STUDENT DETAILS

<table>
<thead>
<tr>
<th>Student ID.</th>
<th>Signature of Student</th>
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**Instructions:**
- Complete the information required on the front page. Use blue / black ink or ball-point pen.
- Students should not keep any helping / study materials with them. Copying, cheating and any kind of malpractice in the examination are strictly prohibited.
- Use of only non-programmable calculators is allowed.
- Answer the questions in the space provided. Extra sheets will not be allowed or provided.
- All necessary steps for solutions must be shown in Section B and Section C, otherwise marks for method will be lost.
- The figures shown, if any, are only for illustration.
- A short list of relevant Formulas is attached at the back.
- Do not open this question paper until the invigilator has told you to do so.
- This exam carries 100% of the overall module mark.

<table>
<thead>
<tr>
<th>Section</th>
<th>No. of Questions × Marks per Question = Total Marks Allocated</th>
<th>1st Marking</th>
<th>2nd Marking</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>20 × 1 = 20 Marks</td>
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<tr>
<td>B</td>
<td>10 × 2 = 20 Marks</td>
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<tr>
<td>C</td>
<td>5 × 2 = 10 Marks</td>
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<td></td>
<td>Total = 50 Marks</td>
<td>/50</td>
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**Final Marks**

/50
Section-A
Circle the correct answer in the following questions. [Total Marks 20]

Each question carries one mark.

1) The radius of a sector is 5 cm and corresponding arc length is 10 cm, then the area of the sector is …

- a) $25 \text{ cm}^2$
- b) $36 \text{ cm}^2$
- c) $12 \text{ cm}^2$

2) If the volume of a cube is $27 \text{ cm}^3$, then the side is …

- a) $25 \text{ cm}$
- b) $10 \text{ cm}$
- c) $3 \text{ cm}$

3) … refers to the number of observations chosen randomly in order to investigate the population.

- a) Statistics
- b) Sample size
- c) Data

4) … is a measure of dispersion.

- a) Mean
- b) Median
- c) Range

5) If a die is rolled 2 times, then the sample size is…

- a) 36
- b) 18
- c) 3
6) … distinct permutations can be made with the letters of the word “TOWN”

| a) 24 | b) 6 | c) 120 |

7) If a card is drawn from an ordinary deck of cards, then the probability that it is Red is...

| a) \(\frac{1}{13}\) | b) \(\frac{1}{26}\) | c) \(\frac{1}{2}\) |

8) If D, E and F are mutually exclusive events and P(D)=0.4, P(E)=0.3 and P(F)=0.2, then P(F′) is..

| a) 0.6 | b) 0.8 | c) 0.9 |

9) In the following figure the codomain is …

```
A  
\downarrow \quad \quad \quad \quad \downarrow 
1 \quad 2 \quad 3 \quad 4 \quad 5 \quad 6 \quad 7 \quad 8

A \rightarrow B
```

| a) \{5, 6, 7, 8\} | b) \{1, 2, 3, 4\} | c) \{5, 6, 8\} |

10) The ordered pairs… represent a function.

```
a) \{(2, 7), (3, 7), (4, 7), (5, 7)\} 
b) \{(1,-5), (1, 6), (2, 6), (6,-3)\} 
c) \{(1,-5), (4, 1), (-5, 4), (4,-2)\}
```
11) … represents a constant function.

\[
\begin{array}{|c|c|c|}
\hline
a) & g(x) = 5x & b) g(x) = 2x^2 - 3 & c) g(x) = 7 \\
\hline
\end{array}
\]

12) The number of times a vertical line crosses the graph of a function is…

\[
\begin{array}{|c|c|c|}
\hline
a) 0 & b) 1 & c) 2 \\
\hline
\end{array}
\]

13) …is an exponential function.

\[
\begin{array}{|c|c|c|}
\hline
a) f(x) = 5^x - 1 & b) f(x) = \sin x & c) f(x) = 3x^2 \\
\hline
\end{array}
\]

14) From the statements below, … is true.

\[
\begin{array}{|c|c|c|}
\hline
a) \log_3 6 = 2 & b) \log_4 16 = 2 & c) \log_2 25 = 5 \\
\hline
\end{array}
\]

