Neap

Trial Examination 2021

Year 12 Mathematics Extension 2

General Instructions	
	• Reading time – 10 minutes • Working time – 3 hours • Write using black pen • Calculators approved by NESA may be used • A reference sheet is provided at the back of this paper • For questions in Section II, show relevant mathematical reasoning and/or calculations

Total Marks: 100	
	Section I – 10 marks (pages 2–5) • Attempt Questions 1–10 • Allow about 15 minutes for this section **Section II – 90 marks (pages 6–13)** • Attempt Questions 11–16 • Allow about 2 hours and 45 minutes for this section

SECTION I

10 marks
Attempt Questions 1–10
Allow about 15 minutes for this section

Use the multiple-choice answer sheet for Questions 1–10.

---

1 Let $\underset{\sim}{a} = 3\underset{\sim}{i} - 4\underset{\sim}{j} + \underset{\sim}{k}$ and $\underset{\sim}{b} = -\underset{\sim}{i} + 2\underset{\sim}{j} - 3\underset{\sim}{k}$.
Which of the following is equal to $2\underset{\sim}{a} - \underset{\sim}{b}$?

A. $7\underset{\sim}{i} - 10\underset{\sim}{j} - \underset{\sim}{k}$

B. $7\underset{\sim}{i} - 10\underset{\sim}{j} + 5\underset{\sim}{k}$

C. $5\underset{\sim}{i} - 10\underset{\sim}{j} + 5\underset{\sim}{k}$

D. $5\underset{\sim}{i} - 10\underset{\sim}{j} - \underset{\sim}{k}$

2 Let $z = \dfrac{\sqrt{3} - i}{1 + i}$.
What is the modulus and argument of z?

A. $\dfrac{1}{\sqrt{2}}$ and $-\dfrac{5\pi}{12}$

B. $\dfrac{1}{\sqrt{2}}$ and $-\dfrac{\pi}{12}$

C. $\sqrt{2}$ and $-\dfrac{5\pi}{12}$

D. $\sqrt{2}$ and $-\dfrac{\pi}{12}$

3 What is the Cartesian equation of the line $\underset{\sim}{r} = \begin{pmatrix} -5 \\ 6 \end{pmatrix} + \lambda \begin{pmatrix} 2 \\ -3 \end{pmatrix}$?

A. $2y + 3x = -3$

B. $2x - 3y = -8$

C. $3y + 2x = 8$

D. $3x - 2y = 28$

 TEN_Y12_MExt2_QB_2021

4 In the complex plane, a circle C has diameter AB, where the points A and B represent the complex numbers $1-5i$ and $3-i$ respectively.
What is the equation of C?

A. $|z-2+3i|=2\sqrt{5}$

B. $|z-2+3i|=\sqrt{5}$

C. $|z+2-3i|=2\sqrt{5}$

D. $|z+2-3i|=\sqrt{5}$

5 A particle moves in a straight line with simple harmonic motion about a centre O. The period of the motion is π seconds. When the particle is 0.50 metres from O, its speed is 2.40 m/s.
What is the particle's maximum speed?

A. 2.40 m/s

B. 2.60 m/s

C. 3.38 m/s

D. 5.20 m/s

6 Which of the following expressions is equal to $\int \frac{8x+1}{x^2+9}dx$?

A. $8\ln\left(x^2+9\right)+3\tan^{-1}\frac{x}{3}+c$

B. $8\ln\left(x^2+9\right)+\frac{1}{3}\tan^{-1}\frac{x}{3}+c$

C. $4\ln\left(x^2+9\right)+3\tan^{-1}\frac{x}{3}+c$

D. $4\ln\left(x^2+9\right)+\frac{1}{3}\tan^{-1}\frac{x}{3}+c$

7 Given that x and y are natural numbers, which of the following is a FALSE statement?

A. $\forall x \exists y\,(x-y=0)$

B. $\forall x \exists y\,(3x-y=0)$

C. $\forall x \exists y\,(x-3y=0)$

D. $\exists x \exists y\,(x+y=8)$

8 Consider the statement, where p and q are odd primes and r and s are positive non-primes.

‘For all odd primes $p < q$ there exists positive non-primes $r < s$ such that $p^2 + q^2 = r^2 + s^2$.’

