(1) $22 = 8A + B + C$
$49 = 22A + 2B + C$
$102 = 49A + 3B + C$
$\Rightarrow A = 2 \quad B = -1 \quad C = 7$
$U_5 = 207$

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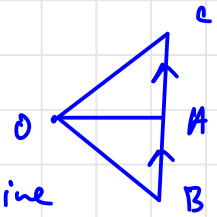
(2) a) $2.5(0.95^4) = 2.036 \approx 2.04$ km

b) $\frac{52}{2} = \frac{2.5(1-0.95^n)}{0.05}$

$n = 14.309$ ∴ 3hr 30mins to 3hr 45mins

c) No. $S_\infty = \frac{2.5}{1-0.95} < 52$ Hence model is not suitable.

(3) a) $\underset{\sim}{a} - \underset{\sim}{b} \parallel \underset{\sim}{a} - \underset{\sim}{c}$ so $\underset{\sim}{a} - \underset{\sim}{b} = k(\underset{\sim}{a} - \underset{\sim}{c})$
$\overrightarrow{BA} = k\overrightarrow{CA}$
A, B, C lies on a straight line



b) $|\underset{\sim}{b} \cdot (\underset{\sim}{c} - \underset{\sim}{d})| = \frac{|\overrightarrow{OB} \cdot \overrightarrow{DC}|}{|\overrightarrow{OB}|}$ ∴ length of projection of $\overrightarrow{DC}$ on $\overrightarrow{OB}$.

c) $2p - 3q + 4q = 0$
$2p = -q$

$p^2 + q^2 + q^2 = 1$
$9p^2 = 1$
$p = \pm\frac{1}{3}$
$q = \pm\frac{2}{3}$

(4) $y = vx$
$\frac{dy}{dx} = \frac{dv}{dx}x + v$
Subin
$x^2\left(\frac{dv}{dx}x + v\right) = v^2x^2 + x^2v$

$\frac{dv}{dx} x = v^2$ Shown

b) $\int \frac{1}{v^2}\, dv = \int \frac{1}{x}\, dx$

$-\frac{1}{v} = \ln|x| + c$

$-\frac{x}{y} = \ln|x| + c \Rightarrow y = -\frac{x}{\ln|x|+c}$ #

(5) $2(w - 4i + 4) + 7i = -iw$

$2w - i + 8 = -iw$

let $w = x + yi \quad x, y \in \mathbb{R}$

$2x + 2yi - i + 8 = -xi + y$

Re : $2x + 8 = y \quad -①$

Im : $2y - 1 = -x$

$2x = 2 - 4y \quad -②$

$y = 2 \quad x = -3 \Rightarrow w = -3 + 2i$

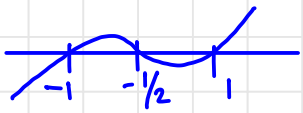
$z = 1 - 2i$ #

(6) a) $\frac{2}{x+1} - \frac{(3-2x)(x+1)}{x+1} < 0$

$\frac{2 - (-2x^2 + x + 3)}{x+1} < 0$

$\Rightarrow (x+1)(2x^2 - x - 1) < 0$

$(x+1)(2x+1)(x-1) < 0$

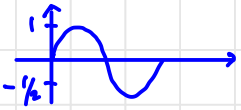


$x < -1$ or $-\frac{1}{2} < x < 1$

b) sub $x = \sin\theta$

$\sin\theta < -1$ or $-\frac{1}{2} < \sin\theta < 1$

rej $\because -1 < \sin\theta < 1$



$0 < \theta < \frac{7\pi}{6}$ or $\frac{11\pi}{6} < \theta < 2\pi, \quad \theta \neq \frac{\pi}{2}$

#1 Math Tuition

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(7) a) $\frac{d}{dx} e^{\cos 2x} = -2\sin 2x\, e^{\cos 2x}$

b) $\int_{\pi/4}^{\pi/2} e^{\cos 2x} 2\sin 2x \cos 2x \, dx$

$u = \cos 2x \qquad \frac{dv}{dx} = e^{\cos 2x} 2\sin 2x$

$\frac{du}{dx} = -2\sin 2x \qquad v = -e^{\cos 2x}$

$= \left[-\cos 2x\, e^{\cos 2x}\right]_{\pi/4}^{\pi/2} - \int_{\pi/4}^{\pi/2} 2\sin 2x\, e^{\cos 2x} \, dx$