15) Using properties of logarithms, \( \log \left( \frac{b^5}{a} \right) \) can be written as …

\[
\begin{array}{|c|c|c|}
\hline
a) 5\log b + 5\log a & b) \log a + 5\log b & c) 5\log b - \log a \\
\hline
\end{array}
\]
16) The value of \( \lim_{x \to \frac{1}{3}} \left( \frac{9x^2-1}{3x-1} \right) \) is…

| a) 0 | b) 2 | c) 3 |

17) If \( y = 3x^2 - 5x + 4 \), then \( \frac{dy}{dx} =… \)

| a) 6x - 5 | b) 3x - 5 | c) 6x + 4 |

18) If \( y = \frac{2}{3x} \), then \( \frac{dy}{dx} =… \)

| a) \(-\frac{1}{3x^2}\) | b) \(\frac{1}{3x^2}\) | c) \(-\frac{2}{3x^2}\) |

19) For the function \( f(x) \) whose graph is given below, the correct statement is…

| a) \( f(3) = \lim_{x \to 3} f(x) \) | b) \( \lim_{x \to 3^-} f(x) = 4 \) | c) \( \lim_{x \to 3^-} f(x) = \lim_{x \to 3^+} f(x) = 2 \) |

20) The derivative of \( x\cos 3x \) is …

| a) \( \cos 3x - 3x \sin 3x \) | b) \( 3 \cos 3x - 3x \sin 3x \) | c) \( \cos 3x + 3x \sin 3x \) |
Section-B

Show your solution step by step in the following questions.
Each question carries two marks. [Total Marks 20]

1) In the following triangle find ‘θ’. (Write the answer to 1 decimal place)

Solution:

2) Height of a cylinder is twice as its diameter and its volume is $864\pi \text{ cm}^3$. What is its radius?

Solution:
3) What is the mode of the following data?
(Write the answer to 1 decimal place)

<table>
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<th>No. students</th>
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<td>21 – 30</td>
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<td>31 – 40</td>
<td>8</td>
</tr>
<tr>
<td>41 – 50</td>
<td>2</td>
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</tbody>
</table>

Solution:

4) A random sample of 300 children are classified below according to gender and the level of education attained.

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nursery</td>
<td>40</td>
<td>45</td>
</tr>
<tr>
<td>Primary School</td>
<td>35</td>
<td>45</td>
</tr>
<tr>
<td>High School</td>
<td>85</td>
<td>50</td>
</tr>
</tbody>
</table>

If a person is picked at random from this group, what is the probability that the person does not have a high school certificate, given that the person is a female? (Write the answer to 1 decimal place)

Solution:
5) If \( f(x) = x - 1 \) and \( g(x) = x^2 - 3x \), find \( (g \circ f)(-3) \)

Solution:

6) NH4 flue disease, is caused by a virus that multiplies exponentially by cell division as modelled by \( V = V_0 e^{1.285t} \)

Where \( V \) is the number of virus present after \( t \) hours and \( V_0 \) is the number of virus present at \( t = 0 \). If we start with 12 virus, how many virus will be present in 5 hours?

(Write the answer to 2 Significant figures)

Solution:

7) Find the value of ‘\( x \)’ in the equation: \( 5^{x+1} = 8 \).

(Write the answer to 1 decimal place)

Solution:
8) Evaluate \( \lim_{x \to \infty} \left( \frac{x - 1}{2x + 3} \right) \).

**Solution:**

9) Determine the \( \lim_{x \to 2} h(x) \) when \( h \) is defined as follows:

\[
h(x) = \begin{cases} 
7x + 6, & \text{if } x < 2 \\
2, & \text{if } x \geq 2 \\
3x + 4, & \text{if } x \geq 2 
\end{cases}
\]

**Solution:**

10) Find the derivative of the function \( y = (3x^2 - 2x)^5 \)

**Solution:**
Section-C

Show your solution step by step in the following questions.

Each question carries two marks. [Total Marks 10]

1) For the function $f(x)$ defined below, determine the value of $b$ so that $\lim_{x\to 5} f(x)$ exists.

$$f(x) = \begin{cases} 
2x - 3 & \text{if } x < 5 \\
\frac{2}{3}x + b & \text{if } x \geq 5
\end{cases}$$

**Solution:**

2) When 9 m$^3$ of water is removed from a cylindrical tank, the level of water in the tank goes down by 2.5 m. What is the radius of the tank? (Write the answer to 1 decimal place)

**Solution:**

3) Determine the co-ordinates of the point on the curve:

$y = 2x^2 - 3x - 5$, where the gradient is 1.