Which of the following is the negation of the statement?

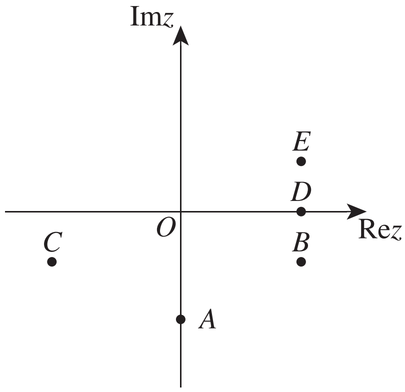
A. For all odd primes $p < q$ there exists positive non-primes $r < s$ such that $p^2 + q^2 = r^2 + s^2$.

B. For all odd primes $p < q$ and for all positive non-primes $r < s, p^2 + q^2 \neq r^2 + s^2$.

C. There exists odd primes $p < q$ such that for all positive non-primes $r < s, p^2 + q^2 = r^2 + s^2$.

D. There exists odd primes $p < q$ such that for all positive non-primes $r < s, p^2 + q^2 \neq r^2 + s^2$.

9 Consider the Argand diagram, where $z = a + ib$.



Which of the following pairs of points in the complex plane could represent the square roots of z?

A. A and D

B. B and C

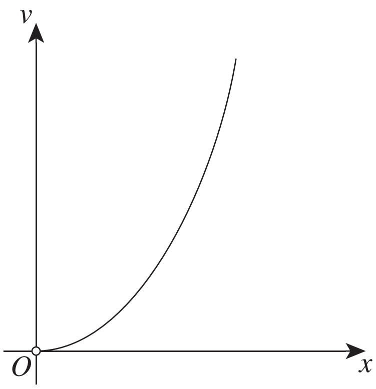
C. B and E

D. C and E

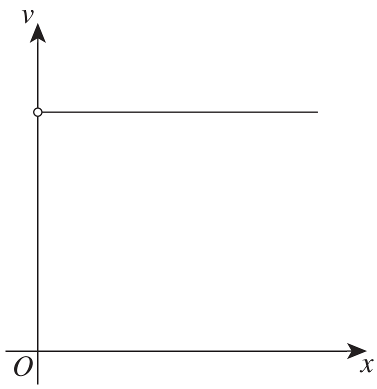
10 A particle moves in a straight line such that its acceleration a is given by $a = vx$, where v is the particle's velocity, x is the particle's position and v, $x > 0$.

Which of the following diagrams best shows the relationship between v and x?

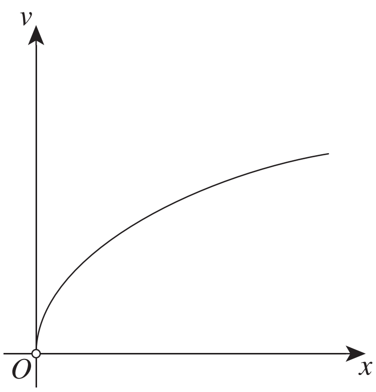
A.



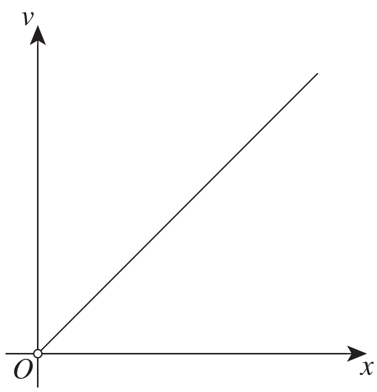
B.



C.



D.



