



Name: _____

Year 11 2024 Mathematics Advanced Assessment Task 1

Assignment with Validation Task

Task number: 1

Weighting: 30%

Due Date: Tuesday
12/3/2024

Outcomes assessed:

- MA 11-1 uses algebraic and graphical techniques to solve, and where appropriate, compare alternative solutions to problems
- MA 11-8 uses appropriate technology to investigate, organize, model and interpret information in a range of contexts
- MA 11-9 provides reasoning to support conclusions which are appropriate to the context

Nature and description of the task:

As a result of completing this Assignment, students should be familiar with all content related to the following topics:

- “The Bread and Butter” Maths i.e. Fraction, Decimal and Percentage Conversions (including recurring decimals to simplified fractions), Significant Figures, Scientific Notation, Order of Operation and questions relating to Percentages.
- Algebraic Techniques ie. Chapter 1 of the Advanced and Extension 1 Grove Books.
- Equations and Inequalities i.e. Chapter 2 of the Advanced and Extension 1 Grove Books. (NOTE: Your teacher will let you know which exercises in this chapter will be included).

On the 12th March, 2024 you will receive a selection of questions similar to the Preparation Activity below to complete in a 1 hour in-class Validation Task. You are expected to investigate/attempt each of these questions before the in-class Validation Task. The final mark for this assessment will be the mark you receive in the in-class Validation task.

NOTE: You will not have to hand in the answers to the questions in this Preparation Activity AND you will not have access to the Preparation Activity during the Validation Task.

Non-Completion of Task:

If you know you are going to be away on the day of the Validation Task and are unable to complete it on the due day, then you must have supportive documentation. *Zero marks will apply if the Assessment Task is completed late, unless an Illness/ Misadventure or Application for Extension form has been submitted.*

“The Bread and Butter” Maths

Part A

Note: Questions 1–11 are non-calculator questions.

1 Write as a fraction in lowest terms:

a 30%

b 80%

c 75%

d 5%

2 Write as a decimal:

a 60%

b 27%

c 9%

d 16.5%

3 Write as a percentage:

a $\frac{1}{4}$

b $\frac{2}{5}$

c $\frac{6}{25}$

d $\frac{13}{20}$

4 Write as a percentage:

a 0.32

b 0.09

c 0.225

d 1.5

5 Factor into primes:

a 35

b 18

c 90

d 220

6 Cancel each fraction down to lowest terms.

a $\frac{4}{12}$

b $\frac{8}{10}$

c $\frac{10}{15}$

d $\frac{21}{28}$

e $\frac{16}{40}$

f $\frac{21}{45}$

g $\frac{24}{42}$

h $\frac{45}{54}$

i $\frac{36}{60}$

j $\frac{54}{72}$

7 Express each fraction as a decimal by rewriting it with denominator 10, 100 or 1000.

a $\frac{1}{2}$

b $\frac{1}{5}$

c $\frac{3}{5}$

d $\frac{3}{4}$

e $\frac{1}{25}$

f $\frac{7}{20}$

g $\frac{1}{8}$

h $\frac{5}{8}$

8 Express each terminating decimal as a fraction in lowest terms.

a 0.4

b 0.25

c 0.15

d 0.16

e 0.78

f 0.005

g 0.375

h 0.264

9 Express each fraction as a recurring decimal by dividing the numerator by the denominator.

a $\frac{1}{3}$

b $\frac{2}{3}$

c $\frac{1}{9}$

d $\frac{5}{9}$

e $\frac{3}{11}$

f $\frac{1}{11}$

g $\frac{1}{6}$

h $\frac{5}{6}$

10 Find the lowest common denominator, then simplify:

a $\frac{1}{2} + \frac{1}{4}$

b $\frac{3}{10} + \frac{2}{5}$

c $\frac{1}{2} + \frac{1}{3}$

d $\frac{2}{3} - \frac{2}{5}$

e $\frac{1}{6} + \frac{1}{9}$

f $\frac{5}{12} - \frac{3}{8}$

g $\frac{7}{10} + \frac{2}{15}$

h $\frac{2}{25} - \frac{1}{15}$

11 Find the value of:

a $\frac{1}{4} \times 20$

b $\frac{2}{3} \times 12$

c $\frac{1}{2} \times \frac{1}{5}$

d $\frac{1}{3} \times \frac{3}{7}$

e $\frac{2}{5} \times \frac{5}{8}$

f $2 \div \frac{1}{3}$

g $\frac{3}{4} \div 3$

h $\frac{1}{3} \div \frac{1}{2}$

i $1\frac{1}{2} \div \frac{3}{8}$

j $\frac{5}{12} \div 1\frac{2}{3}$

12 a Find 12% of \$5.

b Find 7.5% of 200kg.

c Increase \$6000 by 30%.

d Decrease $1\frac{1}{2}$ hours by 20%.