$= \frac{1}{e} + \left[e^{\cos 2x}\right]_{\pi/4}^{\pi/2} = \frac{1}{e} + \frac{1}{e} - 1 = \frac{2}{e} - 1$

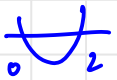
(8) a) $(2x-1)y = 2x^2$

$0 = 2x^2 - 2yx + y$

$b^2 - 4ac < 0$

$4y^2 - 4(2)(y) < 0$

$y(y-2) < 0$



$0 < y < 2$

$\therefore \{ y : y \in \mathbb{R}, \; 0 < y < 2 \}$

b) $y = \frac{4x^2+1}{2x-1} = 2x+1 + \frac{2}{2x-1}$

$\therefore A = 2, \; B = 1, \; C = 2$

$$\begin{array}{r} 2x+1 \\ 2x-1 \overline{)\, 4x^2 + 0x + 1} \\ -(4x^2 - 2x) \\ \hline 2x + 1 \\ -(2x - 1) \\ \hline 2 \end{array}$$

Asymptotes $y = 2x+1 \qquad x = \frac{1}{2}$

c) $y = x + \frac{1}{2x-1}$

sub $y = \frac{y}{2}$

$y = 2x + \frac{2}{2x-1}$

① Scaling // y-axis by factor of 2.

sub $y = y-1$

$y = 2x+1 + \frac{2}{2x-1}$

② Translation 1 unit in the positive y-axis direction.

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(9) a) $f'(x) = \frac{\cos x}{1+\sin x}$

$f''(x) = \frac{-\sin x(1+\sin x) - \cos^2 x}{(1+\sin x)^2}$

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

$= \frac{-(\sin x + 1)}{(1+\sin x)^2} = \frac{-1}{1+\sin x}$ $\therefore k = -1$

b) $f'''(x) = \frac{-(\cos x)(-1)}{(1+\sin x)^2} = \frac{1}{(1+\sin x)^2}$

$f(0) = \ln a \quad f'(0) = 1 \quad f''(0) = -1 \quad f'''(0) = 1$

$f(x) = \ln a + x - \frac{1}{2}x^2 + \frac{1}{6}x^3 + \ldots$

c) (i) $\int_0^{1.2} \ln 2 + x - \frac{1}{2}x^2 + \frac{1}{6}x^3 \, dx = 1.35$ (2 dp)

(ii) $\int_0^{1.2} \ln(2 + 2\sin x) \, dx = 1.32$

(iii) 1.2 is not close enough to zero and insufficient terms used for the series.

(10) a) if $m > 3$ then f is not a 1-1 function.

b) let $y = e^{3-x}$

$\ln y = 3 - x$

$x = 3 - \ln y$

$\therefore f^{-1}(x) = 3 - \ln x \qquad D_{f^{-1}} : [1, \infty)$

c) $|x| \geq 1$

$x \geq 1$ or $x \leq -1$

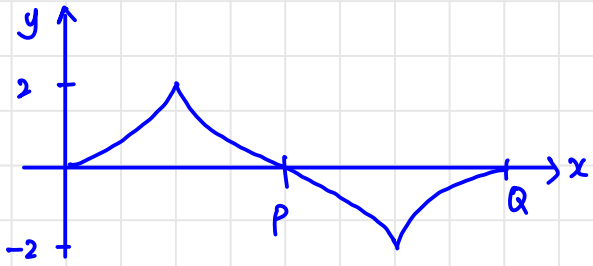
d) $R_g : [n, \infty)$

For $f^{-1}g$ to exist $R_g \subseteq D_{f^{-1}}$

$[n, \infty) \subseteq [1, \infty)$

Hence smallest $n = 1$

11 a)



$P(2\pi, 0)$ $Q(4\pi, 0)$

b) (i) $x = 2\theta + \sin 2\theta$ $y = 2\sin\theta$

$\frac{dx}{d\theta} = 2 + 2\cos 2\theta$ $\frac{dy}{d\theta} = 2\cos\theta$

$\therefore \frac{dy}{dx} = \frac{\cos\theta}{1+\cos 2\theta} = \frac{\cos\theta}{2\cos^2\theta} = \frac{1}{2\cos\theta} = \frac{1}{2}\sec\theta$ ✱ shown

(ii) Suppose $\frac{dy}{dx} = 0$ we have $\frac{1}{2\cos\theta} = 0 \Rightarrow$ No solution

Hence $\frac{dy}{dx} \neq 0$, graph of C has no stationary points.