SECTION II

90 marks

Attempt Questions 11–16

Allow about 2 hours and 45 minutes for this section

Answer each question in a SEPARATE writing booklet. Extra writing booklets are available.

For questions in Section II, your responses should include relevant mathematical reasoning and/or calculations.

Question 11 (15 marks) Use a SEPARATE writing booklet.

(a) The quadratic equation $z^2 + pz + q = 0$, where p and q are real, has a root $\sqrt{5} - i$. **2**

Find the values of p and q.

(b) Use integration by parts to evaluate $\int_0^1 \sin^{-1} x\,dx$. **3**

(c) A particle moves in a straight line. At time t seconds, its displacement from a fixed origin is x metres and its velocity is v m/s. The acceleration of the particle is given by $\ddot{x} = x + 3$. At $t = 0$, the particle is at the origin and moving with velocity 3 m/s.

(i) Show that $v = x + 3$. **2**

(ii) Find an expression for x, the displacement of the particle, in terms of t. **2**

(d) Consider the vectors $\underset{\sim}{a} = \underset{\sim}{i} - \underset{\sim}{j} - \underset{\sim}{k}, \underset{\sim}{b} = 2\underset{\sim}{i} + 3\underset{\sim}{j} - \underset{\sim}{k}$ and $\underset{\sim}{c} = 4\underset{\sim}{i} - \underset{\sim}{j} + 5\underset{\sim}{k}$, where $\underset{\sim}{b}$ is perpendicular to $\underset{\sim}{c}$. Let $\hat{\underset{\sim}{u}} = x\underset{\sim}{i} + y\underset{\sim}{j} + z\underset{\sim}{k}$, where $x > 0$, be a unit vector perpendicular to both $\underset{\sim}{b}$ and $\underset{\sim}{c}$. **3**

Find $\hat{\underset{\sim}{u}}$ and hence show that $\underset{\sim}{a}, \underset{\sim}{b}$ and $\underset{\sim}{c}$ are mutually perpendicular.

(e) Consider $z = \dfrac{2}{1 - e^{2i\theta}}$. **3**

Show that $z = 1 + i\cot\theta$.

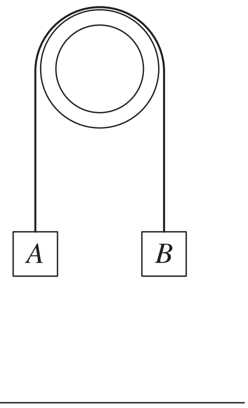
 TEN_Y12_MExt2_QB_2021

Question 12 (15 marks) Use a SEPARATE writing booklet.

(a) A particle is undergoing simple harmonic motion about a fixed origin with period $\frac{\pi}{3}$ seconds. Initially, the particle is at rest 4 metres to the right of the origin. **3**

Find the first TWO times when the particle's speed is half its maximum speed.

(b) Two particles, A and B, have masses $5m$ kg and km kg respectively, where $k < 5$. The particles are connected by a light, inextensible string that passes over a smooth light fixed pulley. The system is held at rest with the string taut, the hanging parts of the string are vertical and A and B are at the same height above a horizontal floor as shown.



The system is released from rest and particle A descends with acceleration $\frac{g}{4}$ m/s^2.

(i) Show that the tension in the string as particle A descends is $\frac{15mg}{4}$ newtons. **2**

(ii) Find the value of k. **2**

(iii) After descending for 1 second, particle A impacts the floor and is immediately brought to rest. In its subsequent motion, particle B does not reach the pulley. **3**

Show that the greatest height reached by particle B above the floor is $\frac{9g}{32}$ metres.

(c) A subset of the complex plane is described by the relation $\left|z-\left(2\sqrt{2}+2\sqrt{2}i\right)\right| \leq 2$.

(i) Draw a sketch of this relation. **1**

(ii) Given that z is a complex number that satisfies the relation, find the minimum and maximum values of $|z|$. **2**

(iii) Given that z is a complex number that satisfies the relation, find the minimum and maximum values of $\operatorname{Arg} z$. **2**

Question 13 (15 marks) Use a SEPARATE writing booklet.

