1 (b) Solve the inequality $3x + 15 < 8x + 3$

Show clear algebraic working.

$3x + 15 < 8x + 3$

$15 - 3 < 8x - 3x$ (1)

$12 < 5x$ (1)

$\frac{12}{5} < x$ (1)

$x > \frac{12}{5}$

(3)

(Total for Question 1 is 3 marks)

2 (d) Solve the inequality $4x + 7 > 2$

$4x + 7 > 2$

$4x > 2 - 7$ -7

$4x > -5$ (1)

$\div 4$

$x > -\frac{5}{4}$ (1)

$x > -\frac{5}{4}$

(2)

(Total for Question 2 is 2 marks)

3 The function f is such that $f(x) = 5 + 6x - x^2$ for $x \leqslant 3$

(a) Express $5 + 6x - x^2$ in the form $p - (x - q)^2$ where p and q are constants.

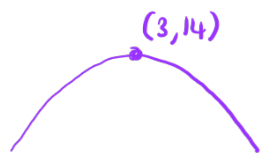
$-x^2 + 6x + 5$

$-(x^2 - 6x - 5)$

$-\left[(x-3)^2 - 9 - 5\right]$ 1

$-(x-3)^2 + 14$

$\therefore\ 14 - (x-3)^2$ 1 where $p = 14$, $q = 3$



$14 - (x-3)^2$
....
(2)

(b) Using your answer to part (a), find the range of values of x for which $f^{-1}(x)$ is positive.

$f(x) = 14 - (x-3)^2$

Range of $f^{-1}(x)$

$y \leq 3$

Let $f(x) = y$: $y = 14 - (x-3)^2$ 1

Find x in terms of y

$y = 14 - (x-3)^2$

$y - 14 = -(x-3)^2$

$(x-3)^2 = 14 - y$

$x - 3 = \pm\sqrt{14 - y}$

$x = 3 \pm \sqrt{14 - y}$ 1

$f^{-1}(x) = 3 - \sqrt{14 - x}$ — since y should be ≤ 3

1

If $f^{-1}(x) > 0$

$3 - \sqrt{14 - x} > 0$ 1 or $3 - \sqrt{14 - x} \leq 3$

$3 > \sqrt{14 - x}$ $\qquad 0 \leq \sqrt{14 - x}$

$9 > 14 - x$ $\qquad x \leq 14$

$x > 5$

$\therefore$ Hence, $5 < x \leq 14$ 1

$5 < x \leq 14$
....
(5)

(Total for Question 3 is 7 marks)

4 (a) Write down the integer values of x that satisfy the inequality $-2 < x \leqslant 4$

$-1, 0, 1, 2, 3, 4$ 2

(2)

The region **R**, shown shaded in the diagram, is bounded by three straight lines.

