Question 1 (14 marks) **Start a new booklet**

(a) Simplify $4\sqrt{45}-3\sqrt{54}-6\sqrt{5}$ (2)

(b) Solve for y: $6(y-1)=3(y+8)$ (2)

(c) Solve simultaneously: $5x-2y=-1$ (3)

$8x-y=5$

(d) Evaluate $\sqrt[3]{\dfrac{84\times 69}{35+37}}$. Round your answer to three significant figures. (2)

(e) Evaluate $|3\times(-7)|+|13-4|$ (1)

(f) Simplify $7-(x+2)+(3-2x)$ (2)

(g) Simplify $\dfrac{a^3-27}{a^2-9}$ (2)

Question 2 (14 marks) **Start a new booklet**

(a) Express the recurring decimal $1.\dot{2}$ as a fraction in simplest terms. (2)

(b) Evaluate $(7.16\times10^{3})\div(4.94\times10^{8})$ and give your answer in scientific notation correct to 3 significant figures. (2)

(c) If $a=-2$, $b=6$ and $c=-1$, evaluate $\dfrac{12a^{2}}{b+2c}$ (1)

(d) Rationalise the denominator: $\dfrac{8}{\sqrt{7}+1}$ (2)

(e) Simplify $\dfrac{x+7}{3}+\dfrac{2x-1}{2}$ (2)

(f) Solve $\dfrac{6}{x}+2=\dfrac{7}{2x}+5$ (2)

(g) Solve and graph your solution on the number line: $\left|\dfrac{3x-1}{2}\right|>1$ (3)

Question 3 (14 marks) **Start a new booklet**

(a) Show that $f(x)=2x^2+5$ is an even function. (2)

(b) Simplify $\left(\frac{8}{27}\right)^{\frac{1}{3}}\times\left(\frac{4}{9}\right)^{-\frac{1}{2}}$ (1)

(c) If $\sqrt{28}+\sqrt{7}=\sqrt{A}$ find A. (1)

(d) Express in simplest form without negative or fractional indices: $\left(8x^6\right)^{\frac{1}{3}}x^{-3}$ (2)

(e) If $f(x)=2^x+2^{-x}$, find $f(1)$ and $f(-2)$. (2)

(f) What is the domain for: (4)

(i) $f(x)=\frac{1}{x+1}$

(ii) $f(x)=\sqrt{25-x^2}$

(iii) $f(x)=\sqrt{6-x}$

$y=\sqrt{6}-\sqrt{x}$

$y=\sqrt{6}-x^{\frac{1}{2}}$

(iv) $f(x)=2^x$

(g) Given the function:

$$f(x)=\begin{cases}2-x^2 & \text{for } x\le 0\\ x^2-2 & \text{for } x>0\end{cases}$$

Find:

(i) f(0)
(ii) $f(a^2)$ (2)

Question 4 (14 marks) **Start a new booklet**

Using a pencil and quarter page diagrams, sketch the following graphs showing all significant features. State the domain and range in each case.

(i) $f(x)=3x+2$ (2)

(ii) $f(x)=x^2-2$ (3)

(iii) $f(x)=\dfrac{2}{x}$ (3)

(iv) $f(x)=|x-1|$ (3)

(v) $f(x)=\sqrt{9-x^2}$ (3)

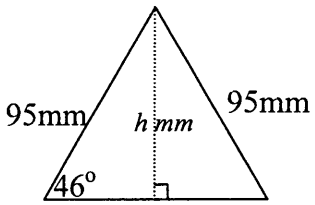
Question 5 (14 marks) **Start a new booklet**

(a) Solve $-2 < 4 - 2x \leq 6$ (2)

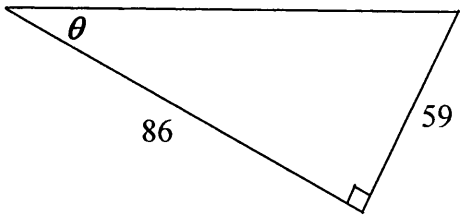
(b) If $\cos A = \frac{2}{7}$ and A is acute, find the exact value of $\sin A$ (2)

(c) Find the value of x if $\cos x^o = \sin 20^o$ (1)

