Dr Oliver Mathematics
Cambridge O Level Additional Mathematics
2011 November Paper 1 Variant 3: Calculator
2 hours

The total number of marks available is 80.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
You must write down all the stages in your working.

1. Given that (3)

$$\frac{(6x^{\frac{3}{2}}y^{\frac{4}{5}})^4}{2x^{\frac{1}{2}}y^{-1}} = ax^p y^q,$$

find the values of the constants a, p, and q.

Solution

Well,

$$\begin{aligned}\frac{(6x^{\frac{3}{2}}y^{\frac{4}{5}})^4}{2x^{\frac{1}{2}}y^{-1}} &= \frac{1\,296x^6y^{\frac{16}{5}}}{2x^{\frac{1}{2}}y^{-1}} \\ &= \underline{\underline{648x^{\frac{11}{2}}y^{\frac{21}{5}}}};\end{aligned}$$

hence, $\underline{\underline{a = 648}}$, $\underline{\underline{b = \frac{11}{2}}}$, and $\underline{\underline{c = \frac{21}{5}}}$.

2. Express in the form (4)

$$\sqrt{\frac{1-\cos^2\theta}{4\sec^2\theta - 4}}$$

in the form

$$k\cos\theta,$$

where k is a constant to be found.

Solution

$$\begin{aligned}\sqrt{\frac{1-\cos^2\theta}{4\sec^2\theta-4}} &\equiv \sqrt{\frac{\sin^2\theta}{4(\tan^2\theta+1)-4}}\\ &\equiv \sqrt{\frac{\sin^2\theta}{4\tan^2\theta}}\\ &\equiv \sqrt{\tfrac{1}{4}\cos^2\theta}\\ &\equiv \underline{\underline{\tfrac{1}{2}\cos\theta}};\end{aligned}$$

hence, $\underline{\underline{k=\tfrac{1}{2}}}$.

3. (a) Given that (2)

$$\mathbf{A} = \begin{pmatrix} 4 & 3 \\ -8 & -2 \end{pmatrix},$$

find $\mathbf{A}^{-1}$.

Solution

Well,

$$\det \mathbf{A} = -8 - (-24) = 16$$

so

$$\mathbf{A}^{-1} = \underline{\underline{\tfrac{1}{16}\begin{pmatrix} -2 & -3 \\ 8 & 4 \end{pmatrix}}}.$$

(b) Hence, find the matrix $\mathbf{M}$ such that (3)

$$\begin{pmatrix} 4 & 3 \\ -8 & -2 \end{pmatrix}\mathbf{M} = \begin{pmatrix} 1 & 4 \\ 2 & 3 \end{pmatrix}.$$

Solution

Now,

$$\begin{pmatrix} 4 & 3 \\ -8 & -2 \end{pmatrix} \mathbf{M} = \begin{pmatrix} 1 & 4 \\ 2 & 3 \end{pmatrix} \Rightarrow \mathbf{M} = \begin{pmatrix} 4 & 3 \\ -8 & -2 \end{pmatrix}^{-1} \begin{pmatrix} 1 & 4 \\ 2 & 3 \end{pmatrix}$$
$$\Rightarrow \mathbf{M} = \tfrac{1}{16} \begin{pmatrix} -2 & -3 \\ 8 & 4 \end{pmatrix} \begin{pmatrix} 1 & 4 \\ 2 & 3 \end{pmatrix}$$
$$\Rightarrow \mathbf{M} = \underline{\underline{\tfrac{1}{16} \begin{pmatrix} -8 & -17 \\ 16 & 44 \end{pmatrix}}}.$$

4. (a) Sets A and B are such that (2)

- $\mathrm{n}(A) = 11$,
- $\mathrm{n}(B) = 13$, and
- $\mathrm{n}(A \cup B) = 18$.

Find $\mathrm{n}(A \cap B)$.