**Solution:**
4) If \( y = \frac{6 \cos 5x}{x^5} \), determine \( \frac{dy}{dx} \)

Solution:

5) Determine the rate of change of voltage, given \( v = 5t \sin 2t \) volts, when \( t = 0.2 \)
(Round off answer to 3 significant figures)

Solution:

END OF QUESTIONS
**Law of Sines and Cosines**

\[
\begin{align*}
\sin \alpha &= \sin \beta = \frac{\sin \gamma}{\cos \alpha} \\
a^2 &= b^2 + c^2 - 2bc \cos \alpha \\
b^2 &= a^2 + c^2 - 2ac \cos \beta \\
c^2 &= a^2 + b^2 - 2ab \cos \gamma \\
\cos \alpha &= \frac{b^2 + c^2 - a^2}{2bc} \\
\cos \beta &= \frac{a^2 + c^2 - b^2}{2ac} \\
\cos \gamma &= \frac{a^2 + b^2 - c^2}{2ab}
\end{align*}
\]

**Perimeter, Area and Volume**

**Triangle:**

\[
P = a + b + c \\
A = \frac{1}{2}bh
\]

**Circle:**

Circumference (C) = \(2\pi r = \pi d\)

\(A = \pi r^2\)

**Rectangle:**

\(P = 2l + 2b\)

\(A = lb\)

**Sector:**

Length of the arc:

\(L = \theta r\) if \(\theta\) is in radians

\(L = \theta \left(\frac{\pi}{180}\right) r\) if \(\theta\) is in degrees

Area:

\[A = \frac{1}{2} L r\]

\[A = \frac{1}{2} \theta r^2\] if \(\theta\) is in radians

\[A = \theta \left(\frac{\pi}{360}\right) r^2\] if \(\theta\) is in degrees

**Square:**

\[P = 4s\]

\[A = s^2\]
Trapezium:

$A = \frac{1}{2}(a + b)h$

Parallelogram:

$A = bh$

Cuboid:

$V = lbh$
$LSA = 2h(l + b)$
$TSA = 2(lb + bh + hl)$

Pyramid:

$V = \frac{1}{3} \text{Area of the base} \times \text{Height} = \frac{1}{3}Ah$

Cube:

$V = S^3$
$LSA = 4s^2$
$TSA = 6s^2$

Prism:

$V = \text{Area of cross section} \times \text{Length}$
$= \left(\frac{1}{2}bh\right)L$

Cone:

$V = \frac{1}{3}\pi r^2h$
$CSA = \pi rl$
$TSA = \pi r^2 + \pi rl$

Cylinder:

$V = \pi r^2h$
$CSA = 2\pi rh$
$TSA = 2\pi r(r + h)$
Sphere:

\[ V = \frac{4}{3} \pi r^3 \]

\[ CSA = TSA = 4\pi r^2 \]

### Statistics

**Relative frequency**

\[ \text{Relative frequency} = \frac{f \text{ of the class}}{\sum f} \]

\[ \theta = \text{relative frequency} \times 360^\circ \]

**Standard deviation**

\[ \text{standard deviation} = \sqrt{\text{Variance}} \]

#### For ungrouped data

**Mean**

\[ \bar{x} = \frac{\sum x}{n} \]

**Sample Variance**

\[ s^2 = \frac{\sum (x_i - \bar{x})^2}{n - 1} \]

**For grouped data**

**Mean**

\[ \bar{x} = \frac{\sum f_i x_i}{\sum f_i} \]

**Median**

\[ L_m + \left[ \frac{N - cf_m}{f_m} \right] i \]

Where, \( L_m \) = lower class boundary of the median class

\( N \) = the number of cases (items) in the set.

\( cf_m \) = the cumulative frequency before the median class.