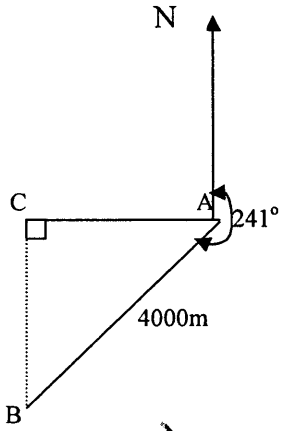
(d) Find the value of h to the nearest whole number. (2)



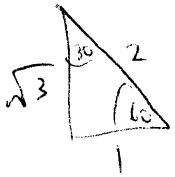
(e) Find θ in degrees and minutes, to the nearest minute. (2)



(f) The bearing of B from A is 241° and B is 4000 metres from A. Find AC, which is the distance that B is west of A. (2)



(g) Give the exact value of $\sin 30^\circ \cos 60^\circ$. (2)



(h) Solve $\sin x = \frac{\sqrt{3}}{2}$ for $0° \leq x \leq 90°$ (1)

Question 6 (14 marks) **Start a new booklet**

(a) Two walkers set off at the same time from a cross road and walk along flat, straight roads inclined to each other at 68°. If they both walk at a speed of 6 *km/h*, find their distance apart 10 minutes later. (3)

(b) Sketch the region in the *xy* plane where $y \geq x^2 + 1$ and $y \leq x + 3$ hold simultaneously. (3)

(c) Solve simultaneously: $y = 3x + 10$
$y = x^2 + x - 5$ (4)

(d) A person, 2m tall, is standing on the ground and looking up at the top of a building. The person is 18m from the building and the angle of elevation to the top of the building is 30°. Draw a diagram representing this information and show that the exact height of the building is $6\sqrt{3} + 2$ metres. (4)

Suggested Solutions | Comments

Question 1 .

a) $4\sqrt{45} - 3\sqrt{54} - 6\sqrt{5} = 12\sqrt{5} - 9\sqrt{6} - 6\sqrt{5}$ ①
$= 6\sqrt{5} - 9\sqrt{6}$ ① — 2

b) $6(y-1) = 3(y+8)$ $6y - 6 = 3y + 24$ ①
$3y = 30$
$y = 10$ ① — 2

c) $5x - 2y = -1$ ① $8x - y = 5$ ②
② × 2 : $16x - 2y = 10$
① : $5x - 2y = -1$ ①
② − ① $11x = 11$
$x = 1$ ③ ①
Substitute ③ into ① $5 \times 1 - 2y = -1$
$-2y = -6$
$y = 3$ ① $x = 1, y = 3$ — 3

d) $\sqrt[3]{\frac{84 \times 69}{35 + 37}} = 4.31783$ ①
$= 4.32$ ① (3 sig figs) — 2

e) $|3 \times (-7)| + |13 - 4| = |-21| + |9|$
$= 21 + 9$
$= 30$ ① — 1

f) $7 - (x+2) + (3 - 2x) = 7 - x - 2 + 3 - 2x$ ①
$= 8 - 3x$ ① — 2

g) $\frac{a^3 - 27}{a^2 - 9} = \frac{(a-3)(a^2 + 3a + 9)}{(a-3)(a+3)}$ ①
$= \frac{a^2 + 3a + 9}{a + 3}$ ① — 2

Suggested Solutions | Comments

Question 2.

a) let $x = 1.2222\ldots$ ①

$10x = 12.2222\ldots$ ②

② − ①: $9x = 11$

$x = \frac{11}{9}$ or $1\frac{2}{9}$ — 2

b) $(7.16\times10^{3}) \div (4.94\times10^{8}) = 0.0000014493\ldots$

$= 1.44939\ldots\times10^{-5}$ — 2

c) $\frac{12a^2}{b+2c} = \frac{12\times(-2)^2}{6+2\times-1}$

$= \frac{48}{4}$

$= 12$ — 1

d) $\frac{8}{(\sqrt{7}+1)} \times \frac{(\sqrt{7}-1)}{(\sqrt{7}-1)}$ ① $= \frac{8(\sqrt{7}-1)}{7-1}$