(iii) when $\theta = \frac{\pi}{3}$ $x = \frac{2\pi}{3} + \frac{\sqrt{3}}{2}$ $y = \sqrt{3}$

$\left.\frac{dy}{dx}\right|_{\theta = \pi/3} = 1$ $\therefore$ Eqn of tangent $y - \sqrt{3} = x - \frac{2\pi}{3} - \frac{\sqrt{3}}{2}$

$x = 0$ $y = \frac{\sqrt{3}}{2} - \frac{2\pi}{3}$

$y = 0$ $x = \frac{2\pi}{3} - \frac{\sqrt{3}}{2}$

$$RS = \sqrt{\left(\frac{\sqrt{3}}{2} - \frac{2\pi}{3}\right)^2 + \left(\frac{2\pi}{3} - \frac{\sqrt{3}}{2}\right)^2} = \sqrt{2}\left(\frac{2\pi}{3} - \frac{\sqrt{3}}{2}\right)$$ //

(12) a) $\overrightarrow{AB} = \overrightarrow{OB} - \overrightarrow{OA}$

$= \begin{pmatrix} 5 \\ 8 \\ -40 \end{pmatrix} - \begin{pmatrix} 10 \\ 15 \\ -60 \end{pmatrix} = \begin{pmatrix} -5 \\ -7 \\ 20 \end{pmatrix}$

$\overrightarrow{AC} = \overrightarrow{OC} - \overrightarrow{OA}$

$= \begin{pmatrix} -5 \\ 10 \\ -50 \end{pmatrix} - \begin{pmatrix} 10 \\ 15 \\ -60 \end{pmatrix} = \begin{pmatrix} -15 \\ -5 \\ 10 \end{pmatrix} = -5\begin{pmatrix} 3 \\ 1 \\ -2 \end{pmatrix}$

$\begin{pmatrix} -5 \\ -7 \\ 20 \end{pmatrix} \times \begin{pmatrix} 3 \\ 1 \\ -2 \end{pmatrix} = \begin{pmatrix} -6 \\ 50 \\ 16 \end{pmatrix} = 2\begin{pmatrix} -3 \\ 25 \\ 8 \end{pmatrix}$

$\underset{\sim}{r} \cdot \begin{pmatrix} -3 \\ 25 \\ 8 \end{pmatrix} = \begin{pmatrix} -3 \\ 25 \\ 8 \end{pmatrix} \cdot \begin{pmatrix} 10 \\ 15 \\ -60 \end{pmatrix} = -135$

Cartesian eqn: $-3x + 25y + 8z = -135$

b) $\cos\theta = \dfrac{\begin{pmatrix} -3 \\ 25 \\ 8 \end{pmatrix} \cdot \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}}{\left|\begin{matrix} -3 \\ 25 \\ 8 \end{matrix}\right| \left|\begin{matrix} 0 \\ 0 \\ 1 \end{matrix}\right|}$ $\theta = 72.37°$ $\approx 72.4°$

c) Vertical line containing point P : $l : \underset{\sim}{r} = \begin{pmatrix} -17 \\ 188 \\ 0 \end{pmatrix} + \lambda\begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$ $\lambda \in \mathbb{R}$

Subin $\begin{pmatrix} -17 \\ 188 \\ \lambda \end{pmatrix} \cdot \begin{pmatrix} -3 \\ 25 \\ 8 \end{pmatrix} = -135 \Rightarrow \lambda = -\frac{2443}{4}$

$\therefore$ Vertical dist : $\frac{2443}{4}$ m

d) $\underset{\sim}{r} \cdot \begin{pmatrix} -3 \\ 25 \\ 8 \end{pmatrix} = \begin{pmatrix} -3 \\ 25 \\ 8 \end{pmatrix} \cdot \begin{pmatrix} -17 \\ 188 \\ 0 \end{pmatrix} = 4751$

$\therefore$ dist $= \dfrac{4886}{\left|\begin{matrix} -3 \\ 25 \\ 8 \end{matrix}\right|} = 184.937 \approx 185$ m

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H2

MINISTRY OF EDUCATION, SINGAPORE
in collaboration with
CAMBRIDGE INTERNATIONAL EDUCATION
General Certificate of Education Advanced Level

MATHEMATICS **9758/01**

Paper 1 **October/November 2026**

3 hours

You must answer on the printed answer booklet.