13 Express each fraction as a decimal.

a $\frac{33}{250}$

b $\frac{1}{40}$

c $\frac{5}{16}$

d $\frac{27}{80}$

e $\frac{7}{12}$

f $1\frac{9}{11}$

g $\frac{2}{15}$

h $\frac{13}{55}$

14 a Steve's council rates increased by 5% this year to \$840. What were his council rates last year?

b Joanne received a 10% discount on a pair of shoes. If she paid \$144, what was the original price?

c Marko spent \$135 this year at the Easter Show, a 12.5% increase on last year. How much did he spend last year?

Answers

1a $\frac{3}{10}$ b $\frac{4}{5}$ c $\frac{3}{4}$ d $\frac{1}{20}$

2a 0.6 b 0.27 c 0.09 d 0.165

3a 25% b 40% c 24% d 65%

4a 32% b 9% c 22.5% d 150%

5a 5×7 b 2×3^2 c $2 \times 3^2 \times 5$ d $2^2 \times 5 \times 11$

6a $\frac{1}{3}$ b $\frac{4}{5}$ c $\frac{2}{3}$ d $\frac{3}{4}$ e $\frac{2}{5}$ f $\frac{7}{15}$ g $\frac{4}{7}$ h $\frac{5}{6}$ i $\frac{3}{5}$ j $\frac{3}{4}$

7a 0.5 b 0.2 c 0.6 d 0.75 e 0.04 f 0.35

g 0.125 h 0.625

8a $\frac{2}{5}$ b $\frac{1}{4}$ c $\frac{3}{20}$ d $\frac{4}{25}$ e $\frac{39}{50}$ f $\frac{1}{200}$ g $\frac{3}{8}$ h $\frac{33}{125}$

9a 0.3̇ b 0.6̇ c 0.1̇ d 0.5̇ e 0.27̇ f 0.09̇

g 0.16̇ h 0.83̇

10a $\frac{3}{4}$ b $\frac{7}{10}$ c $\frac{5}{6}$ d $\frac{4}{15}$ e $\frac{5}{18}$ f $\frac{1}{24}$ g $\frac{5}{6}$ h $\frac{1}{75}$

11a 5 b 8 c $\frac{1}{10}$ d $\frac{1}{7}$ e $\frac{1}{4}$ f 6 g $\frac{1}{4}$ h $\frac{2}{3}$ i 4 j $\frac{1}{4}$

