Appendix – AD
(Comprehensive test for terminal behaviour for experiment)

Time: 3 hours                                      Max. Marks: 100
Roll No.                                           Name:

(Note: All questions are compulsory in all sections)

I. Please write your answer in the space provided 20 × 2 = 40

1. A bicycle was bought for Rs.240 and sold for Rs.290: Find the profit as a percentage of cost price.

2. Calculate mentally: 125% of Rs.7.80.

3. Insert the appropriate symbol in blank spaces.
   If A =\{1,2,3\}.
   (iv) 1..........A   (ii) 4........A.

4. Solve the equation 10 - 3x = 7.

5. At which one of the following times is the angle between the hands of a clock exactly one right angle?
   A) 12:15  B) 03:00  C) 03:30  D) 06:45
   A) 3:35   B) 3:25   C) 2:35   D) 2:25

7. Use the slope formula to find \( \frac{d}{dx} (3x^2) \)

8. What is \( \int 3x^2 \, dx \)?

9. What is the mean of these numbers:
   12, -1, 8, 2, -10, 0, -5, 3, 20, -2

10. How many different committees of 5 people can be chosen from 10 people?
II. Answer for the following questions 10 × 3 = 30

1. Rs.5000 is invested at 8% p.a. compound interest with interest calculated annually.
   a) What will it amount to after 3 years?
   b) Find the interest earned.

2. Find the value of each expression when $x = 3$ and $y = -4$.
   a. $5xy$
   b. $2y^2$

3. A farmer has a field in the shape of a regular heptagon which has a perimeter of 700 m. What is its area?

4. Is there a solution to $x^5 - 2x^3 - 2 = 0$ between $x=0$ and $x=2$?

5. How many permutations of 4 different letters are there, chosen from the twenty six letters of the alphabet (repetition is not allowed)?
III. Answer for the following questions $6 \times 5 = 30$

1. Two tankers contain 850 litres and 680 litres of kerosene oil, respectively.
   Find the maximum capacity of a container which can measure the kerosene oil of both the tankers when used an exact number of times.

2. Which is the size of angle $x^\circ$?

3. A bag contains 3 red marbles and 4 blue marbles. Two marbles are drawn at random without replacement. If the first marble drawn is red, what is the probability the second marble is blue?
Appendix – AE

Key (Comprehensive Test for terminal behaviour for experiment)

I.
1. Profit = selling price - cost price
   = Rs.290 - Rs.240
   = Rs.50

   Therefore, profit as a percentage of cost price

2. 125% means one and a quarter times: 100% + 25%.

   Now, to take a quarter of Rs.7.80, we may think of it as Rs.8.00 minus 20 paise.

   A quarter of Rs.8.00 is Rs.2.00.

   A quarter of 20 paisa is 5 paisa.

   Therefore, 125% of Rs.7.80 = Rs. 7.80 + Rs.2.00 – 5 paisa

3. (i) ∈ (ii) ≠

4. 
   \[ 10 - 3x = 7 \]
   \[ 10 - 3x - 10 = 7 - 10 \]
   \[ -3x = -3 \]
   \[ -\frac{3x}{-3} = \frac{-3}{-3} \]
   \[ x = 1 \]

5. B

6. Ans: D

   Subtract the Hours: 5 - 2 = 3

   Subtract the Minutes: 20 - 55 = -35

   The minutes are less than 0, so add 60 to Minutes (-35 + 60 = 60 - 35 = 25 Minutes)

   and subtract 1 from Hours (3 - 1 = 2 Hours) ... answer is 2:25

7. 
   \[ f(x) = 3x^2 \]

   So \( f(x + \triangle x) = 3(x + \triangle x)^2 = 3(x^2 + 2x\triangle x + (\triangle x)^2) \)

   \[ = 3x^2 + 6x\triangle x + 3(\triangle x)^2 \]

   \[ \frac{\Delta y}{\Delta x} = \frac{f(x + \triangle x) - f(x)}{\triangle x} \]

   \[ = \frac{3x^2 + 6x\triangle x + 3(\triangle x)^2 - 3x^2}{\triangle x} \]

   \[ = \frac{6x\triangle x + 3(\triangle x)^2}{\triangle x} \]

   \[ = 6x + 3\triangle x \]