Solution
Well,

$$\begin{aligned} \mathrm{n}(A \text{ only}) &= 18 - 11 = 7, \\ \mathrm{n}(B \text{ only}) &= 18 - 13 = 5, \\ \mathrm{n}(A \cap B) &= 18 - 7 - 5 = \underline{\underline{6}}. \end{aligned}$$

(b) Sets $\mathscr{E}$, X, and Y are such that

- $\mathscr{E} = \{\theta : 0 \leqslant \theta \leqslant 2\pi\}$,
- $X = \{\theta : \sin\theta = -0.5\}$, and
- $Y = \left\{\theta : \sec^2\theta = \frac{4}{3}\right\}$.

(i) Find, in terms of π , the elements of the set X. (1)

Solution
Well,

$$\sin\theta = -0.5 \Rightarrow \underline{\underline{\theta = \tfrac{7}{6}\pi,\ \tfrac{11}{6}\pi}}.$$

(ii) Find, in terms of π , the elements of the set Y. (2)

Solution
Now,

$$\begin{aligned}\sec^2\theta = \tfrac{4}{3} &\Rightarrow \sec\theta = \pm\tfrac{2}{\sqrt{3}} \\ &\Rightarrow \cos\theta = \pm\tfrac{\sqrt{3}}{2}.\end{aligned}$$

$\underline{\cos\theta = \tfrac{\sqrt{3}}{2}:}$

$$\cos\theta = \tfrac{\sqrt{3}}{2} \Rightarrow \theta = \tfrac{1}{6}\pi,\ \tfrac{11}{6}\pi.$$

$\underline{\cos\theta = -\tfrac{\sqrt{3}}{2}:}$

$$\cos\theta = -\tfrac{\sqrt{3}}{2} \Rightarrow \theta = \tfrac{5}{6}\pi,\ \tfrac{7}{6}\pi.$$

Hence,

$$\underline{\underline{\theta = \tfrac{1}{6}\pi,\ \tfrac{5}{6}\pi,\ \tfrac{7}{6}\pi,\ \tfrac{11}{6}\pi}}.$$

(iii) Use set notation to describe the relationship between the sets X and Y. (1)

Solution
$\underline{\underline{X \subset Y}}$.

5. It is given that

$$\log_{10} p^3 q = 10a \text{ and } \log_{10}\left(\frac{p}{q^2}\right) = a.$$

(a) Find, in terms of a, expressions for $\log_{10} p$ and $\log_{10} q$. (5)

Solution

$$\begin{aligned}\log_{10} p^3 q = 10a &\Rightarrow \log_{10} p^3 + \log_{10} q = 10a \\ &\Rightarrow 3\log_{10} p + \log_{10} q = 10a \\ &\Rightarrow 6\log_{10} p + 2\log_{10} q = 20a \quad (1)\end{aligned}$$

and

$$\begin{aligned}\log_{10}\left(\frac{p}{q^2}\right) = a &\Rightarrow \log_{10} p - \log_{10} q^2 = a \\ &\Rightarrow \log_{10} p - 2\log_{10} q = a \quad (2).\end{aligned}$$

Add (1) + (2):

$$7\log_{10} p = 21a \Rightarrow \underline{\underline{\log_{10} p = 3a}}$$
$$\Rightarrow \underline{\underline{\log_{10} q = a}}.$$

(b) Find the value of $\log_p q$. (1)

Solution
Finally,

$$\begin{aligned}\log_p q &= \frac{\log_{10} q}{\log_{10} p} \\ &= \frac{a}{3a} \\ &= \underline{\underline{\tfrac{1}{3}}}.\end{aligned}$$

6. A curve has equation

$$y = 6\cos(\tfrac{1}{2}x) + 4\sin(\tfrac{1}{2}x), \text{ for } 0 < x < 2\pi \text{ radians.}$$

(a) Find the x-coordinate of the stationary point on the curve. (5)