12a 60c b 15kg c \$7800 d 72 min or $1\frac{1}{5}$ h

13a 0.132 b 0.025 c 0.3125 d 0.3375 e 0.583̇

f 1.81̇ g 0.13̇ h 0.236̇

14a \$800 b \$160 c \$120

Part B

- 1 Classify these real numbers as rational or irrational. Express those that are rational in the form $\frac{a}{b}$ in lowest terms, where a and b are integers.
- | | | | | |
|-----------------|------------------------|--------------|--------------|------------------|
| a -3 | b $1\frac{1}{2}$ | c $\sqrt{3}$ | d $\sqrt{4}$ | e $\sqrt[3]{27}$ |
| f $\sqrt[4]{8}$ | g $\sqrt{\frac{4}{9}}$ | h 0.45 | i 12% | j 0.333 |
| k $0.\dot{3}$ | l $3\frac{1}{7}$ | m π | n 3.14 | o 0 |
- 2 Write each number correct to one decimal place.
- | | | |
|----------|----------|-----------|
| a 0.32 | b 5.68 | c 12.75 |
| d 0.05 | e 3.03 | f 9.96 |
- 3 Write each number correct to two significant figures.
- | | | |
|------------|-----------|-----------|
| a 0.429 | b 5.429 | c 5.029 |
| d 0.0429 | e 429 | f 4290 |
- 4 Use a calculator to find each number correct to three decimal places.
- | | | |
|-------------------|---------------|------------------|
| a $\sqrt{10}$ | b $\sqrt{47}$ | c $\frac{9}{16}$ |
| d $\frac{37}{48}$ | e π | f π^2 |
- 5 Use a calculator to find each number correct to three significant figures.
- | | | |
|---------------|-------------------|--------------|
| a $\sqrt{58}$ | b $\sqrt[3]{133}$ | c 62^2 |
| d 14^5 | e $\sqrt[4]{0.3}$ | f 124^{-1} |
- 6 To how many significant figures is each of these numbers accurate?
- | | | |
|-----------|-----------|-----------|
| a 0.04 | b 0.40 | c 0.404 |
| d 0.044 | e 4.004 | f 400 |
- 7 Prove algebraically that $0.2\dot{6}$ can be written as $\frac{4}{15}$.
- 8 Use algebra to prove that $0.3\dot{1}\dot{8} \times 0.\dot{8}$ is equal to $\frac{28}{99}$.
- 9 Prove that the recurring decimal $0.\dot{2}\dot{1}$ has the value $\frac{7}{33}$.
- 10 a) Express the following in scientific notation
- | | | |
|----------------|------------------|----------|
| i) 725000000 | ii) 0.00004567 | iii) 1 |
|----------------|------------------|----------|
- b) Express the following as ordinary numerals
- | | | |
|---------------------------|-----------------------|---------------------------|
| i) 3.267×10^{-3} | ii) 1.0×10^1 | iii) 5.0003×10^8 |
|---------------------------|-----------------------|---------------------------|

11 Calculate, correct to four significant figures:

a $10^{-0.4}$

b $\frac{1}{240 - 13 \times 17}$

c $\frac{\sqrt{6.5 + 8.3}}{2.7}$

d $\sqrt[3]{10.57 \times 12.83}$

e $\frac{3.5 \times 10^4}{2.3 \times 10^5}$

f $20000 \times (1.01)^{25}$

g $\frac{11.3}{\sqrt{19.5 - 14.7}}$

h $\frac{3\frac{2}{3} + 5\frac{1}{4}}{4\frac{1}{2} + 6\frac{4}{5}}$

i $(87.3 \times 10^4) \div (0.629 \times 10^{-8})$

j $\frac{\sqrt{3} + \sqrt[3]{4}}{\sqrt[4]{5} + \sqrt[5]{6}}$

k $\frac{\left(\frac{2}{5}\right)^4 \times \left(\frac{3}{4}\right)^5}{\left(\frac{6}{7}\right)^2 + \left(\frac{2}{3}\right)^3}$

l $\sqrt{\frac{36.41 - 19.57}{23.62 - 11.39}}$

Answers

1a rational, $\frac{-3}{1}$ b rational, $\frac{3}{2}$ c irrational d rational, $\frac{2}{1}$

e rational, $\frac{3}{1}$ f irrational g rational, $\frac{2}{3}$ h rational, $\frac{9}{20}$

i rational, $\frac{3}{25}$ j rational, $\frac{333}{1000}$

k rational, $\frac{1}{3}$ l rational, $\frac{22}{7}$ m irrational

n rational, $3\frac{7}{50}$ o rational, $\frac{0}{1}$

2a 0.3 b 5.7 c 12.8 d 0.1 e 3.0 f 10.0

3a 0.43 b 5.4 c 5.0 d 0.043 e 430 f 4300

4a 3.162 b 6.856 c 0.563 d 0.771

e 3.142 f 9.870

5a 7.62 b 5.10 c 3840 d 538000

e 0.740 f 0.00806

6a 1 b 2 c 3 d 2 e 4 f either 1, 2 or 3

11 a i) 7.25×10^8 ii) 10 iii) 1.0×10^0

b i) 0.003267 ii) 7.25×10^8 iii) 500030000

11a 0.3981 b 0.05263 c 1.425 d 5.138

e 0.1522 f 25650 g 5.158 h 0.7891

i 1.388×10^{14} j 1.134 k 0.005892 l 1.173

Algebraic Techniques:

Part A

10 multiple-choice questions
Circle the correct answer.

