Question 1 (11 Marks) **Marks**

(a) Simplify $\dfrac{\left(2^3\right)^n\left(4^{2n-1}\right)}{\left(8^n\right)^{\frac{1}{3}}}$. **2**

(b) Convert $0.4\dot{8}\dot{5}$ to a fraction in its simplest terms. **2**

(c) Simplify $\dfrac{1}{x-y}+\dfrac{2x-y}{x^2-y^2}$. **2**

(d) Factorise fully

(i) $2x^3+54$. **2**

(ii) a^2-b^2-6b-9. **3**

Question 2 (9 Marks)

(a) Rearrange the formula $\dfrac{1}{f}+\dfrac{3}{g}=\dfrac{7}{h}$ so that g is the subject. **2**

(b) Expand and simplify $(1-\sqrt{2})^3$ **2**

(c) Simplify the following by rationalising the denominator.

$$\frac{\sqrt{10}-\sqrt{6}}{\sqrt{10}+\sqrt{6}}$$ **2**

(d) If $2x-y+\sqrt{x-y}=2\sqrt{3}$ find x and y. **3**

Question 3 (15 Marks) START A NEW PAGE **Marks**

(a) Solve $|x+1| \le 5$. **2**

(b) State the domain of the function $f(x) = \sqrt{x^2 - 9}$. **2**

(c) Sketch each of the following graphs on separate axes. Label carefully.

(i) $x^2 + (y-2)^2 = 4$. **2**

(ii) $f(x) = \sqrt{1-x}$. **2**

(d) Consider $f(x) = \dfrac{2x}{1-x^2}$.

(i) Determine the equation of the vertical and horizontal asymptotes. **2**

(ii) Show that $f(x)$ is odd. **2**

(iii) Show that $f(x)$ passes through the origin. **1**

(iv) Hence sketch the curve. **2**

Question 4 (10 Marks) **START A NEW PAGE**

(a) Solve $\dfrac{x}{x+5} \le 2$. **3**

(b) Shade the region where $y \le \sqrt{2-x^2}$ and $y > x$ hold simultaneously. Carefully label curves and show points of intersection. **3**

(c) Sketch $y = |2x-1|$ and $y = x+1$ on the same axes. Find any points of intersection. Hence use your graph to solve $|2x-1| \le x+1$. **4**

END OF PAPER

Question 1 [11 Marks]

(a) $\dfrac{(2^3)^n (4^{2n-1})}{(8^n)^{1/3}}$

$= \dfrac{2^{3n} \cdot 2^{4n-2}}{2^n}$ ✓

$= 2^{6n-2}$ ✓

(b) Let $p = 0.4\dot{8}\dot{5}$

$\therefore 100p = 48.5\dot{8}\dot{5}$ ✓

$\therefore 99p = 48.1$

$p = \dfrac{481}{990}$ ✓

(c) $\dfrac{1}{x-y} + \dfrac{2x-y}{(x-y)(x+y)}$

$= \dfrac{x+y+2x-y}{(x-y)(x+y)}$ ✓

$= \dfrac{3x}{(x-y)(x+y)}$ ✓

(d) (i) $2x^3 + 54$

$= 2(x^3 + 27)$ ✓

$= 2(x+3)(x^2 - 3x + 9)$ ✓

(ii) $a^2 - b^2 - 6b - 9$

$= a^2 - (b^2 + 6b + 9)$ ✓

$= a^2 - (b+3)^2$ ✓

$= (a-b-3)(a+b+3)$ ✓

Question 2 [9 Marks]

(a) $\frac{1}{f} + \frac{3}{g} = \frac{7}{h}$ find g

$$\frac{3}{g} = \frac{7}{h} - \frac{1}{f}$$

$$\frac{3}{g} = \frac{7f-h}{hf}$$ ✓

$$\frac{g}{3} = \frac{hf}{7f-h}$$

$$g = \frac{3hf}{7f-h}$$ ✓

(b) $(1-\sqrt{2})^3 = 1 - 3(\sqrt{2}) + 3(\sqrt{2})^2 - (\sqrt{2})^3$ ✓

$$= 1 - 3\sqrt{2} + 6 - 2\sqrt{2}$$

$$= 7 - 5\sqrt{2}$$ ✓

(c) $\frac{\sqrt{10}-\sqrt{6}}{\sqrt{10}+\sqrt{6}} \times \frac{\sqrt{10}-\sqrt{6}}{\sqrt{10}-\sqrt{6}}$