Solution
Well,

$$y = 6\cos(\tfrac{1}{2}x) + 4\sin(\tfrac{1}{2}x) \Rightarrow \frac{\mathrm{d}y}{\mathrm{d}x} = -3\sin(\tfrac{1}{2}x) + 2\cos(\tfrac{1}{2}x)$$

and

$$\begin{aligned}\frac{\mathrm{d}y}{\mathrm{d}x} = 0 &\Rightarrow -3\sin(\tfrac{1}{2}x) + 2\cos(\tfrac{1}{2}x) = 0 \\ &\Rightarrow 3\sin(\tfrac{1}{2}x) = 2\cos(\tfrac{1}{2}x) = 0 \\ &\Rightarrow \tan(\tfrac{1}{2}x) = \tfrac{2}{3} \\ &\Rightarrow \tfrac{1}{2}x = 0.588\,002\,603\,5 \text{ (FCD)} \\ &\Rightarrow x = 1.176\,005\,207 \text{ (FCD)} \\ &\Rightarrow \underline{\underline{x = 1.18 \text{ (3 sf)}}}.\end{aligned}$$

(b) Determine the nature of this stationary point. (2)

Solution
Now,

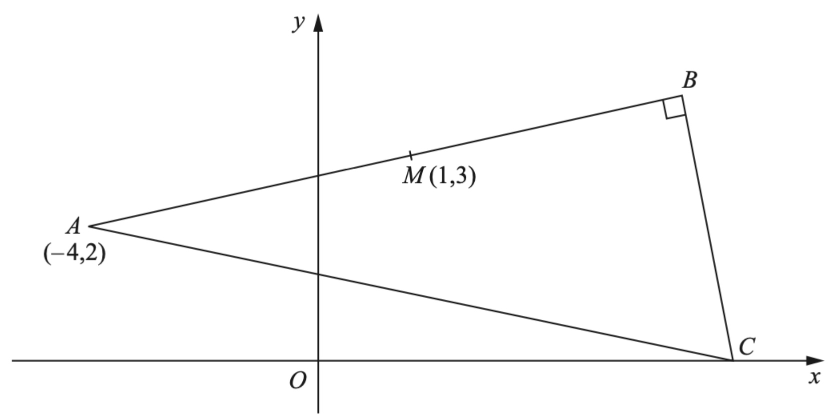
$$\frac{d^2y}{dx^2} = -\tfrac{3}{2}\cos(\tfrac{1}{2}x) - \sin(\tfrac{1}{2}x)$$

and

$$x = 1.176\ldots \Rightarrow \frac{d^2y}{dx^2} = -1.802\ldots < 0$$

so it is a maximum.

7. The figure shows a right-angled triangle ABC, where the point A has coordinates $(-4, 2)$, the angle B is 90° and the point C lies on the x-axis. (7)



The point $M(1, 3)$ is the midpoint of AB.

Find the area of the triangle ABC.

Solution

Well,

$$\begin{aligned}\overrightarrow{OB} &= \overrightarrow{OA} + \overrightarrow{AB}\\ &= \overrightarrow{OA} + 2\overrightarrow{AM}\\ &= \begin{pmatrix} -4 \\ 2 \end{pmatrix} + 2\begin{pmatrix} 1-(-4) \\ 3-2 \end{pmatrix}\\ &= \begin{pmatrix} -4 \\ 2 \end{pmatrix} + 2\begin{pmatrix} 5 \\ 1 \end{pmatrix}\\ &= \begin{pmatrix} -4 \\ 2 \end{pmatrix} + \begin{pmatrix} 10 \\ 2 \end{pmatrix}\\ &= \begin{pmatrix} 6 \\ 4 \end{pmatrix};\end{aligned}$$

so, $B(6, 4)$.

Now,

$$\begin{aligned}m_{AB} &= \frac{4-2}{6-(-4)}\\ &= \tfrac{2}{10}\\ &= \tfrac{1}{5}\end{aligned}$$

and

$$m_{BC} = -5.$$

Next, the equation of BC is

$$y - 4 = -5(x - 6)$$

and

$$\begin{aligned}y = 0 &\Rightarrow -4 = -5(x-6)\\ &\Rightarrow \tfrac{4}{5} = x - 6\\ &\Rightarrow x = \tfrac{34}{5};\end{aligned}$$

so, $C(\frac{34}{5}, 0)$.