1 Solve $3x + 9 = 4 - 2(x + 5)$.

- A $x = -2$
- B $x = 2$
- C $x = -3$
- D $x = -15$

2 $\frac{1}{(x+y)^{-3}}$ is equivalent to:

- A $\left(\frac{1}{x+y}\right)^3$
- B $(x+y)^3$
- C $x^3 + y^3$
- D $\frac{1}{x^3 + y^3}$

3 Simplify $\frac{5k^{-2} \times (4k^3)^2}{4k^{-1}}$.

- A $\frac{5}{k^5}$
- B $5k^5$
- C $10k^5$
- D $20k^5$

4 Expand $(a - 4)(a^2 + 2a - 3)$.

- A $a^3 + 2a^2 + 11a + 12$
- B $a^3 + 2a^2 + 11a - 12$
- C $a^3 - 2a^2 - 11a + 12$
- D $a^3 - 2a^2 - 11a - 12$

5 Factorise $9x^2 + 3xy - 2y^2$.

- A $(3x - 2y)(3x + y)$
- B $(3x + 2y)(3x + y)$
- C $(3x - 2y)(3x - y)$
- D $(3x + 2y)(3x - y)$

6 Simplify $\frac{n+2}{n^2 - n - 6}$.

- A $\frac{2}{n-3}$
- B $\frac{1}{n-3}$
- C $\frac{1}{n+3}$
- D $n-3$

7 Simplify $m+n+\frac{1}{m-n}$.

A $\frac{m+n+1}{m-n}$

B $\frac{m^2+n^2+1}{m-n}$

C $\frac{m^2-n^2+1}{m-n}$

D $\frac{m^2-2mn-n^2+1}{m-n}$

8 The conversion of degrees Celsius to degrees Fahrenheit is given by the formula

$$F = \frac{9}{5}C + 32.$$

Find F when $C = -10$.

A -50

B -14

C 50

D 14

9 Evaluate $-x^5 + 2x^3 - 3x^2 + 4x - 5$ when $x = -1$.

A -6

B -13

C 1

D 7

10 Find the value of n if $2\sqrt{180} - \frac{\sqrt{80}}{2} = \sqrt{n}$.

A 500

B 50

C 10

D 5

Part B

10 free-response questions
Show your working where appropriate.

11 Solve $\frac{x+5}{2} - \frac{4-x}{3} = 1$.

12 Simplify each expression.

a $\frac{4^{n+3} \times 2^{4-n}}{8^{n+1}}$

b $2\sqrt{5a^4} \times \sqrt{5} \times \sqrt[3]{a}$

13 Simplify and express with positive indices: $\frac{2w^6h^3}{9h^5} \div \frac{4w^{-5}h^7}{(3w^{-2}h^3)^2}$

14 Expand and simplify $(2a - 3)(2a + 3)(a - 1)$.

15 Factorise each expression.

a $45x^3 - 5xy^2 - 18x^2y + 2y^3$

b $3p^3 + 30p^2 + 75p$

16 Simplify each expression.

a $\frac{p+2}{3} - \frac{p-1}{4}$

b $\frac{2m+1}{m+2} + \frac{3m}{m^2+m-2}$

17 Simplify $\frac{2x^2-5x-3}{x+3} \div \frac{2x-6}{6x+18}$.

18 If $a=2\sqrt{3}$, then evaluate $a^3 + (a+1)^2$.

19 Simplify $\frac{12\sqrt{10}}{4\sqrt{2}} + \sqrt{80}$.

20 Simplify $\frac{2}{\sqrt{5}+1} - \frac{1}{2-\sqrt{3}}$, writing your answer with a rational denominator.

Answers

1 C 2 B 3 D 4 C 5 D

6 B 7 C 8 D 9 B 10 A

11 $x = -\frac{1}{5}$

12 a 2^{7-2n}

b $10\sqrt[3]{a^7}$

13 $\frac{w^7}{2h^3}$

14 $4a^3 - 4a^2 - 9a + 9$

15 a $(5x - 2y)(3x + y)(3x - y)$

b $3p(p + 5)^2$

16 a $\frac{p+11}{12}$

b $\frac{2m^2 + 2m - 1}{(m+2)(m-1)}$

17 $3(2x + 1)$

18 $28\sqrt{3} + 13$

19 $7\sqrt{5}$

20 $\frac{\sqrt{5} - 2\sqrt{3} - 5}{2}$

Equations and Inequalities:

Part A

10 multiple-choice questions

Circle the correct answer.