$$= \frac{(\sqrt{10}-\sqrt{6})^2}{10-6}$$ ✓

$$= \frac{10 - 2\sqrt{60} + 6}{4}$$

$$= \frac{16 - 2\sqrt{60}}{4}$$

$$= \frac{16 - 4\sqrt{15}}{4}$$

$$= 4 - \sqrt{15}$$ ✓

(d) $2x - y + \sqrt{x-y} = 2\sqrt{3}$

$\therefore (2x-y) + \sqrt{x-y} = \sqrt{12}$ ✓

$\therefore 2x - y = 0$ ...(i) ✓

$x - y = 12$ ...(ii)

$\therefore x = -12$ [(i) − (ii)]

$\therefore y = -24$ ✓

Question 3 [15 Marks]

(a) $|x+1| \leq 5$ or $-5 \leq x+1 \leq 5$ ✓

$x+1 \leq 5$ and $x+1 \geq -5$ $-6 \leq x \leq 4$ ✓

$\therefore -6 \leq x \leq 4$

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

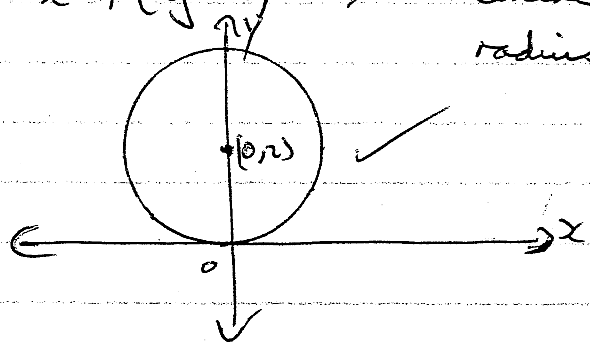
Domain: $x^2-9 \geq 0$

$(x-3)(x+3) \geq 0$ ✓

$\therefore x \geq 3$ or $x \leq -3$ ✓

(c) (i) $x^2+(y-2)^2 = 4$ centre $(0,2)$ ✓

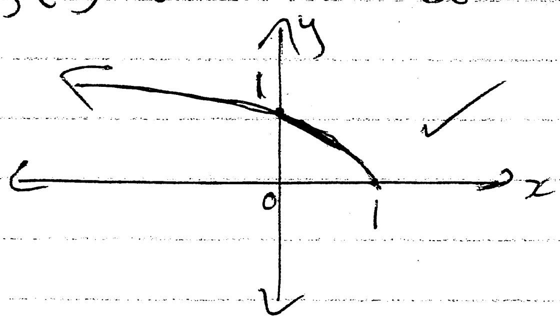
radius 2



✓

(ii) $f(x) = \sqrt{1-x}$ Domain: $1-x \geq 0$ ✓

$x \leq 1$



✓

Question 3 (continued)