In addition, we need the lengths of AB and BC:

$$\begin{aligned}AB &= \sqrt{[6-(-4)]^2 + (4-2)^2}\\ &= \sqrt{10^2 + 2^2}\\ &= \sqrt{104}\end{aligned}$$

and

$$\begin{aligned} BC &= \sqrt{(6 - \tfrac{34}{5})^2 + (4-0)^2} \\ &= \sqrt{(\tfrac{4}{5})^2 + 4^2} \\ &= \sqrt{\tfrac{416}{25}}. \end{aligned}$$

Finally,

$$\begin{aligned} \text{area} &= \tfrac{1}{2} \times AB \times BC \\ &= \tfrac{1}{2} \times \sqrt{104} \times \sqrt{\tfrac{416}{25}} \\ &= \underline{\underline{20\tfrac{4}{5}}}. \end{aligned}$$

8. Vectors $\mathbf{a}$ and $\mathbf{b}$ are such that

$$\mathbf{a} = \begin{pmatrix} 3+m \\ 5-2n \end{pmatrix} \text{ and } \mathbf{b} = \begin{pmatrix} 4-2n \\ 10+3m \end{pmatrix}.$$

(a) Given that (4)

$$3\mathbf{a} + \mathbf{b} = \begin{pmatrix} 1+n \\ -5 \end{pmatrix},$$

find the value of m and of n.

Solution

Well,

$$\begin{aligned} & 3\mathbf{a} + \mathbf{b} = \begin{pmatrix} 1+n \\ -5 \end{pmatrix} \\ \Rightarrow \quad & 3\begin{pmatrix} 3+m \\ 5-2n \end{pmatrix} + \begin{pmatrix} 4-2n \\ 10+3m \end{pmatrix} = \begin{pmatrix} 1+n \\ -5 \end{pmatrix} \\ \Rightarrow \quad & \begin{pmatrix} 9+3m \\ 15-6n \end{pmatrix} + \begin{pmatrix} 4-2n \\ 10+3m \end{pmatrix} = \begin{pmatrix} 1+n \\ -5 \end{pmatrix} \\ \Rightarrow \quad & \begin{pmatrix} 13+3m-2n \\ 25-6n+3m \end{pmatrix} = \begin{pmatrix} 1+n \\ -5 \end{pmatrix} \end{aligned}$$

and

$$\begin{aligned} 3m - 3n &= -12 \quad (1) \\ 3m - 6n &= -30 \quad (2). \end{aligned}$$

Subtract (1) − (2):

$$3n = 18 \Rightarrow \underline{\underline{n = 6}}$$
$$\Rightarrow 3m - 3(6) = -12$$
$$\Rightarrow 3m = 6$$
$$\Rightarrow \underline{\underline{m = 2}}.$$

[Check: $3 \times 2 - 6 \times 6 = -30$ ✓]

(b) Show that the magnitude of $\mathbf{b}$ is $k\sqrt{5}$, where k is an integer to be found. (2)

Solution

Now,

$$\mathbf{b} = \begin{pmatrix} -8 \\ 16 \end{pmatrix}$$

and the magnitude of $\mathbf{b}$ is

$$\begin{aligned} \sqrt{(-8)^2 + 16^2} &= \sqrt{64 + 256} \\ &= \sqrt{320} \\ &= \sqrt{64 \times 5} \\ &= \sqrt{64} \times \sqrt{5} \\ &= \underline{\underline{8\sqrt{5}}}; \end{aligned}$$

hence, $\underline{\underline{k = 8}}$.

(c) Find the unit vector in the direction of $\mathbf{b}$. (1)

Solution

Finally, the unit vector in the direction of $\mathbf{b}$ is

$$\tfrac{1}{8\sqrt{5}} \begin{pmatrix} -8 \\ 16 \end{pmatrix} = \underline{\underline{\tfrac{1}{\sqrt{5}} \begin{pmatrix} -1 \\ 2 \end{pmatrix}}}.$$

9. The function f is defined, for $0^\circ \leqslant x \leqslant 360^\circ$, by

$$\mathrm{f}(x) = 2\sin 3x - 1.$$

(a) State the amplitude and period of f. (2)

Solution

The amplitude is $\underline{\underline{2}}$ and the period is

$$\frac{360}{3} = \underline{\underline{120^\circ}}.$$

(b) State the maximum value of f and the corresponding values of x. (3)