You will need: Printed answer booklet
List of formulae and results (MF27)

INSTRUCTIONS

- Answer **all** questions.
- Write your answers on the printed answer booklet. Follow the instructions on the front cover of the answer booklet.
- Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place for angles in degrees, unless a different level of accuracy is specified in the question.
- You should use an approved graphing calculator.
- Unsupported answers from a graphing calculator are allowed unless a question specifically states otherwise.
- Where unsupported answers from a graphing calculator are **not** allowed in a question, you must present the mathematical steps using mathematical notations and not calculator commands.
- You must show all working clearly.

INFORMATION

- The total mark for this paper is 100.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **8** pages. Any blank pages are indicated.

Singapore Examinations and Assessment Board

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[Turn over

1 A sequence $u_1, u_2, u_3, \ldots$ is such that $u_{n+1} = Au_n + Bn + C$, where $n \geqslant 1$ and A, B and C are constants. It is given that $u_1 = 8$, $u_2 = 22$, $u_3 = 49$ and $u_4 = 102$.

Find the value of u_5. [4]

2 An athlete is running in an ultramarathon race. The distance travelled by the athlete is modelled by the following.

- In the first 15 minutes she runs a distance of 2.5 km.
- In subsequent 15-minute time intervals she runs 95% of the distance she ran in the previous 15-minute time interval.

(a) According to the model, find the distance she runs between 1 hour and 1 hour 15 minutes after the start. [1]

The total distance of this ultramarathon is 52 km.

(b) According to the model, find the 15-minute time interval in which the athlete will reach the half-way point. [3]

(c) According to the model, determine whether she will complete the ultramarathon, and hence explain whether the model is suitable. [3]

3 Relative to the origin O, the distinct points A, B, C and D have position vectors $\mathbf{a}$, $\mathbf{b}$, $\mathbf{c}$ and $\mathbf{d}$ respectively.

(a) It is given that $(\mathbf{a}-\mathbf{b}) \times (\mathbf{a}-\mathbf{c}) = \mathbf{0}$. State the relationship between the points A, B and C, justifying your answer. [2]

It is given that $\mathbf{b}$ is a unit vector.

(b) Give a geometrical interpretation of $|\mathbf{b}.(\mathbf{c}-\mathbf{d})|$. [1]

It is also given that $\mathbf{a} = \begin{pmatrix} 2 \\ -3 \\ 4 \end{pmatrix}$, $\mathbf{b} = \begin{pmatrix} p \\ q \\ q \end{pmatrix}$, where p and q are constants, and that OA is perpendicular to OB.

(c) Find the possible values of p and q. [4]

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4 **(a)** Use the substitution $y = vx$ to show that the differential equation

$$x^2\frac{\mathrm{d}y}{\mathrm{d}x} = y^2 + xy$$

reduces to

$$x\frac{\mathrm{d}v}{\mathrm{d}x} = v^2.$$

[3]

(b) Hence find the general solution of the differential equation

$$x^2\frac{\mathrm{d}y}{\mathrm{d}x} = y^2 + xy.$$

Give your answer in the form $y = \mathrm{f}(x)$, where $\mathrm{f}(x)$ is a function to be determined. [3]

5 **Do not use a calculator in answering this question.**

Find the complex numbers z and w which satisfy these simultaneous equations.

$$2z + 7\mathrm{i} = -\mathrm{i}w$$
$$z - 4 = w - 4\mathrm{i}$$

Give your answers in the form $a + \mathrm{i}b$, where a and b are real numbers. [5]

6 **(a)** Solve the inequality $\dfrac{2}{x+1} < 3 - 2x$. [4]

(b) Hence solve exactly the inequality $\dfrac{2}{\sin\theta + 1} < 3 - 2\sin\theta$, for $0 < \theta < 2\pi$. [3]

7 **(a)** Differentiate $\mathrm{e}^{\cos 2x}$ with respect to x. [2]

(b) Hence, find the exact value of $\displaystyle\int_{\frac{1}{4}\pi}^{\frac{1}{2}\pi} \mathrm{e}^{\cos 2x}\sin 4x \,\mathrm{d}x$. [5]

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[Turn over

8 **(a)** A curve C has equation $y = \dfrac{2x^2}{2x-1}$.