(d) $f(x) = \frac{2x}{1-x^2}$

(i) Vertical asymptotes $x = \pm 1$ ✓
Horizontal asymptote $f(x) = 0$ ✓

(ii) $f(-x) = \frac{-2x}{1-(-x)^2}$ ✓

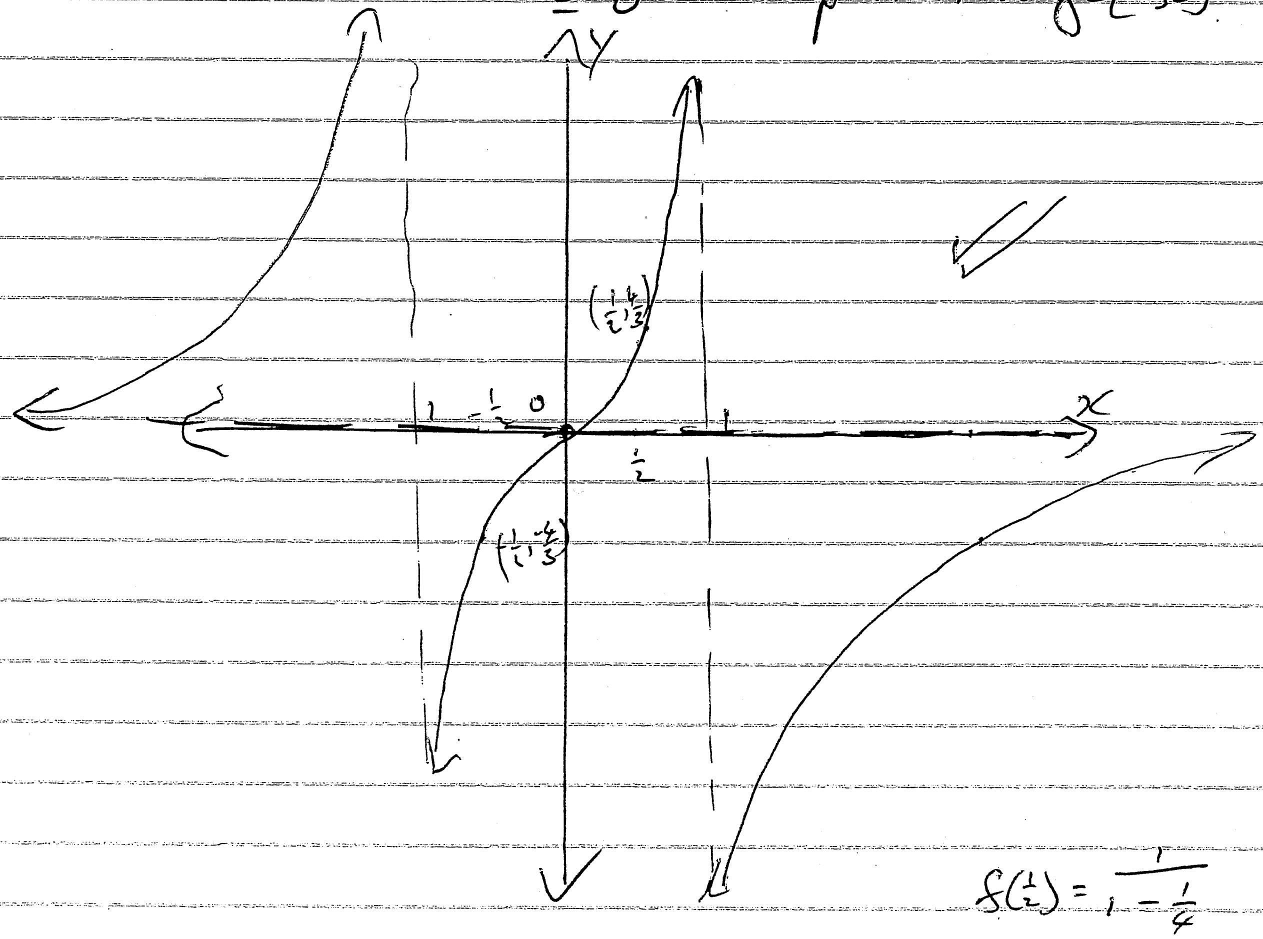
$= \frac{-2x}{1-x^2}$

$= -\left(\frac{2x}{1-x^2}\right)$

$= -f(x)$ ∴ odd ✓

(iii) let $x = 0$ ∴ $f(0) = \frac{2(0)}{1-0}$ ✓

$= 0$ ∴ passes through $(0,0)$



$f(\frac{1}{2}) = \frac{1}{1-\frac{1}{4}}$

$= \frac{4}{3}$

Question 4

(a) $\frac{x}{x+5} \le 2, \quad x \ne -5$

$\therefore \frac{x}{x+5} \times \frac{(x+5)^2}{1} \le 2 \times (x+5)^2$ ✓

$x(x+5) \le 2(x+5)^2$