Solution

The maximum value is

$$2 - 1 = \underline{\underline{1}}.$$

Now,

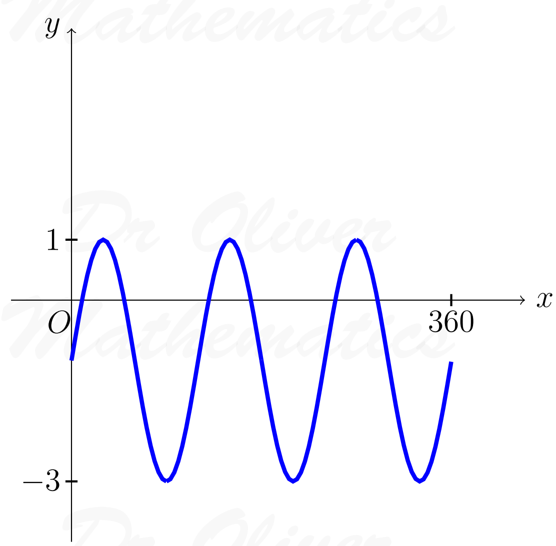
$$0^\circ \leqslant x \leqslant 360^\circ \Rightarrow 0^\circ \leqslant 3x \leqslant 1\,080^\circ$$

and the corresponding values of x is

$$\begin{aligned} \sin 3x = 1 &\Rightarrow 3x = 90, 450, 810 \\ &\Rightarrow \underline{\underline{x = 30, 150, 270}}. \end{aligned}$$

(c) Sketch the graph of f. (2)

Solution



10. (a) Differentiate (2)

$$\tan(3x+2)$$

with respect to x.

Solution

$$\frac{\mathrm{d}}{\mathrm{d}x}\left[\tan(3x+2)\right] = \sec^2(3x+2)\times 3$$
$$= \underline{\underline{3\sec^2(3x+2)}}.$$

(b) Differentiate (3)

$$(\sqrt{x}+1)^{\frac{2}{3}}$$

with respect to x.

Solution

Well,

$$\sqrt{x} = x^{\frac{1}{2}}$$

and

$$\frac{\mathrm{d}}{\mathrm{d}x}\left[(\sqrt{x}+1)^{\frac{2}{3}}\right] = \tfrac{2}{3}(\sqrt{x}+1)^{-\frac{1}{3}} \times \tfrac{1}{2}x^{-\frac{1}{2}}$$
$$= \tfrac{1}{3}(\sqrt{x}+1)^{-\frac{1}{3}}x^{-\frac{1}{2}}$$
$$= \underline{\underline{\frac{(\sqrt{x}+1)^{-\frac{1}{3}}}{3\sqrt{x}}}}.$$

(c) Differentiate (3)

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

with respect to x.

Solution

Quotient rule:

$$u = \ln(x^3-1) \Rightarrow \frac{\mathrm{d}u}{\mathrm{d}x} = \frac{3x^2}{x^3-1}$$
$$v = 2x+3 \Rightarrow \frac{\mathrm{d}v}{\mathrm{d}x} = 2$$

and

$$\frac{\mathrm{d}}{\mathrm{d}x}\left[\frac{\ln(x^3-1)}{2x+3}\right] = \frac{(2x+3)\left(\frac{3x^2}{x^3-1}\right)-(2)(\ln(x^3-1))}{(2x+3)^2}$$
$$= \frac{(2x+3)(3x^2)-(2\ln(x^3-1))(x^3-1)}{(x^3-1)(2x+3)^2}$$
$$= \underline{\underline{\frac{3x^2(2x+3)-2(x^3-1)\ln(x^3-1)}{(x^3-1)(2x+3)^2}}}.$$

11. A particle moves in a straight line so that, t s after leaving a fixed point O, its velocity v ms^{-1} is given by

$$v = 3\mathrm{e}^{2t} + 4t.$$

(a) Find the initial velocity of the particle. (1)