   And then as \( \triangle x \) heads towards 0 we get \[ \frac{d}{dx} (3x^2) = 6x \]
8.
\[
\frac{d}{dx}(x^3) = 3x^2
\]
Therefore \[\int 3x^2 \, dx = x^3 + c\]

9. Put the numbers in order first: 3, 3, 4, 5, 6, 7, 10, 11, 12

The median is the middle number = 6

10. In choosing a committee, order doesn’t matter; so we need the number of combinations of 5 people chosen from 10

\[
= 10C5
= \frac{10!}{(5!)(5!)}
= \frac{(10 \times 9 \times 8 \times 7 \times 6)/(5 \times 4 \times 3 \times 2 \times 1)}{120}
= 30,240/120
= 252
\]

II.

1. a) The multiplier is 108% = 1.08

Therefore, value after 3 years = Rs.5000 X (1.08)^3

= Rs.6298.56

b) Interest earned = Rs.6298.56 - Rs.5000

= Rs.1298.56

2. a. This expression indicates to multiply 5 by x by y:

\[
5xy = 5 \times (3) (-4)
\]
substituting for variables

= - 60 multiplying

Note how we used parentheses when substituting for variables. This is often a good idea to distinguish negative numbers from subtraction.

b. This expression indicates to square y, then multiply by 2:

\[
2y^2 = 2 \times (-4)^2
\]
substituting for variables

= 2 \times (16)
computing the exponent

= 32 multiplying

3. If the perimeter is 700m, then the length of one side = 700m ÷ 7 = 100 m

Now use the formula:
\[
\text{Area} = \frac{1}{4} \times n \times \frac{\text{Side}^2}{\tan\left(\frac{\pi}{n}\right)}
\]

Substitute \(n = 7\) and \(\text{Side} = 100\ m\)

\[
\text{Area} = \frac{1}{4} \times 7 \times \frac{(100\ m)^2}{\tan\left(\frac{\pi}{7}\right)}
\]

\[
= \frac{1}{4} \times 7 \times \frac{10,000\ m^2}{\tan\left(\frac{\pi}{7}\right)}
\]

\[
= \frac{17,500\ m^2}{\tan\left(\frac{\pi}{7}\right)}
\]

\[
= \frac{17,500\ m^2}{\tan(0.4487...)}
\]

\[
= \frac{17,500\ m^2}{0.4815...}
\]

\[
= 36,339\ m^2
\]

4. At \(x=0:\)

\[
0^5 - 2 \times 0^3 - 2 = -2
\]

At \(x=2:\)

\[
2^5 - 2 \times 2^3 - 2 = 14
\]

- No at \(x=0\), the curve is below zero
- at \(x=2\), the curve is above zero

we know:

And, being a polynomial, the curve will be continuous, so somewhere in between, the curve must cross through \(y=0\)

Yes, there is a solution to \(x^5 - 2x^3 - 2 = 0\) in the interval \([0, 2]\)

5. The number of permutations of 4 digits chosen from 26 is \(^{26}P_4 = 26 \times 25 \times 24 \times 23 = 358,800\)

III.

1. The required container has to measure both the tankers in a way that the count is an exact number of times. So its capacity must be an exact divisor of the capacities of both the tankers. Moreover this capacity should be \textbf{maximum}. Thus the maximum capacity of such a container will be the HCF of 850 and 680. The HCF of 850 and 680 is 170.

Therefore, maximum capacity of the required container is 170 litres. It will fill the first container in 5 and the second in 4 refills.
2. We know the opposite 4,000 and the hypotenuse 6,000, so we use sine:
\[
\sin x^\circ = \frac{\text{opposite}}{\text{hypotenuse}} = \frac{4,000}{6,000} = 0.6666...
\]
\[\Rightarrow x^\circ = \sin^{-1}(0.6666...) = 41.8^\circ\]

3. After the first marble is drawn and found to be red, there are now 6 marbles left in the bag, 4 of which are blue.

Therefore

\[
P(\text{The second marble is blue given that the first marble is red}) = \frac{4}{6} = \frac{2}{3}
\]