1 Solve $x - 11 = 2(5 - 3x)$.

A $x = 3$

B $x = -\frac{21}{5}$

C $x = -\frac{1}{5}$

D $x = -\frac{1}{7}$

2 Solve $3n + 5 \leq n + 1$.

A $n \leq -4$

B $n \leq -2$

C $n \geq -2$

D $n \geq 4$

3 Evaluate $4 - |-3|^2$.

A 13

B 10

C -2

D -5

4 Solve $|2y - 3| = 9$.

A $y = -3$

B $y = 6$

C $y = -3, y = 6$

D $y = -6, y = 3$

5 Solve $2a^3 + 11 = -5$.

A $a = -8$

B $a = -2$

C $a = 2$

D $a = 8$

6 Solve $m^2 - 2m = 15$.

A $m = -3$ or -5

B $m = -3$ or 5

C $m = 3$ or -5

D $m = 3$ or 5

7 Solve $2k^2 - 5k - 1 = 0$.

A $k = \frac{5 \pm \sqrt{33}}{4}$

B $k = \frac{-5 \pm \sqrt{33}}{4}$

C $k = \frac{5 \pm \sqrt{17}}{4}$

D $k = \frac{-5 \pm \sqrt{17}}{4}$

8 The formula to calculate the volume of a cone is

$$V = \frac{1}{3}\pi r^2 h.$$

Find the value of h when $V = 95.3$ and $r = 2.4$.

A 49.6

B 37.9

C 15.8

D 1.8

9 Solve simultaneously $2x - y = 2$ and $x + 4y = 1$.

A $x = 1, y = 1$

B $x = -1, y = 0$

C $x = 1, y = 0$

D $x = 0, y = 1$

10 Solve $\frac{2}{2x - 1} = \frac{4}{x}$.

A $x = \frac{2}{3}$

B $x = \frac{3}{2}$

C $x = -\frac{3}{2}$

D $x = -\frac{2}{3}$

Part B

10 free-response questions
Show your working where appropriate.

11 Solve each equation.

a $1 - \frac{2p}{3} = 5$

b $\frac{x+5}{2} + \frac{x-2}{3} = 1$

12 Solve $3(1-x) \leq 2x+5$ and graph the solution on a number line.

13 Solve $|5w-3|=2$.

14 Show that $|a + b| \leq |a| + |b|$ when $a = 2$ and $b = -5$.

15 Solve $3^{x-1} = \frac{1}{9}$.

16 Solve $(2x + 5)(x + 1)(x - 4) = 0$.

17 Solve each equation.

a $(y + 5)^2 = 4$

b $3n^2 + 2n = 1$

Answers

1 A 2 B 3 D 4 C 5 B

6 B 7 A 8 C 9 C 10 A

11 a $p = -6$ b $x = -1$

12 $x \geq -\frac{2}{5}$



13 $w = \frac{1}{5}$ or 1

14 LHS = $|2 + -5|$
= $|-3|$
= 3
RHS = $|2| + |-5|$
= $2 + 5$
= 7
 $\therefore 3 < 7$

15 $x = -1$

16 $x = -\frac{5}{2}, -1, 4$

17 a $y = -7, -3$ b $n = -1, \frac{1}{3}$

18 $a = 1.855$

19 $x = -1, y = -6$ and $x = -4, y = -9$

20 $A = 4, B = -2, C = -\frac{1}{2}$

Mathematics Advanced
Mathematics Extension 1
Mathematics Extension 2

REFERENCE SHEET

Measurement

Length

$$l = \frac{\theta}{360} \times 2\pi r$$

Area

$$A = \frac{\theta}{360} \times \pi r^2$$

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

Surface area

$$A = 2\pi r^2 + 2\pi rh$$

$$A = 4\pi r^2$$

Volume

$$V = \frac{1}{3}Ah$$

$$V = \frac{4}{3}\pi r^3$$

Functions

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

For $ax^3 + bx^2 + cx + d = 0$:

$$\alpha + \beta + \gamma = -\frac{b}{a}$$

$$\alpha\beta + \alpha\gamma + \beta\gamma = \frac{c}{a}$$

$$\text{and } \alpha\beta\gamma = -\frac{d}{a}$$

Relations

$$(x - h)^2 + (y - k)^2 = r^2$$

Financial Mathematics

$$A = P(1 + r)^n$$

Sequences and series

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

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

$$T_n = ar^{n-1}$$

$$S_n = \frac{a(1 - r^n)}{1 - r} = \frac{a(r^n - 1)}{r - 1}, r \neq 1$$

$$S = \frac{a}{1 - r}, |r| < 1$$

Logarithmic and Exponential Functions

$$\log_a a^x = x = a^{\log_a x}$$

$$\log_a x = \frac{\log_b x}{\log_b a}$$

$$a^x = e^{x \ln a}$$

Trigonometric Functions

$$\sin A = \frac{\text{opp}}{\text{hyp}}, \quad \cos A = \frac{\text{adj}}{\text{hyp}}, \quad \tan A = \frac{\text{opp}}{\text{adj}}$$