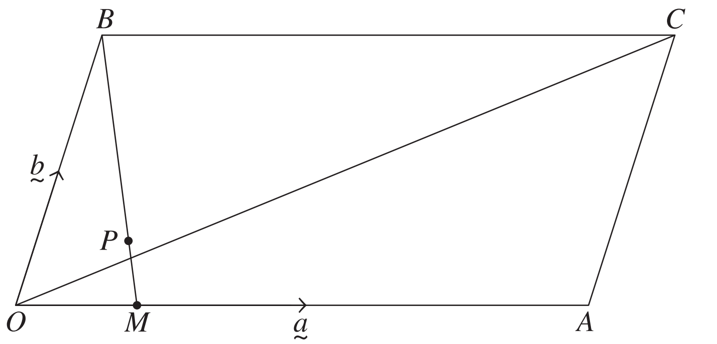
(a) Consider the statement, where x is an integer.

'If $x^2 - 6x + 5$ is even, then x is odd.'

(i) Write down the contrapositive of the statement. **1**

(ii) Prove the statement by proving the contrapositive. **2**

(b) Let $OACB$ be a parallelogram with $\overrightarrow{OA} = \underset{\sim}{a}$ and $\overrightarrow{OB} = \underset{\sim}{b}$. M is a point on OA such that $\left|\overrightarrow{OM}\right| = \frac{1}{5}\left|\overrightarrow{OA}\right|$. P is a point on MB such that $\left|\overrightarrow{MP}\right| = \frac{1}{6}\left|\overrightarrow{MB}\right|$, as shown in the diagram.



(i) Show that P lies on OC. **3**

(ii) State the ratio of lengths $OP : PC$. **1**

(c) (i) Show that, for any integer n, $e^{in\theta} + e^{-in\theta} = 2\cos n\theta$. **1**

(ii) By expanding $\left(e^{i\theta} + e^{-i\theta}\right)^5$, show that $\cos^5\theta = \frac{1}{16}\left(\cos 5\theta + 5\cos 3\theta + 10\cos\theta\right)$. **3**

(iii) Hence, or otherwise, find $\int_0^{\frac{\pi}{2}} \cos^5\theta\, d\theta$. **2**

(iv) Using the result of part (ii), solve the equation $\cos 5\theta + 5\cos 3\theta + 9\cos\theta = 0$ for $0 \le \theta \le \pi$. **2**

Question 14 (15 marks) Use a SEPARATE writing booklet.

(a) (i) Prove that $\frac{a+b}{2} \geq \sqrt{ab}$ for all positive real numbers a and b. **1**

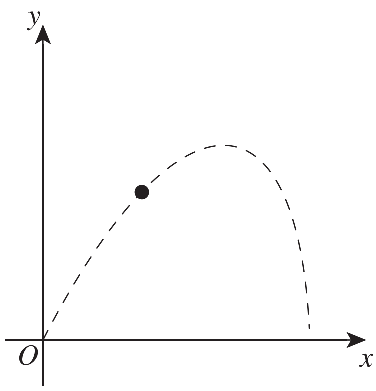
(ii) Prove that $(a+b)(b+c)(c+a) \geq 8abc$ for all positive real numbers a, b and c. **1**

(iii) Suppose that x, y and z are the sides of a triangle. **2**

Using the result from part (ii), deduce that $xyz \geq (y+z-x)(z+x-y)(x+y-z)$.

(b) Prove by contradiction that $\sin\theta + \cos\theta \geq 1$ for $0 \leq \theta \leq \frac{\pi}{2}$. **3**

(c) A particle is projected from a fixed origin, as shown in the diagram. The forces acting on the particle are its weight and air resistance. Its initial horizontal component of velocity is v_1 and its subsequent horizontal velocity $\dot{x}$ is modelled by $\frac{d\dot{x}}{dt} = -k\dot{x}$. The particle's displacement is measured in metres and time is measured in seconds.