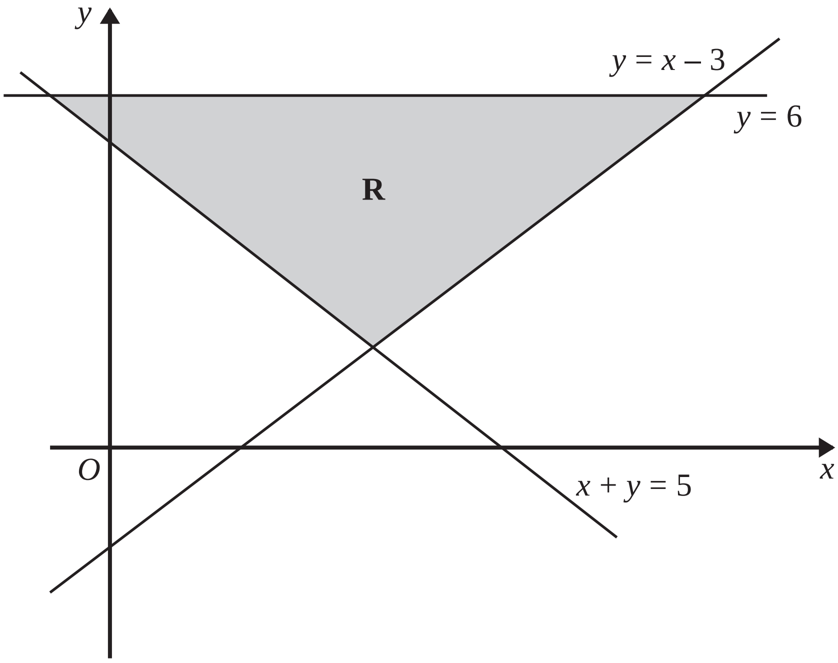


Diagram **NOT** accurately drawn

(b) Write down the three inequalities that define the region **R**.

$y \leqslant 6$

$x + y \geqslant 5$ 2

$y \geqslant x - 3$

(2)

(Total for Question 4 is 4 marks)

5 (a) Solve the inequality $2x + 7 > 4$ -7

$2x > 4 - 7$ (1)

$2x > -3$ $\div 2$

$x > \frac{-3}{2}$

$x > -1.5$ (1)

$x > -1.5$

....

(2)

(Total for Question 5 is 2 marks)

6 $-4 \leqslant 2y < 6$

y is an integer.

(a) Write down all the possible values of y.

$-4 \leqslant 2y < 6$ $\div 2$

$-2 \leqslant y < 3$

$-2, -1, 0, 1, 2$ (2)

(2)

(b) Solve the inequality $7t - 3 \leqslant 2t + 31$

Show your working clearly.

$7t - 3 \leqslant 2t + 31$

$7t - 2t \leqslant 31 + 3$

$5t \leqslant 34$ (1)

$t \leqslant \frac{34}{5}$

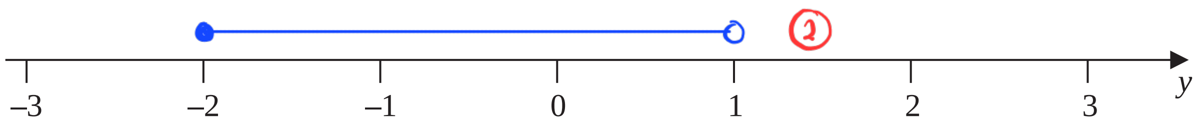
$t \leqslant 6.8$ (1)

$t \leqslant 6.8$

(2)

(Total for Question 6 is 4 marks)

7 (a) On the number line, show the inequality $-2 \leqslant y < 1$



(2)

n is an integer. — n is a whole number

(b) Write down all the values of n that satisfy $-3.4 < n \leqslant 2$

-3, -2, -1, 0, 1, 2 2

(2)

(Total for Question 7 is 4 marks)

8 (c) (i) Solve the inequality $7t - 8 < 2t + 7$

$7t - 8 < 2t + 7$

$7t - 2t < 8 + 7$

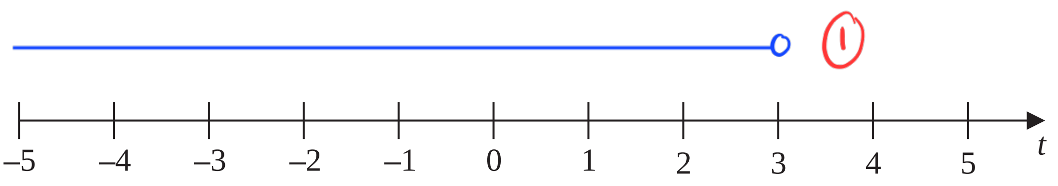
$5t < 15$ 1

$t < 3$ 1

$t < 3$ ....

(2)

(ii) On the number line below, represent the solution set of the inequality solved in part (c)(i)



(1)

(Total for Question 8 is 3 marks)

9 Solve the inequality $3 - 4x \leqslant 11$

$3 - 4x \leqslant 11$

$3 - 11 \leqslant 4x$

$-8 \leqslant 4x$ (1)

$\frac{-8}{4} \leqslant x$

$-2 \leqslant x$ (1)

$x \geqslant -2$

(Total for Question 9 is 2 marks)

10 $f(x) = x^2 - 4$

$g(x) = 2x + 1$

Solve $fg(x) > 0$

Show clear algebraic working.