Solution
Well,

$$t = 0 \Rightarrow \underline{\underline{v = 3 \text{ ms}^{-1}}}.$$

(b) Find the initial acceleration of the particle. (3)

Solution
Now,

$$v = 3\mathrm{e}^{2t} + 4t \Rightarrow a = 6\mathrm{e}^{2t} + 4$$

and

$$t = 0 \Rightarrow a = 6 + 4 = \underline{\underline{10 \text{ ms}^{-2}}}.$$

(c) Find the distance travelled by the particle in the third second. (4)

Solution
Well,

$$v = 3\mathrm{e}^{2t} + 4t \Rightarrow s = \tfrac{3}{2}\mathrm{e}^{2t} + 2t^2 + c,$$

for some constant c. Now,

$$\begin{aligned} \text{distance travelled} &= s(3) - s(2) \\ &= (\tfrac{3}{2}\mathrm{e}^6 + 18 + c) - (\tfrac{3}{2}\mathrm{e}^2 + 8 + c) \\ &= \underline{\underline{\tfrac{3}{2}\mathrm{e}^4(\mathrm{e}^2 - 1) + 10 \text{ or } 533 \text{ m (3 sf)}}}. \end{aligned}$$

EITHER

12. A function f is such that

$$\mathrm{f}(x) = \ln(5x - 10), \text{ for } x > 2.$$

(a) State the range of f. (1)

Solution

$$\underline{\underline{-\infty < \mathrm{f}(x) < \infty}}.$$

(b) Find $\mathrm{f}^{-1}(x)$. (3)

Solution

Well,

$$\begin{aligned} y = \ln(5x - 10) &\Rightarrow \mathrm{e}^y = 5x - 10 \\ &\Rightarrow \mathrm{e}^y + 10 = 5x \\ &\Rightarrow \tfrac{1}{5}(\mathrm{e}^y + 10) = x \end{aligned}$$

and so

$$\mathrm{f}^{-1}(x) = \underline{\underline{\tfrac{1}{5}(\mathrm{e}^x + 10)}}.$$

(c) State the range of f^{-1}. (1)

Solution

$$\underline{\underline{2 < \mathrm{f}^{-1}(x) < \infty}}.$$

(d) Solve (2)

$$\mathrm{f}(x) = 0.$$

Solution
Now,

$$\begin{aligned} \mathrm{f}(x) = 0 &\Rightarrow \ln(5x - 10) = 0 \\ &\Rightarrow 5x - 10 = \mathrm{e}^0 \\ &\Rightarrow 5x = 11 \\ &\Rightarrow \underline{\underline{x = 2\tfrac{1}{5}}}. \end{aligned}$$

A function g is such that

$$\mathrm{g}(x) = 2x - \ln 2, \text{ for } x \in \mathbb{R}.$$

(e) Solve (5)

$$\mathrm{g}\,\mathrm{f}(x) = \mathrm{f}(x^2).$$

Solution
Well,

$$\begin{aligned} \mathrm{g}\,\mathrm{f}(x) &= \mathrm{g}(\mathrm{f}(x)) \\ &= \mathrm{g}(\ln(5x - 10)) \\ &= 2\ln(5x - 10) - \ln 2 \end{aligned}$$

and

$$\mathrm{f}(x^2) = \ln(5x^2 - 10).$$

Now,

$$\begin{aligned} \mathrm{g}\,\mathrm{f}(x) = \mathrm{f}(x^2) &\Rightarrow 2\ln(5x - 10) - \ln 2 = \ln(5x^2 - 10) \\ &\Rightarrow \ln(5x - 10)^2 - \ln(5x^2 - 10) = \ln 2 \end{aligned}$$

$\times$	$5x$	-10
$5x$	$25x^2$	$-50x$
-10	$-50x$	$+100$

$$\begin{aligned}
&\Rightarrow \ln(25x^2 - 100x + 100) - \ln(5x^2 - 10) = \ln 2 \\
&\Rightarrow \ln\left(\frac{25x^2 - 100x + 100}{5x^2 - 10}\right) = \ln 2 \\
&\Rightarrow \frac{25x^2 - 100x + 100}{5x^2 - 10} = 2 \\
&\Rightarrow 25x^2 - 100x + 100 = 2(5x^2 - 10) \\
&\Rightarrow 25x^2 - 100x + 100 = 10x^2 - 20 \\
&\Rightarrow 15x^2 - 100x + 120 = 0 \\
&\Rightarrow 5(3x^2 - 20x + 24) = 0
\end{aligned}$$