Find the set of values that y can **not** take. [3]

(b) A curve D has equation $y = \dfrac{4x^2+1}{2x-1}$.

(i) Express $y = \dfrac{4x^2+1}{2x-1}$ in the form $y = ax+b+\dfrac{c}{2x-1}$, where a, b and c are constants.

Hence write down the equations of the asymptotes of D. [3]

(ii) Describe a sequence of two transformations that transforms the graph of $y = x+\dfrac{1}{2x-1}$ onto D. [2]

9 It is given that $\mathrm{f}(x) = \ln(a+a\sin x)$ for $-\frac{1}{2}\pi < x < \frac{1}{2}\pi$, where a is a positive constant.

(a) Show that $\mathrm{f}''(x) = \dfrac{k}{1+\sin x}$, where k is a constant to be found. [3]

(b) By further differentiation of the result in **9(a)**, find the Maclaurin series for $\mathrm{f}(x)$, up to and including the term in x^3. [4]

(c) It is now given that $a = 2$.

(i) Use the series found in **9(b)** to find an approximate value of $\displaystyle\int_0^{1.2} \mathrm{f}(x)\,\mathrm{d}x$, giving your answer to 2 decimal places. [2]

(ii) Use a calculator to evaluate $\displaystyle\int_0^{1.2} \mathrm{f}(x)\,\mathrm{d}x$, giving your answer to 2 decimal places. [1]

(iii) Explain why your answers to **9(c)(i)** and **9(c)(ii)** are different. [1]

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10 The function $\mathrm{f}(x)$ is defined by $\mathrm{f}: x \mapsto \mathrm{e}^{|3-x|}$, $x \in \mathbb{R}$, $x \leqslant m$.

(a) Explain why 3 is the greatest value of m for which the inverse function f^{-1} exists. [1]

For the remainder of the question, $m = 3$.

(b) Find $\mathrm{f}^{-1}(x)$ and state its domain [3]

(c) Solve the inequality $\mathrm{f}\left(\mathrm{f}^{-1}(|x|)\right) \geqslant 1$. [3]

The function $\mathrm{g}(x)$ is defined by $\mathrm{g}: x \mapsto n + \sqrt{x-4}$, $x \in \mathbb{R}$, $x \geqslant 4$ and $n \in \mathbb{R}$.

(d) Find the smallest value of n for the composite function $\mathrm{f}^{-1}\mathrm{g}(x)$ to exist.

Justify your answer. [2]

11 The parametric equations of a curve C are

$$x = 2\theta + \sin 2\theta, \ y = 2\sin\theta \text{ for } 0 \leqslant \theta \leqslant 2\pi.$$

The graph of C meets the x-axis at the origin and the point Q. The graph of C crosses the x-axis at the point P.

(a) Sketch the graph of C and determine the exact coordinates of P and Q. [4]

(b) **(i)** Show that $\dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{1}{2}\sec\theta$. [4]

(ii) Hence explain why the graph of C has no stationary points. [1]

(iii) The tangent to C at the point where $\theta = \dfrac{1}{3}\pi$ cuts the x-axis and the y-axis at the points R and S respectively. Find the distance RS. [5]

Question 12 is printed on the next page.

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[Turn over

12 A mining company has identified a mineral layer below ground. The mining company intends to drill down to the mineral layer.

The ground is modelled as a plane with equation $z = 0$, with respect to an origin O.

The mineral layer is modelled as part of a plane that contains the points $A(10, 15, -60)$, $B(5, 8, -40)$ and $C(-5, 10, -50)$ where the units are metres.

(a) Find a cartesian equation of the plane containing A, B and C. [5]

(b) Find the acute angle between the ground and the mineral layer. [2]

The mining company plans to drill vertically from the point $P(-17, 188, 0)$ on the ground to reach the mineral layer.

(c) Find the vertical distance from P to the plane containing the mineral layer. [2]

(d) Find the shortest distance from P to the plane containing the mineral layer. [6]

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