$fg(x) = (2x+1)^2 - 4$ 1

$fg(x) > 0$

$(2x+1)^2 - 4 > 0$ 1

$(2x+1)^2 > 4$

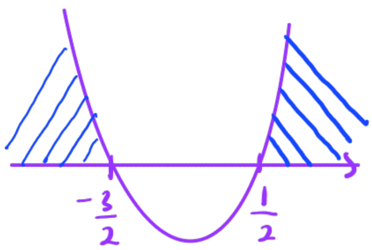
$2x+1 > \pm\sqrt{4}$

$2x+1 = 2$, $2x+1 = -2$

$x = \frac{1}{2}$, $x = -\frac{3}{2}$ 1

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

$fg(x) > 0$



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

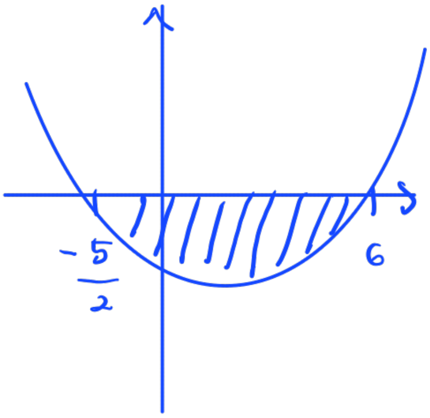
(Total for Question 10 is 4 marks)

11 (b) Solve the inequality $2y^2 - 7y - 30 \leqslant 0$
Show your working clearly.

$(2y+5)(y-6) \leq 0$ (1)

$y = -\frac{5}{2}$, $y = 6$ (1)

$-2.5 \leq y \leq 6$ (1)



$-2.5 \leq y \leq 6$

(3)

(Total for Question 11 is 3 marks)

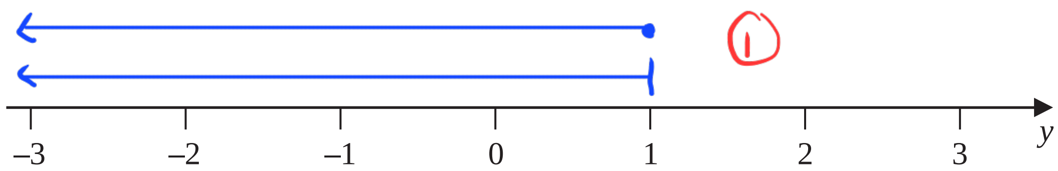
12 n is an integer.

(a) Write down all the values of n such that $-2 \leqslant n < 3$

-2, -1, 0, 1, 2 2

(2)

(b) On the number line, represent the inequality $y \leqslant 1$



(1)

(Total for Question 12 is 3 marks)

13 Two particles, P and Q, move along a straight line.
The fixed point O lies on this line.

The displacement of P from O at time t seconds is s metres, where

$$s = t^3 - 4t^2 + 5t \quad \text{for } t > 1$$

The displacement of Q from O at time t seconds is x metres, where

$$x = t^2 - 4t + 4 \quad \text{for } t > 1$$

Find the range of values of t where $t > 1$ for which both particles are moving in the same direction along the straight line.

$\frac{ds}{dt} = 3t^2 - 8t + 5$ (1)

$\frac{ds}{dt} = 0$, $3t^2 - 8t + 5 = 0$ (1)

$(3t - 5)(t - 1)$

$t = \frac{5}{3}$ or $t = 1$

since $t > 1$, $t = \frac{5}{3}$ (1)

$\frac{dx}{dt} = 2t - 4$

$\frac{dx}{dt} = 0$, $2t - 4 = 0$ (1)

$t = 2$ (1)

$t > 1$, $t < \frac{5}{3}$, $t > 2$

(1)

$t > 1$, $t > \frac{5}{3}$, $t > 2$

(Total for Question 13 is 6 marks)

14 (a) Solve $4y + 5 > 12$

$4y > 12 - 5$ (1)