$= \frac{4(\sqrt{7}-1)}{3}$ ① — 2

e) $\frac{(x+7)}{3}\times\frac{2}{2} + \frac{(2x-1)}{2}\times\frac{3}{3} = \frac{2x+14+6x-3}{6}$

$= \frac{8x+11}{6}$ — 2

f) $\frac{6}{x}\times(2x) + 2\times(2x) = \frac{7}{2x}\times(2x) + 5\times(2x)$

$12 + 4x = 7 + 10x$

$5 = 6x$

$x = \frac{5}{6}$ — 2

g) $\left|\frac{3x-1}{2}\right| > 1$

$\frac{3x-1}{2} > 1$ or $\frac{3x-1}{2} < -1$

$3x-1 > 2$

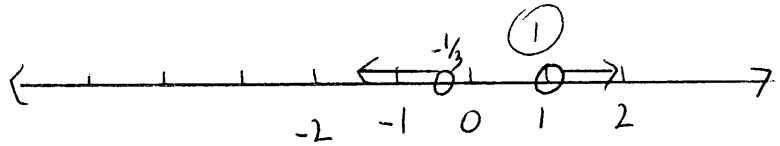
$3x > 3$

$x > 1$ ①

$3x-1 < -2$

$3x < -1$

$x < -\frac{1}{3}$ ① — 3



Suggested Solutions | Comments

Question 3

a) $f(-x) = 2\times(-x)^2+5$ (1)
$= 2x^2+5$
$= f(x)$ (1)
$f(x) = f(-x) \therefore f(x)$ is even — 2

b) $\left(\frac{8}{27}\right)^{\frac{1}{3}} \times \left(\frac{4}{9}\right)^{-\frac{1}{2}} = \frac{2}{3} \times \frac{3}{2}$ (1)
$= 1$ — 1

c) $\sqrt{28} + \sqrt{7} = 2\sqrt{7} + \sqrt{7}$ (1)
$= 3\sqrt{7}$ (1)
$= \sqrt{63}$ $A = 63$ — 1

d) $(8x^6)^{1/3} x^{-3} = 2x^2 \times x^{-3}$ (1)
$= \frac{2}{x}$ (1) — 2

e) $f(1) = 2^1 + 2^{-1}$
$= 2 + \frac{1}{2}$
$= 2\frac{1}{2}$ (1)
$f(-2) = 2^{-2} + 2^2$
$= \frac{1}{4} + 4$
$= 4\frac{1}{4}$ (1) — 2

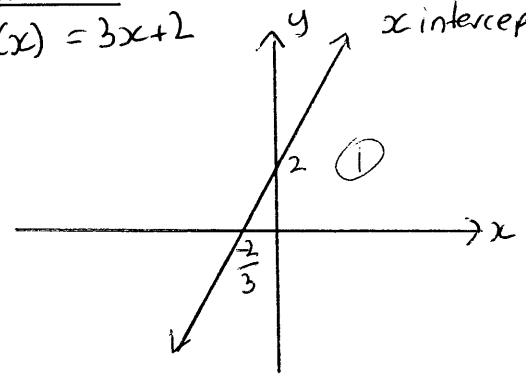
f) i) $x \neq -1$, otherwise x is any real number (1) — 4
ii) $-5 \leq x \leq 5$ (1)
iii) $x \leq 6$ (1)
iv) x can be any real number (1)

g) i) $f(0) = 2 - 0$
$= 2$ (1) — 2
ii) $f(a^2)$ $(a^2 \geq 0$ for all $a.)$
$= (a^2)^2 - 2$
$= a^4 - 2$ (1)

Suggested Solutions | Comments

Question 4.