$$A = \frac{1}{2}ab \sin C$$

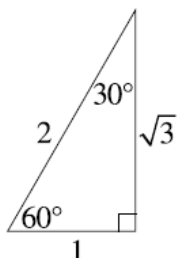
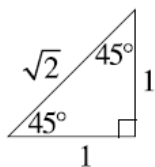
$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

$$c^2 = a^2 + b^2 - 2ab \cos C$$

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

$$l = r\theta$$

$$A = \frac{1}{2}r^2\theta$$



Trigonometric identities

$$\sec A = \frac{1}{\cos A}, \quad \cos A \neq 0$$

$$\operatorname{cosec} A = \frac{1}{\sin A}, \quad \sin A \neq 0$$

$$\cot A = \frac{\cos A}{\sin A}, \quad \sin A \neq 0$$

$$\cos^2 x + \sin^2 x = 1$$

Compound angles

$$\sin(A + B) = \sin A \cos B + \cos A \sin B$$

$$\cos(A + B) = \cos A \cos B - \sin A \sin B$$

$$\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B}$$

$$\text{If } t = \tan \frac{A}{2} \text{ then } \sin A = \frac{2t}{1 + t^2}$$

$$\cos A = \frac{1 - t^2}{1 + t^2}$$

$$\tan A = \frac{2t}{1 - t^2}$$

$$\cos A \cos B = \frac{1}{2}[\cos(A - B) + \cos(A + B)]$$

$$\sin A \sin B = \frac{1}{2}[\cos(A - B) - \cos(A + B)]$$

$$\sin A \cos B = \frac{1}{2}[\sin(A + B) + \sin(A - B)]$$

$$\cos A \sin B = \frac{1}{2}[\sin(A + B) - \sin(A - B)]$$

$$\sin^2 nx = \frac{1}{2}(1 - \cos 2nx)$$

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

Statistical Analysis

$$z = \frac{x - \mu}{\sigma}$$

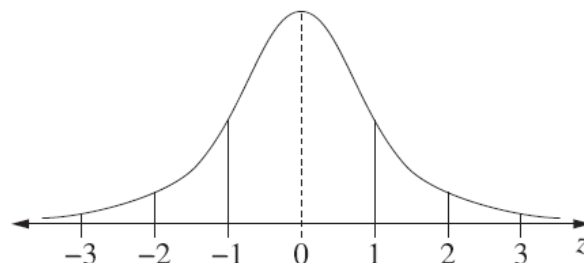
An outlier is a score

less than $Q_1 - 1.5 \times IQR$

or

more than $Q_3 + 1.5 \times IQR$

Normal distribution



- approximately 68% of scores have z -scores between -1 and 1
- approximately 95% of scores have z -scores between -2 and 2
- approximately 99.7% of scores have z -scores between -3 and 3