(i) Show that the particle's horizontal displacement, x, from the origin is given by **2**

$x = \frac{v_1}{k}\left(1 - e^{-kt}\right)$.

The particle's initial vertical component of velocity is v_2 and its subsequent vertical velocity $\dot{y}$ is modelled by $\frac{d\dot{y}}{dt} = -k\dot{y} - g$, where g is the acceleration due to gravity.

(ii) Show that the particle's vertical displacement, y, from the origin is given by **3**

$y = \frac{kv_2 + g}{k^2}\left(1 - e^{-kt}\right) - \frac{g}{k}t$.

Question 14 continues on page 10

Question 14 (continued)

(iii) Show that the Cartesian equation of the particle's path of flight is given by **2**

$$y = \left(\frac{kv_2 + g}{kv_1}\right)x + \frac{g}{k^2}\ln\left(1 - \frac{kx}{v_1}\right).$$

(iv) In the case $v_1 = v_2 = 10, k = 0.1$ and $g = 9.8,$ determine whether the particle will pass over a wall of height 4 metres at a horizontal distance of 6 metres from the origin. **1**

End of Question 14

Question 15 (15 marks) Use a SEPARATE writing booklet.

(a) The line l_1 has vector equation $\underset{\sim}{r} = \begin{pmatrix} 1 \\ 0 \\ 2 \end{pmatrix} + \lambda_1 \begin{pmatrix} 2 \\ 2 \\ -3 \end{pmatrix}$ and the line l_2 has vector equation

$\underset{\sim}{r} = \begin{pmatrix} 4 \\ -2 \\ 9 \end{pmatrix} + \lambda_2 \begin{pmatrix} 1 \\ 2 \\ -2 \end{pmatrix}$.

(i) Show that l_1 and l_2 do NOT intersect. **3**

(ii) Show that the distance d between a point on l_1 and a point on l_2 is given by **4**

$d = \sqrt{\left(3\lambda_2 - 4\lambda_1 - 5\right)^2 + \left(\lambda_1 - 1\right)^2 + 36}$.

(iii) Hence, determine the minimum distance between l_1 and l_2. **1**

(iv) Find the coordinates of the points on the two lines that are the minimum distance apart. **1**

(b) A particle is projected from the origin on a horizontal plane with initial velocity v m/s

at an angle θ to the horizontal. The position vector $\underset{\sim}{r}(t)$ of the particle is given by

$\underset{\sim}{r}(t) = \begin{pmatrix} vt\cos\theta \\ vt\sin\theta - \frac{1}{2}gt^2 \end{pmatrix}$, where g is the acceleration due to gravity. (Do NOT prove this.)

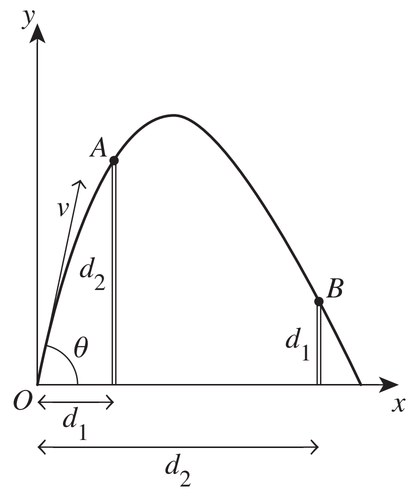
(i) Show that the Cartesian equation of the path of flight is given **2**

by $y = x\tan\theta - \dfrac{gx^2}{2v^2\cos^2\theta}$.

Question 15 continues on page 12

Question 15 (continued)

(ii) The particle just passes over two walls at points A and B. The two walls are at horizontal distance d_1 and d_2 metres from the point of projection and are of heights d_2 and d_1 metres respectively, as shown in the diagram. **4**



Show that $\theta = \tan^{-1}\left(\dfrac{d_1{}^2 + d_1 d_2 + d_2{}^2}{d_1 d_2}\right)$. You may use the result $a^3 - b^3 = (a-b)\left(a^2 + ab + b^2\right)$.