i) $f(x) = 3x+2$



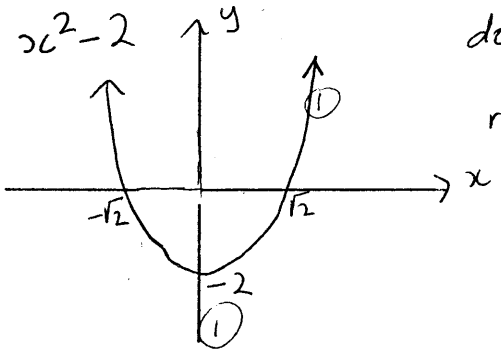
x intercept: $-\frac{2}{3}$, y intercept: 2 (1)

domain: x is any real number (1)

range: y is any real number

2

ii) $f(x) = x^2 - 2$

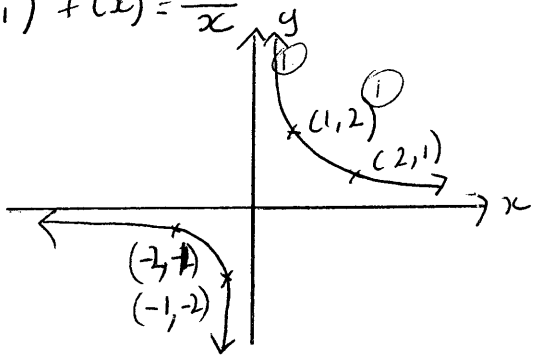


domain: x is any real number (1)

range: $y \geq -2$ (1)

3

iii) $f(x) = \frac{2}{x}$

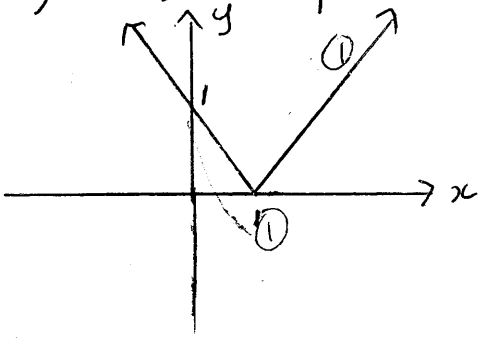


domain: $x \neq 0$ (1)

range: $y \neq 0$

3

iv) $f(x) = |x-1|$



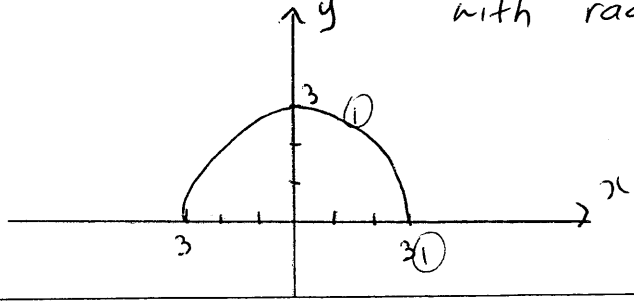
domain: x is any real number (1)

range: $y \geq 0$

3

v) $f(x) = \sqrt{9-x^2}$

top half of circle centre (0,0) with radius = 3. (1)



domain: $-3 \leq x \leq 3$

range: $0 \leq y \leq 3$

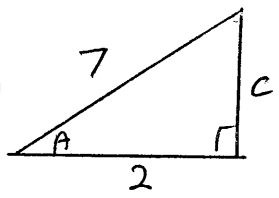
3

Suggested Solutions | Comments

Question 5

a) $-2 < 4 - 2x \leq 6$ $\quad -4]$ $\quad -6 < -2x \leq 2$ (1) — 2

$\div -2]$ $\quad 3 > x \geq -1$ or $-1 \leq x < 3$

b) 

$c = \sqrt{7^2 - 2^2}$ — 2

$= \sqrt{45}$ (1)

$\sin A = \frac{\sqrt{45}}{7}$ or $\frac{3\sqrt{5}}{7}$ (1)

c) $x = 70°$ — 1

d) $\sin 46° = \frac{h}{95}$ — 2

$h = 95 \sin 46°$ (1)

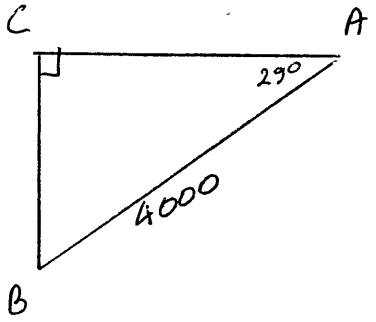
$= 68.337$

$= 68\text{mm}$ (1)

e) $\tan \theta = \frac{59}{86}$ (1) — 2

$\theta = 34.45°$

$= 34°27'$ (1)

f) 

