2021 Mathematical Methods (Unit 1-2)
Task 1

Paper 1 – Calculator not allowed

Number of marks: 10
Writing time: 15 minutes

Name: Marks:

Instructions

Answer **all** questions in the spaces provided.
In all questions where a numerical answer is required, an exact value must be given unless otherwise specified.
In questions where more than one mark is available, appropriate working **must** be shown.
Unless otherwise indicated, the diagrams in this book are **not** drawn to scale.

Question 1 2 marks

Find the equation of the line which passes through the point $(-8,4)$, and is perpendicular to the line $2x-3y+6=0$. $\Rightarrow$ $y=\frac{2}{3}x+2$

$m=-\frac{3}{2}$ $\Rightarrow$ $y=\frac{-3}{2}x+c$

$(-8,4)$: $4=\frac{-3}{2}\times -8+c$

$\Rightarrow c=-8$ $\Rightarrow$ $y=\frac{-3}{2}x-8$

1 mark for $m=\frac{-3}{2}$
1 mark for correct equation or equivalent.

Question 2 2 marks

Solve for r where $t \in R\setminus\{0\}$.

$\left(\frac{\frac{r}{t}+1}{t}=t\right)\times t$

$\left(\frac{r}{t}+1=t^2\right)\times t$

$r+t=t^3$

$r=t^3-t$

1 mark for working out correct

1 mark for correct answer or factorised form

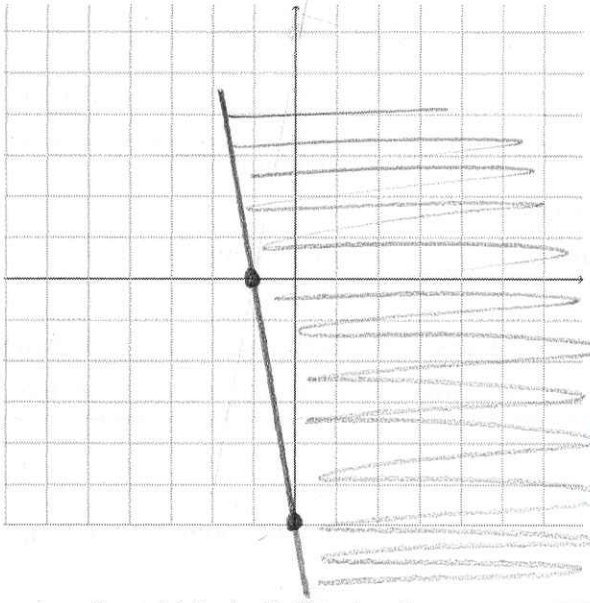
Question 3 2 marks

On the Cartesian plane below, sketch the region described by $3x+\frac{y}{2}\geq -3$.

$3x+\frac{y}{2}=-3$

$(0,-6)$

$(-1,0)$



1 mark for correct line

1 mark for the correct region. (even the line is wrong)

Question 4 2 marks

Determine the value of a for which the following is a correct statement.

$$\frac{1}{\sqrt{2}-\sqrt{3}}-\frac{1}{\sqrt{2}+\sqrt{3}}=a\sqrt{3}$$

$$\frac{\sqrt{2}+\sqrt{3}-(\sqrt{2}-\sqrt{3})}{(\sqrt{2}-\sqrt{3})(\sqrt{2}+\sqrt{3})}=\frac{2\sqrt{3}}{2-3}=-2\sqrt{3}$$

1 mark

$\Rightarrow a=-2$

1 mark for correct rationalising the denominator.

1 mark for $a=-2$.

Question 5 2 marks

Simplify.

$$\frac{9x^2-36}{x^4-x^3-2x^2}\div\frac{45}{x^3+x^2}$$

$$\frac{9(x-2)(x+2)}{x^2(x-2)(x+1)}\times\frac{(x+1)x^2}{45_5}=\frac{x+2}{5}$$

1 mark for correct factorisation (2 out 3 1 mark)

1 mark for correct simplification

2021 Mathematical Methods (Unit 1-2)
Task 1

Paper 2 – Calculator allowed

Number of marks: 15
Writing time: 25 minutes

Name: Marks – Section 1: Section 2:

SECTION 1

Instructions for Section 1

Answer **all** questions in pencil on the answer sheet provided for multiple-choice questions.
Choose the response that is **correct** for the question.
A correct answer scores 1, an incorrect answer scores 0.
Marks will **not** be deducted for incorrect answers.
No marks will be given if more than one answer is completed for any question.