$\therefore 2(x+5)^2 - x(x+5) \ge 0$ ✓

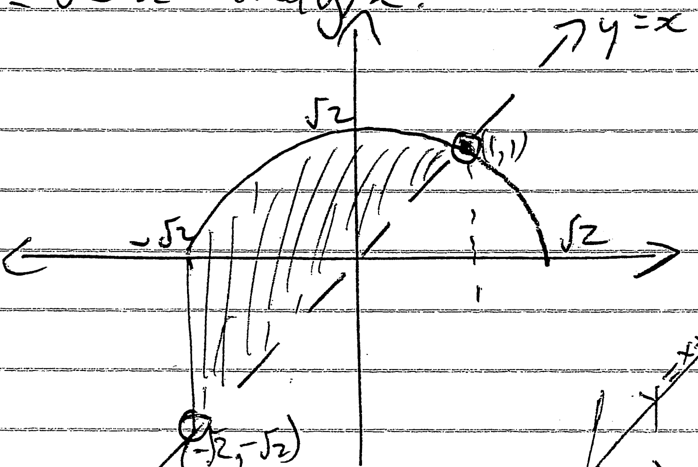
$(x+5)[2x+10-x] \ge 0$

$(x+5)(x+10) \ge 0$

$\therefore x > -5 \text{ or } x \le -10$ ✓

[deduct 1 for ≥ -5]

(b) $y \le \sqrt{2-x^2}$ and $y > x$:



✓ – both graphs

✓ – pts of intersection + dotted line

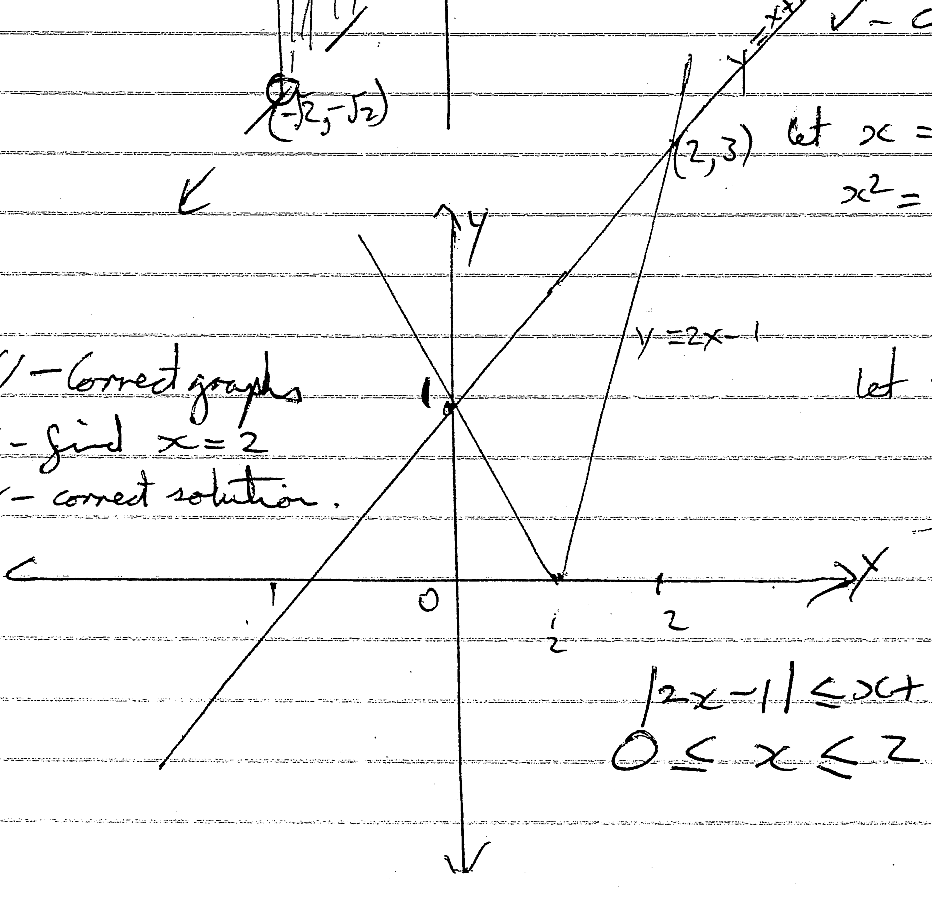
✓ – correct shading

let $x = \sqrt{2-x^2}$

$x^2 = 2 - x^2 \quad x^2 = 1$

$x = 1$

(c)



✓✓ – Correct graphs

✓ – find $x = 2$

✓ – correct solution.

let $2x - 1 = x + 1$

$x = 2$

$|2x-1| \le x+1$

$0 \le x \le 2$