$4y > 7$

$y > \frac{7}{4}$ (1)

$y > \frac{7}{4}$

(2)

(Total for Question 14 is 2 marks)

15 (a) Solve the inequality $5x - 7 \leqslant 2$

$5x \leqslant 2 + 7$ (1)

$5x \leqslant 9$

$x \leqslant \frac{9}{5}$

$x \leqslant 1.8$ (1)

$x \leqslant 1.8$
....
(2)

(Total for Question 15 is 2 marks)

16 Here is a rectangle.

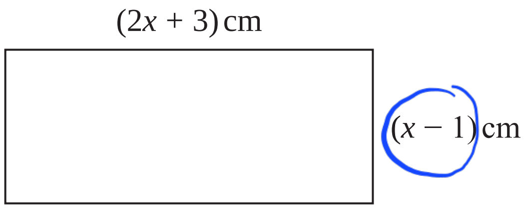


Diagram **NOT** accurately drawn

Given that the area of the rectangle is less than 75 cm²

find the range of possible values of x

$(2x+3)(x-1) < 75$ 1

$2x^2 - 2x + 3x - 3 - 75 < 0$

$2x^2 + x - 78 < 0$ 1

$(x-6)(2x+13) < 0$ 1

$x = 6$, $x = -\frac{13}{2}$ is not a solution
1

$x > 1$ since length cannot be 0 or less.

Hence, $1 < x < 6$ 1

$1 < x < 6$ ....

(Total for Question 16 is 5 marks)

$-4 < y \leq 1$

17 $-8 < 2y \leqslant 2$

y is an integer.

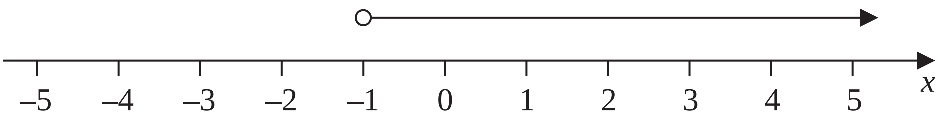
(a) Find all the possible values of y

$-3, -2, -1, 0, 1$ 2

....

(2)

(b) Write down the inequality shown on the number line.



$x > -1$ 1

....

(1)

(Total for Question 17 is 3 marks)

18 (b) Write down the inequality shown on the number line

$x \leq 3$ 1

....

(1)

(c) Solve the inequality $7w + 6 > 12w + 14$

$7w - 12w > 14 - 6$ 1

$-5w > 8$ 1

$w < -\frac{8}{5}$ 1

$w < -\frac{8}{5}$

....

(3)

(Total for Question 18 is 4 marks)

19 (b) Find the range of values of x for which **T** has a positive gradient.
Give your values correct to 3 significant figures.
Show your working clearly.

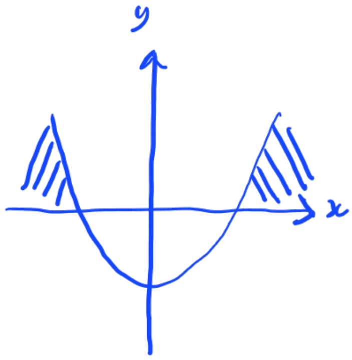
$$x = \frac{4 \pm \sqrt{(-4)^2 - 4(3)(-9)}}{6} \quad 1$$

$$= \frac{4 \pm \sqrt{16 + 108}}{6}$$

$$= \frac{4 \pm \sqrt{124}}{6}$$

$$= \frac{4 + \sqrt{124}}{6} \text{ or } \frac{4 - \sqrt{124}}{6}$$

$$= 2.52\ldots \text{ or } -1.19\ldots \quad 1$$



1 1

$x < -1.19$, $x > 2.52$

(4)

(Total for Question 19 is 4 marks)

20 (a) Solve $9 - 4x > 17$

$-4x > 17 - 9$ (1)

$-4x > 8$

$x < \frac{8}{-4}$

$x < -2$ (1)

$x < -2$
....
(2)

(Total for Question 20 is 2 marks)