$a = 3$, $b = -20$, and $c = 24$:

$$\begin{aligned}
x &= \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
&= \frac{20 \pm \sqrt{(-20)^2 - 4 \times 3 \times 24}}{2 \times 3} \\
&= \frac{20 \pm \sqrt{112}}{6} \\
&= 1.569\,499\,126,\ 5.097\,167\,541 \text{ (FCD)};
\end{aligned}$$

but $x > 2$ so

$$\underline{\underline{x = 5.10 \text{ (3 sf)}}}.$$

OR

13. A function f is such that

$$\mathrm{f}(x) = 4\mathrm{e}^{-x} + 2, \text{ for } x \in \mathbb{R}.$$

(a) State the range of f. (1)

Solution

$\underline{\underline{f(x) > 2}}$.

(b) Solve (2)

$$f(x) = 26.$$

Solution

Well,

$$\begin{aligned} f(x) = 26 &\Rightarrow 4e^{-x} + 2 = 26 \\ &\Rightarrow 4e^{-x} = 24 \\ &\Rightarrow e^{-x} = 6 \\ &\Rightarrow e^{x} = \tfrac{1}{6} \\ &\Rightarrow \underline{\underline{x = \ln \tfrac{1}{6}}}. \end{aligned}$$

(c) Find $f^{-1}(x)$. (3)

Solution

Now,

$$\begin{aligned} y = 4e^{-x} + 2 &\Rightarrow y - 2 = 4e^{-x} \\ &\Rightarrow \frac{y-2}{4} = e^{-x} \\ &\Rightarrow \frac{4}{y-2} = e^{x} \\ &\Rightarrow \ln\left(\frac{4}{y-2}\right) = x \end{aligned}$$

and so

$$\underline{\underline{f^{-1}(x) = \ln\left(\frac{4}{x-2}\right)}}.$$

(d) State the domain of f^{-1}. (1)

Solution

$$\underline{\underline{2 < f^{-1}(x) < \infty}}.$$

A function g is such that

$$\mathrm{g}(x) = 2\mathrm{e}^x - 4, \text{ for } x \in \mathbb{R}.$$

(e) Using the substitution (5)

$$t = \mathrm{e}^x$$

or otherwise, solve

$$\mathrm{g}(x) = \mathrm{f}(x).$$

Solution

Well,

$$\begin{aligned}
\mathrm{g}(x) = \mathrm{f}(x) &\Rightarrow 2\mathrm{e}^x - 4 = 4\mathrm{e}^{-x} + 2 \\
&\Rightarrow 2t - 6 = \frac{4}{t} \\
&\Rightarrow 2t^2 - 6t = 4 \\
&\Rightarrow 2t^2 - 6t - 4 = 0 \\
&\Rightarrow 2(t^2 - 3t - 2) = 0
\end{aligned}$$

$a = 1$, $b = -3$, and $c = -2$:

$$\begin{aligned}
&\Rightarrow \quad t = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \\
&\Rightarrow \quad t = \frac{3 \pm \sqrt{(-3)^2 - 4 \times 1 \times (-2)}}{2 \times 1} \\
&\Rightarrow \quad t = \frac{3 \pm \sqrt{17}}{2} \\
&\Rightarrow \quad t = -0.561\,552\,812\,8,\ 3.561\,552\,813 \text{ (FCD)};
\end{aligned}$$

but $x > 2$:

$$\begin{aligned}
&\Rightarrow \quad \mathrm{e}^x = 3.561\,552\,813 \text{ (FCD)} \\
&\Rightarrow \quad x = 1.270\,196\,633 \text{ (FCD)} \\
&\Rightarrow \quad \underline{\underline{x = 1.27 \text{ (3 sf)}}}.
\end{aligned}$$