Question 1

If $-5y+3x+9=0$, $y+4x-11=0$ and $-2y+ax-10=0$ are concurrent, then a is equal to:

(2, 3)

$-2\times3+2a-10=0$

$2a=16$

$a=8$

(A) 8
B -8
C 3
D 2
E -2

Question 2

The difference between the largest and the smallest coefficients in the expansion of $(5y+2x)^6$ could be:

$37500-64=37436$

A 37500
B 64
C 600
D 15625
(E) 37436

Question 3

The value of a such that there would be no point of intersection between the two lines $ay+3x=4$ and $2y+4x=3$ is:

A 2

B. 1.5

C −0.5

D. −2

E. $\frac{8}{3}$

$y=\frac{-3}{a}x+\frac{4}{a}$

$y=-2x+\frac{3}{2}$

$m_1=m_2$; $\frac{-3}{a}=-2$

$a=1.5$

Question 4

The values of x which $\frac{x-5}{4x^4-36x^2}$ would be undefined are:

A. $\mathbb{R}$

$4x^2(x^2-9)=0$

B. $\mathbb{R}\setminus\{-3,0,3\}$

C. $\{-3,3\}$

D. $\{0,3\}$

E. $\{-3,0,3\}$

Question 5

The equation of the line which passes through the point $(-2,4)$ at an angle of $71.5°$ to the positive direction of x-axis is closest to:

A. $y-3x-10=0$

B. $y-3x+10=0$

C. $4y+2x=0$

D. $4x+2y=0$

E. $y+x+10=0$

$m=\tan 71.5°$

$m=2.99\simeq 3$

$y=3x+C$

$4=3\times-2+C$

$C=10$

$y=3x+10$

SECTION 2

Instructions for Section 2

Answer **all** questions in the spaces provided.
In all questions where a numerical answer is required, an exact value must be given unless otherwise specified.
In questions where more than one mark is available, appropriate working **must** be shown.
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Question 1

The Sheraton Brick Company manufactures a standard stone block for the building industry.

The production capacity for the year is n standard blocks. The selling price per block is \$1.50, production costs are \$0.60 per brick and fixed costs are \$60,000 per annum.

a. Write down an expression for the profit. 1 mark

$C = 60000 + 0.6n$

$R = 1.5n$

$P = R - C$

1 mark $P = 1.5n - (60000 + 0.6n)$

OR $P = 0.9n - 60000$ 1 mark

b. Find the least value of n for a profit to be made. 1 mark

$P > 0 \quad : \quad 0.9n - 60000 > 0$

$n > \frac{60000}{0.9} = 66666.7$

$n = 66,667$ 1 mark

OR $\frac{60000}{0.9}$ accepted. 2 marks

Question 2

Show that $\frac{1-9n^2}{1-81n^4}\left(\frac{1+27n^3}{3n+1}+3n\right)=1$

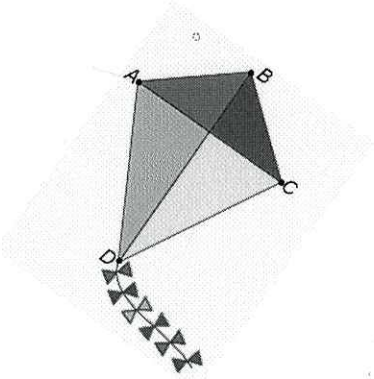
$\frac{1-9n^2}{(1-9n^2)(1+9n^2)}\left(\frac{(1+3n)(1-3n+9n^2)}{3n+1}+3n\right)$

$\frac{1}{1+9n^2} \times (1+9n^2) = 1$

1 mark for correct factorisation (2 out of 3 - 1 mark)
1 mark for correct simplification. OR $(1+9n^2 \neq 0$ stated.)

Question 3

Given the points $A(-3,3)$, $B(4,5)$, $C(6,-2)$ and $D(-6,-13)$.



a. Show that BD is the perpendicular to AC. 2 marks

$m_{BD} = \frac{9}{5}$

$m_{AC} = \frac{5}{-9}$

$\frac{9}{5} \times \frac{5}{-9} = -1 \therefore BD \perp AC$

1 mark for both gradients
1 mark for showing $m_1 \times m_2 = -1$
(even with wrong gradients)

b. Find the equation of the line passing through BD. 2 marks

OR any point on BD

$y = \frac{9}{5}x + c$

$B(4,5)$: $5 = \frac{9}{5} \times 4 + c$

$c = \frac{25}{5} - \frac{36}{5} = -\frac{11}{5} \Rightarrow y = \frac{9}{5}x - \frac{11}{5}$

1 mark for working out.
1 mark for correct equation.

c. Show that the line from Part **b** is also the bisector of AC. 2 marks

$M_{AC}\left(\frac{3}{2}, \frac{1}{2}\right)$

$\frac{1}{2} \stackrel{?}{=} \frac{9}{5} \times \frac{3}{2} - \frac{11 \times 2}{5 \times 2}$

$\frac{1}{2} \stackrel{?}{=} \frac{27-22}{10} = \frac{5}{10} = \frac{1}{2}$ ✓

$\therefore$ BD bisects AC.

1 mark for midpoint
1 mark for substitution.

OR

1 mark for finding the equation of the perpendicular bisector to show the line is the same line as part b.