End of Question 15

Question 16 (15 marks) Use a SEPARATE writing booklet.

(a) Prove by mathematical induction that a convex polygon with n vertices has $\frac{1}{2}n(n-3)$ diagonals for $n \geq 4$. **4**

(b) Let $t = \tan\frac{x}{2}$.

(i) Show that $\frac{dx}{dt} = \frac{2}{1+t^2}$. **1**

(ii) Show that $\frac{2\tan\frac{x}{2}}{1+\tan^2\frac{x}{2}} = \sin x$. **1**

(iii) Hence, show that $\int_0^{\frac{\pi}{2}} \frac{1}{1+k\sin x}dx = \frac{2}{\sqrt{1-k^2}}\tan^{-1}\sqrt{\frac{1-k}{1+k}}$, where $0 < k < 1$. **4**

Let $I_n = \int_0^{\frac{\pi}{2}} \frac{\sin^n x}{2+\sin x}dx$, where $n = 0, 1, 2, \ldots$.

(iv) Show that $I_{n+1} + 2I_n = \int_0^{\frac{\pi}{2}} \sin^n x dx$. **1**

(v) Hence, or otherwise, find the value of I_2. Give your answer in the form $m\pi + 1$, where m is irrational. **4**

End of paper

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

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

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

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

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

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

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

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

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

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

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

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

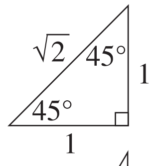
$\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

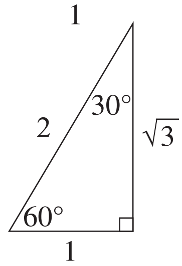
$c^2 = a^2 + b^2 - 2ab\cos C$

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

$l = r\theta$

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





Trigonometric identities

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

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

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

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

Compound angles

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

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

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

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

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

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

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

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

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

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

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

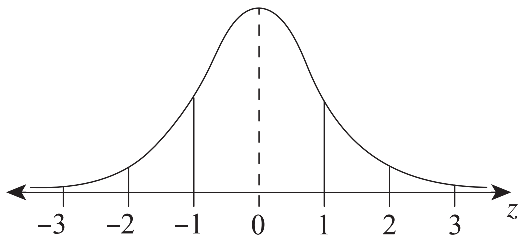
$\cos^2 nx = \dfrac{1}{2}(1 + \cos 2nx)$