\( f_m \) = frequency of the median class

\( i \) = class width or class size

### Probability

1) If an experiment can result in any one of \( N \) different equally likely outcomes, and if exactly \( n \) of these outcomes corresponds to event A, then the probability of event A is given by

\[ P(A) = \frac{n}{N} \]

2) The number of permutations of \( n \) distinct objects is \( n! \)

3) The number of permutations of \( n \) distinct objects taken \( r \) at a time is

\[ n_P_r \]

4) The number of permutations of \( n \) distinct objects arranged in a circle is \((n - 1)!\)

5) The number of combinations of \( n \) distinct objects taken \( r \) at a time is

\[ n_C_r \]

6) If A and B are any two events, then

\[ P(A \cup B) = P(A) + P(B) - P(A \cap B) \]

7) If A and B are two mutually exclusive events, then

\[ P(A \cup B) = P(A) + P(B) \]

8) If A and A' are complementary events, then

\[ P(A) + P(A') = 1 \]
9) If in an experiment, the events A and B can both occur, then
\[ P(A \cap B) = P(A) \cdot P(B|A) \]

10) If two events A and B are independent, then
\[ P(A \cap B) = P(A) \cdot P(B) \]

**Properties of exponential function**

1) \( a^x a^y = a^{x+y} \)
2) \( (a^x)^y = a^{xy} \)
3) \( (ab)^x = a^x b^x \)
4) \( \left( \frac{a}{b} \right)^x = \frac{a^x}{b^x} \)
5) \( \frac{a^x}{a^y} = a^{x-y} \)
6) \( a^x = a^y \) if and only if \( x = y \)
7) \( a^x = b^x \) if and only if \( a = b \)

**Definition of logarithmic function**

\[ y = \log_a x \iff x = a^y \]

**Properties of Logarithms**

1) \( \log_a (xy) = \log_a x + \log_a y \)
2) \( \log_a \left( \frac{x}{y} \right) = \log_a x - \log_a y \)
3) \( \log_a x^b = b \log_a x \)

**Quadratic Equation**

Solution of \( ax^2 + bx + c = 0 \) is given by
\[ x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \]

**Rules Of Differentiation**

1. \( \frac{d(c)}{dx} = 0 \) where \( c \) is any constant.
2. \( \frac{d}{dx} [a \cdot f(x)] = a \cdot \frac{d f(x)}{dx} \)
3. \( \frac{d(x^n)}{dx} = nx^{n-1} \)
4. \( \frac{d}{dx} [f(x) \pm g(x)] = f'(x) \pm g'(x) \)
5. \( \frac{d}{dx} [f(x) \cdot g(x)] = f(x) \cdot g'(x) + g(x) \cdot f'(x) \)
   or
   \[
   \frac{d}{dx} [u \cdot v] = u \cdot \frac{dv}{dx} + v \cdot \frac{du}{dx}
   \]
   where \( u \) and \( v \)

6. if \( y = \frac{f(x)}{g(x)} \), then
   \[
   \frac{dy}{dx} = \frac{g(x)f'(x) - f(x)g'(x)}{[g(x)]^2}
   \]

**General Power form:**

\[
\frac{d(u^n)}{dx} = n u^{n-1} \frac{d(u)}{dx}
\]

where \( u = f(x) \).

**Derivatives of Trigonometric Functions**

1. \( \frac{d}{dx} (\sin u) = \cos u \cdot \frac{d(u)}{dx} \) where \( u = f(x) \).
2. \( \frac{d}{dx} (\cos u) = -\sin u \cdot \frac{d(u)}{dx} \)
3. \( \frac{d}{dx} (\tan u) = \sec^2 u \cdot \frac{d(u)}{dx} \)

**Derivatives of Exponential Functions**

Let \( a \) be any real number but not zero and \( u = f(x) \)

1. \( \frac{d}{dx} (a^u) = a^u \ln a \cdot \frac{d(u)}{dx} \)
2. \( \frac{d}{dx} (e^u) = e^u \cdot \frac{d(u)}{dx} \)
Derivatives of Logarithmic Functions

Let \( a \) be any real number but not zero and \( u = f(x) \)

1. \[ \frac{d}{dx} (\log_a u) = \frac{1}{u \ln a} \frac{d}{dx} (u) \]

2. \[ \frac{d}{dx} (\ln u) = \frac{1}{u} \frac{d}{dx} (u) \]
ANSWERS

SECTION A

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<td>20</td>
<td>a</td>
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SECTION B

1) 40.4°
2) 6
3) 26.5
4) 0.6
5) 28
6) 7400
7) 0.3
8) \( \frac{1}{2} \)
9) 10
10) \( 5(3x^2 - 2x)^4(6x - 2) \)

SECTION C

1) \( \frac{11}{3} \)
2) 1.1
3) \((1, -6)\)
4) \(\frac{-30x^5 \sin 5x - 30x^4 \cos 5x}{x^{10}}\)
5) 2.03