$$E(X) = \mu$$

$$\operatorname{Var}(X) = E[(X - \mu)^2] = E(X^2) - \mu^2$$

Probability

$$P(A \cap B) = P(A)P(B)$$

$$P(A \cup B) = P(A) + P(B) - P(A \cap B)$$

$$P(A|B) = \frac{P(A \cap B)}{P(B)}, \quad P(B) \neq 0$$

Continuous random variables

$$P(X \leq x) = \int_a^x f(x) dx$$

$$P(a < X < b) = \int_a^b f(x) dx$$

Binomial distribution

$$P(X = r) = {}^n C_r p^r (1 - p)^{n-r}$$

$$X \sim \operatorname{Bin}(n, p)$$

$$\Rightarrow P(X = x)$$

$$= \binom{n}{x} p^x (1 - p)^{n-x}, \quad x = 0, 1, \dots, n$$

$$E(X) = np$$

$$\operatorname{Var}(X) = np(1 - p)$$

Differential Calculus

Function

$$y = f(x)^n$$

$$y = uv$$

$$y = g(u) \text{ where } u = f(x)$$

$$y = \frac{u}{v}$$

$$y = \sin f(x)$$

$$y = \cos f(x)$$

$$y = \tan f(x)$$

$$y = e^{f(x)}$$

$$y = \ln f(x)$$

$$y = a^{f(x)}$$

$$y = \log_a f(x)$$

$$y = \sin^{-1} f(x)$$

$$y = \cos^{-1} f(x)$$

$$y = \tan^{-1} f(x)$$

Derivative

$$\frac{dy}{dx} = n f'(x) [f(x)]^{n-1}$$

$$\frac{dy}{dx} = u \frac{dv}{dx} + v \frac{du}{dx}$$

$$\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$$

$$\frac{dy}{dx} = \frac{v \frac{du}{dx} - u \frac{dv}{dx}}{v^2}$$

$$\frac{dy}{dx} = f'(x) \cos f(x)$$

$$\frac{dy}{dx} = -f'(x) \sin f(x)$$

$$\frac{dy}{dx} = f'(x) \sec^2 f(x)$$

$$\frac{dy}{dx} = f'(x) e^{f(x)}$$

$$\frac{dy}{dx} = \frac{f'(x)}{f(x)}$$

$$\frac{dy}{dx} = (\ln a) f'(x) a^{f(x)}$$

$$\frac{dy}{dx} = \frac{f'(x)}{(\ln a) f(x)}$$

$$\frac{dy}{dx} = \frac{f'(x)}{\sqrt{1-[f(x)]^2}}$$

$$\frac{dy}{dx} = -\frac{f'(x)}{\sqrt{1-[f(x)]^2}}$$

$$\frac{dy}{dx} = \frac{f'(x)}{1+[f(x)]^2}$$

Integral Calculus

$$\int f'(x) [f(x)]^n dx = \frac{1}{n+1} [f(x)]^{n+1} + c$$

where $n \neq -1$

$$\int f'(x) \sin f(x) dx = -\cos f(x) + c$$

$$\int f'(x) \cos f(x) dx = \sin f(x) + c$$

$$\int f'(x) \sec^2 f(x) dx = \tan f(x) + c$$

$$\int f'(x) e^{f(x)} dx = e^{f(x)} + c$$

$$\int \frac{f'(x)}{f(x)} dx = \ln |f(x)| + c$$

$$\int f'(x) a^{f(x)} dx = \frac{a^{f(x)}}{\ln a} + c$$

$$\int \frac{f'(x)}{\sqrt{a^2 - [f(x)]^2}} dx = \sin^{-1} \frac{f(x)}{a} + c$$

$$\int \frac{f'(x)}{a^2 + [f(x)]^2} dx = \frac{1}{a} \tan^{-1} \frac{f(x)}{a} + c$$

$$\int u \frac{dv}{dx} dx = uv - \int v \frac{du}{dx} dx$$

$$\int_a^b f(x) dx$$

$$\approx \frac{b-a}{2n} \{f(a) + f(b) + 2[f(x_1) + \dots + f(x_{n-1})]\}$$

where $a = x_0$ and $b = x_n$

Combinatorics

$${}^n P_r = \frac{n!}{(n-r)!}$$

$$\binom{n}{r} = {}^n C_r = \frac{n!}{r!(n-r)!}$$

$$(x+a)^n = x^n + \binom{n}{1}x^{n-1}a + \dots + \binom{n}{r}x^{n-r}a^r + \dots + a^n$$

Vectors

$$|\underline{u}| = |x\underline{i} + y\underline{j}| = \sqrt{x^2 + y^2}$$

$$\underline{u} \cdot \underline{v} = |\underline{u}| |\underline{v}| \cos \theta = x_1 x_2 + y_1 y_2,$$

$$\text{where } \underline{u} = x_1 \underline{i} + y_1 \underline{j}$$

$$\text{and } \underline{v} = x_2 \underline{i} + y_2 \underline{j}$$

$$\underline{r} = \underline{a} + \lambda \underline{b}$$

Complex Numbers

$$z = a + ib = r(\cos \theta + i \sin \theta) \\ = r e^{i\theta}$$

$$[r(\cos \theta + i \sin \theta)]^n = r^n (\cos n\theta + i \sin n\theta) \\ = r^n e^{in\theta}$$

Mechanics

$$\frac{d^2 x}{dt^2} = \frac{dv}{dt} = v \frac{dv}{dx} = \frac{d}{dx} \left(\frac{1}{2} v^2 \right)$$

$$x = a \cos(nt + \alpha) + c$$

$$x = a \sin(nt + \alpha) + c$$

$$\ddot{x} = -n^2(x - c)$$