— 2

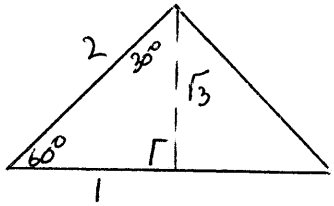
$\angle A = 360° - 241° - 90°$

$= 29°$ (1)

$\frac{AC}{4000} = \cos 29$ (1) any rounding

$AC = 3498.4788829\text{ m}$ (6dp)

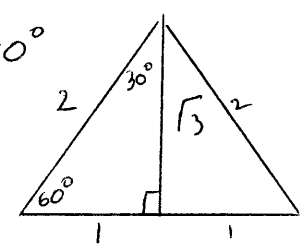
g) $\sin 30° \cos 60° = \frac{1}{2} \times \frac{1}{2}$ (1) (1) — 2



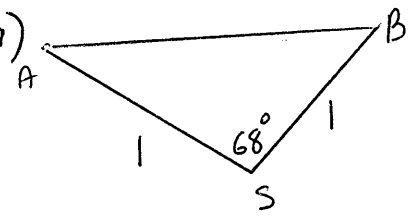
$= \frac{1}{4}$

h) $\sin x = \frac{\sqrt{3}}{2}$ for $0° \leq x \leq 90°$ — 1

$x = 60°$ (1)



Question 6 .

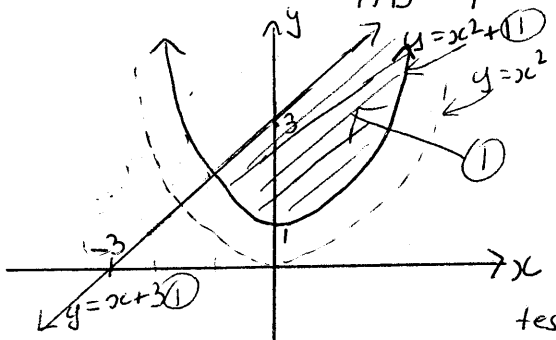
a) 

after 10 mins travelled $\frac{10}{60} \times 6 = 1$ km ① 3

$AB^2 = 1^2 + 1^2 - 2\times1\times1\cos 68°$ ①

$AB^2 = 1.250787$ ①

$AB = 1.11839$ km ① (any rounding) 3

b) 

test (0,0)

$0 \geq 0+1$ no

∴ shade inside ①

$y = x+3$ intercepts $(0,3)$ $(-3,0)$

test $(0,0)$ $0 \leq 0+3$ ✓

c) $y = 3x + 10$ ①

$y = x^2 + x - 5$ ②

Sub ① into ②: $3x + 10 = x^2 + x - 5$ 4

$0 = x^2 - 2x - 15$

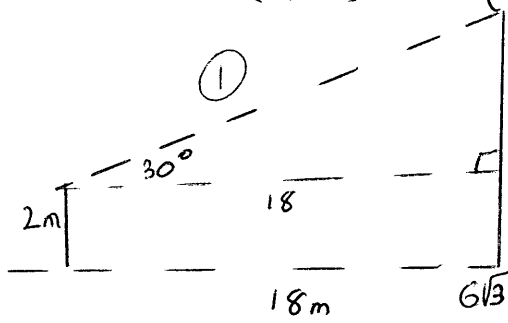
$0 = (x-5)(x+3)$

$x = 5$ or -3

sub ③ into ① $y = 3\times5 + 10$ or $y = 3\times-3 + 10$

$= 25$ $= 1$

solution: (① ①) $(5, 25)$ or (① ①) $(-3, 1)$

d) 

4

$\tan 30° = \frac{h}{18}$ ①

$\frac{1}{\sqrt{3}} = \frac{h}{18}$

$h = \frac{18}{\sqrt{3}}$ ① or $\frac{18}{\sqrt{3}} \times \frac{\sqrt{3}}{\sqrt{3}} = 6\sqrt{3}$

building height ①

$= \frac{18}{\sqrt{3}} + 2$

$= \frac{18\sqrt{3}}{3} + \frac{6}{3}$

$= \frac{18\sqrt{3} + 6}{3}$ ①

$= 6\sqrt{3} + 2$m