Statistical Analysis

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

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

$E(X) = \mu$

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

Probability

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

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

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

Continuous random variables

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

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

Binomial distribution

$P(X = r) = {}^nC_r\, p^r(1-p)^{n-r}$

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

$\Rightarrow P(X = x)$

$= \dbinom{n}{x} p^x (1-p)^{n-x}, \ x = 0, 1, \ldots, n$

$E(X) = np$

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

Differential Calculus

Function	Derivative
$y = f(x)^n$	$\frac{dy}{dx} = nf'(x)\left[f(x)\right]^{n-1}$
$y = uv$	$\frac{dy}{dx} = u\frac{dv}{dx} + v\frac{du}{dx}$
$y = g(u)$ where $u = f(x)$	$\frac{dy}{dx} = \frac{dy}{du} \times \frac{du}{dx}$
$y = \frac{u}{v}$	$\frac{dy}{dx} = \frac{v\frac{du}{dx} - u\frac{dv}{dx}}{v^2}$
$y = \sin f(x)$	$\frac{dy}{dx} = f'(x)\cos f(x)$
$y = \cos f(x)$	$\frac{dy}{dx} = -f'(x)\sin f(x)$
$y = \tan f(x)$	$\frac{dy}{dx} = f'(x)\sec^2 f(x)$
$y = e^{f(x)}$	$\frac{dy}{dx} = f'(x)e^{f(x)}$
$y = \ln f(x)$	$\frac{dy}{dx} = \frac{f'(x)}{f(x)}$
$y = a^{f(x)}$	$\frac{dy}{dx} = (\ln a)f'(x)a^{f(x)}$
$y = \log_a f(x)$	$\frac{dy}{dx} = \frac{f'(x)}{(\ln a)f(x)}$
$y = \sin^{-1} f(x)$	$\frac{dy}{dx} = \frac{f'(x)}{\sqrt{1-\left[f(x)\right]^2}}$
$y = \cos^{-1} f(x)$	$\frac{dy}{dx} = \frac{f'(x)}{\sqrt{1-\left[f(x)\right]^2}}$
$y = \tan^{-1} f(x)$	$\frac{dy}{dx} = \frac{f'(x)}{\sqrt{1+\left[f(x)\right]^2}}$

Integral Calculus

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

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

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

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

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

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

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

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

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

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

$$\int_a^b f(x)dx$$
$$\approx \frac{b-a}{2n}\left\{f(a) + f(b) + 2\left[f\left(x_1\right) + \ldots + f\left(x_{n-1}\right)\right]\right\}$$
where $a = x_0$ and $b = x_n$

Combinatorics

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

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

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

Vectors

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

$$\underset{\sim}{u}\cdot\underset{\sim}{v} = |\underset{\sim}{u}||\underset{\sim}{v}|\cos\theta = x_1x_2 + y_1y_2,$$

where $\underset{\sim}{u} = x_1\underset{\sim}{i} + y_1\underset{\sim}{j}$

and $\underset{\sim}{v} = x_2\underset{\sim}{i} + y_2\underset{\sim}{j}$

$$\underset{\sim}{r} = \underset{\sim}{a} + \lambda\underset{\sim}{b}$$

Complex Numbers

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

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

Mechanics

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

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

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

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

Neap

Trial Examination 2021

HSC Year 12 Mathematics Extension 2

Section II Writing Booklet

Student Name/Number: ______________________________

Instructions

Use a separate writing booklet for each question in Section II.

Write the number of this booklet and the total number of booklets that you have used for this question (e.g. [1] of [3]) ⇒ [ ] of [ ]

this booklet — number of booklets for this question

Write in black or blue pen (black is recommended).

You may ask for an extra writing booklet if you need more space.

If you have not attempted the question(s), you must still hand in a writing booklet, with 'NOT ATTEMPTED' written clearly on the front cover.

You may NOT take any writing booklets, used or unused, from the examination room.

Tick this box if you have continued this answer in another writing booklet. ☐

Trial Examination 2021

HSC Year 12 Mathematics Extension 2

DIRECTIONS:

Write your name in the space provided.
Write your student number in the boxes provided below. Then, in the columns of digits below each box, fill in the oval which has the same number as you have written in the box. Fill in **one** oval only in each column.
Read each question and its suggested answers. Select the alternative A, B, C, or D that best answers the question. Fill in the response oval completely, using blue or black pen. Mark only **one** oval per question.

A B C D

If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

A B C D

If you change your mind and have crossed out what you consider to be the correct answer, then indicate this by writing the word *correct* and draw an arrow as follows.

correct

A B C D

STUDENT NAME: ______________________________

STUDENT NUMBER:

1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7
8	8	8	8	8	8	8	8	8
9	9	9	9	9	9	9	9	9
0	0	0	0	0	0	0	0	0

SECTION I
MULTIPLE-CHOICE ANSWER SHEET

1.	A	B	C	D
2.	A	B	C	D
3.	A	B	C	D
4.	A	B	C	D
5.	A	B	C	D
6.	A	B	C	D
7.	A	B	C	D
8.	A	B	C	D
9.	A	B	C	D
10.	A	B	C	D

STUDENTS SHOULD NOW CONTINUE WITH SECTION II